论文编号：

PROCESS AND CRITICAL APPROACHES TO SOLVING THE SYSTEMIC CLIMATE CHANGE GOVERNANCE PROBLEM

FOO WOO CHECK

专　　业：国际法学

研究方向：国际私法

指导教师：宣增益 教授

中国政法大学研究生院

二○一九

ABSTRACT

The most important and urgent task, besides avoiding nuclear war, is abatement of the existential threat of systemic climate change, which must engage the thinking and action of humankind at all levels of organization and every sphere of endeavor. The threat of nuclear war is subdued for now, but because humankind is a significant bio-geophysical force in the 'Anthropocene', the probability of the Earth's climate system tipping over, due to anthropogenic greenhouse gas (GHG) emissions, increases with each passing day.

International climate change governance, with the legal instruments of United Nations Convention on Climate Change (UNFCCC) and Kyoto Protocol (KP), was established to stabilize GHG concentrations. This 'monocentric' approach had failed. Emissions are still increasing and global average temperature will likely reach 3.0°C above pre-industrial level by 2100. The 2015 Paris Agreement, based on voluntary nationally determined contributions (NDCs), was then universally adopted. It relies on state and non-state actors at all levels to cut GHG emissions and reduce it by 55% or 25% in 2030 (vs. 2017) and carbon neutrality by 2050 for a least-cost pathway to keep temperature rise to 1.5°C or 2.0°C respectively in 2100. The 'rulebook' for its implementation has been agreed upon at the 2018 Katowice Conference.

A multi-factorial and multi-level solution set that constrains and works with the dynamics of the social-ecological system is required. Nation-States must focus on implementing concrete plans at both national and sub-national levels that engender trust, reciprocity and reputation for concerted collective action. Free riding does not go away but there is extensive empirical evidence that lower-level communities do cooperate to avoid the tragedy of the commons. The multiple benefits of actions from many decision-making centers establishing rules-in-use and plans in context will add up, albeit not optimally, to reduce catastrophic climate risks at this critical juncture. As an integral part of the polycentric approach, the thesis also advocates the immediate use of carbon tax legislation to ratchet up NDCs to the required progressive ambition levels. A national carbon tax system, e.g. Baker-Schultz Carbon Dividends Plan, will restrain indiscriminate emissions at national and sub-national levels as well as incentivize efforts for greater energy efficiency and low-carbon energy sources usage. If US, China, EU and India with about 60% of total nominal GDP and about 60% of total GHG

emissions were to introduce carbon taxes, it would have a domino effect on the rest of the world.

The "Integrated Systemic Process-Oriented" (ISPO) framework, integrating the socio-ecological system of Elinor Ostrom, process approach of global governance by the Commission on Global Governance, and the New Haven School of social jurisprudence associated with Myers S. McDougal, was developed for understanding, explaining and solving the climate change problem. As an evolutionary and dynamic framework, it was used for analysis or framing questions in the study of the evolution of ocean commons governance, systemic nature of the climate system, evolution of international environmental governance, the evolution of international climate change governance, critical success factors for effective governance, and limitations of international law and international politics.

Evolution of international climate change governance from the scientific period to international law period was paused at the 1989 Noordwijk Ministerial Conference when the US delegation forced the conference to abandon agreement to freeze GHG emissions at 1990 levels by 2000 due to the turn in US political economy from classical liberalism to neoliberalism, which was also responsible for the US-Europe political divide, the North-South economic divide, and the resistance of US to concede national sovereignty and power to a supranational authority. In fact, these differences in international politics were responsible for the non-implementation of the deep seabed regime in the law of the sea convention at about the same time.

These differences were also responsible later for failure to extend the KP. The negotiating positions of developing countries hardened in the aftermath of the Asian financial crisis, which was due to indiscriminate implementation of neoliberal economic policies. They were against emission targets/timelines for developing countries during negotiations to extend the commitment period of KP. Meanwhile, the developed countries, especially the US, were adamant that developing countries, especially fast developing ones, should share the burden of emissions cut. Provisions of flexible market-based mechanisms, based on neoliberal ideology, also contributed to the failure of KP, resulting in another pause in the evolution of climate change governance. It led to the disastrous 2009 Copenhagen Conference.

Evolution of climate change governance hewed closely to non-legal critical success factors of clear and updated science and iterative approach to policy and legislation but

was constrained by international politics in implementing fair burden sharing by all and effective and efficient international organization. However, out of the ashes of the 'top-down' international law approach did arise the phoenix of a 'bottom-up' international politics approach with the Copenhagen Accord, which led to the Paris Agreement. The Agreement is a legally binding treaty among nation-States but it relies on collective goal-setting, voluntary NDCs, pursuit of domestic mitigation measures, reporting and review mechanisms, and regular stock-takes to shape state behavior and world public opinion in order to achieve its temperature goals.

The four types of modern legal doctrines use a descending-ascending argumentative structure, which is capable of providing a valid criticism of each substantive position but by itself cannot justify any, is one of the limitations of international law. The structure does not possess distance from politics and the four doctrines only provide a partial solution respectively. A full solution requires a political choice in terms of an external universal conception of justice, which is contradictory to the Rule of Law. Besides, there is no strong evidence of effective governance by multilateral agreements, which is limited by fragmentation into specific regimes, ineffectiveness of multilateral legislative processes, and the logic of collective action, as well as the adoption of the law of least ambitious program, shallowness of commitments to ensure compliance, and easy withdrawal of Parties in the implementation phase.

The limitations of neoliberal ideology with complete reliance on free competitive market forces were exposed during the Asian financial crisis. It is now accepted that the free competitive market must be coupled with appropriate state regulation. According to Morgenthau, to reform within the international system is bound to fail. What is needed is a radical transformation of the existing international community of sovereign nations into a supranational community of individuals. A world community antedates a world state, and a world community still cannot be established under the current moral, social and political conditions. However, world conditions may arise soon for the establishment of a constitutionalism approach. Hence, the international community, after implementation of the Paris Agreement has stabilized, must begin political negotiations to establish global environmental constitutionalism as part of the long-term solution to the climate change problem.

KEYWORDS: Existential Threat, Systemic Climate Change, Governance Process, Social-Ecological Approach, International Law, International Politics, Global Environmental Constitutionalism.

摘要

除了避免核战争之外，当今人类最重要和迫切的任务是消除系统性气候变化而导致的生存威胁，而这任务必须由来自各阶层组织，结合人类思想和行动的努力。目前，核战争的威胁已经减弱，但是由于人类在“人类世”中已成为重要的地质力量，因此由于人类造所成的温室气体效应，地球气候系统被倾覆的可能性每天都在增加。

为了稳定温室气体（GHG）的浓度，以联合国气候变化公约和京都议定书（KP），国际气候变化治理会，建立了具有法律依据的文书。可是这种由“单一中心”来操控的方法已经失败了。排放量仍继续增加，到2100年，全球平均温度可能会比工业化前的水平高出摄氏3.0度。2015年的《巴黎协定》以各国家自愿定的标准为基础（NDC），得到了普遍的接受。它依靠各个国家和非国家级别的集体行动来减少温室气体排放，并计划在2030年将其减少55％或25％（与2017年相比），并在2050年之前实现碳中和，以最低的成本在2100年将温度升高分别控制在摄氏1.5度或摄氏2.0度。这是在2018年卡托维兹会议上已商定了实施的“规则”。

这需要一个多元素及多层次的解决方案，以共同约束及配合社会生态系统的动态改变。国家必须集中精力与国家级别以下的机构执行具体计划，实现互惠，保持声誉和信任，以采取协调一致的集体行动。搭便车的行为并不会消失，但是有大量的经验证据表明，下层社区确实为了避免公地悲剧而会相互合作。在这一关键时刻，许多决策中心在制定使用规则和计划时，即使不是最完善，对减低灾难性气候风险，也带来了许多好处。作为多元中心方法的一部分，本文主张立即使用碳税立法，以逐步使NDC达到所需的愿景。国家碳税制度，例如贝克-舒尔茨碳

股息计划将限制国家和国家以下各级的无控制排放，并激励人们为提高能源效率和使用低碳能源做出努力。如果中国，美国，欧盟和印度（占GDP的大约60％，温室气体总排放量的大约60％）实行碳税，那么它将对世界产生多米诺骨牌效应。

“整合的系统过程导向”（ISPO）框架整合了埃里诺·奥斯特罗姆的社会生态系统，全球治理委员会的全球治理过程方法以及与迈尔斯·麦克杜格尔相关的纽黑文社会法学。这个框架的开发用于了解，解释和解决气候变化问题。它是一个演化和动态的框架，用于研究海洋公域治理的演变，气候系统的系统性质，国际环境治理的演变，国际气候变化治理的演变，有效治理的关键因素以及国际法和国际政治的局限性。

1989年的诺德韦克部长级会议暂停了国际气候变化治理从科学时期到国际法律时期的演变，当时由于美国政治经济的转变，美国代表团强迫该会议放弃将2000年二氧化碳排的放量，冻结在1990年水平的原本协议。传统自由主义对新自由主义的影响，造成了美欧政治分歧，南北经济分歧，以及美国对将国家主权和权力让给超国家权威的抵制。实际上，这些国际政治问题也是造成海洋法公约几乎未实施深海海底政权的原因。

这些差异其后甚至导致无法扩展KP。在亚洲金融危机之后，发展中国家的谈判立场变得强硬。这是由于新自由主义经济政策无控制性的实施。在延长KP承诺期的谈判中，它们反对发展中国家的排放目标/时间表。同时，发达国家，尤其是美国，坚决主张发展中国家，尤其是快速发展中的发展中国家，应该共同承担减排的重担。根据新自由主义意识形态，市场灵活的机制的提供，也促成了这一时期KP的失败，及导致气候变化治理发展的另一次停顿。这导致了灾难性的2009年哥本哈根会议。

气候变化治理的演变与更清晰及更新的科学非法律关键成功因素，立法的迭代方法有密切的关系，但它受到国际政治的约束，无法实现公平分担和高效的国际组织。在“自上而下”国际法方法的失败中，确实出现了哥本哈根协议所采用的“自下而上”国际政治方法的曙光，这导致了《巴黎协定》的达成。该协定是民族国家之间的具有法律约束力的条约，但它依赖于集体目标设定，自愿的国家自主贡献，追求国内减缓措施，报告和审查机制以及定期盘点以塑造国家行为和世界舆论，以便达到其温度目标。

四种类型的现代法律学说使用的是递减或递增的论证结构，该结构能够对每个实质性立场提供有效的批判，但其本身不能为任何立场辩护，这正是国际法的局限。该结构与政治靠拢，而这四个学说仅分别提供了部分解决方案。全面解决方案需要从外部普遍的正义概念出发进行政治选择，这却与法治相矛盾。至今也没有强有力的证据表明多边协议就能有效地进行治理，因受到如下所述的限制：具体制度分散，多边立法程序无效，集体行动的逻辑，最低限度计划的法律，确保履约的承诺薄弱，轻易在执行阶段退出缔约。

新自由主义意识形态的完全依赖自由竞争市场力量的局限性，在亚洲金融危机期间完全曝露。现在已经公认，自由竞争市场必须与适当的国家法规相结合。摩根索认为，在国际体系内进行改革，注定会失败。所需要做的是将现有的主权国家的国际社会彻底转变为超国家的个别社区。世界共同体的产生早于世界国家，在目前的道德，社会和政治条件下是无法建立世界共同体。但是，建立宪政主义方法的世界条件可能很快就会出现。因此，在《巴黎协定》的执行稳定之后，国际社会必须开始政治谈判，以建立全球环境宪政，作为长期解决方案的一部分。

关键词：生存威胁，系统性气候变化，治理过程，社会生态方法，国际法，国际政治，全球环境宪政 .

ACKNOWLEDGEMENTS

I like to take this opportunity to express my deep gratitude and sincere thanks to Professor XUAN Zengyi and Associate Professor Maggie QIN Huaping for their enduring patience, astute advice, strong encouragement, and kindness of heart; to Ms Vera Ting and Ms Lisa Liu in the International Students Office of CUPL for their caring assistance and helpfulness.

I have not forgotten my fellow students, Dr Mohammad Saleh, for encouraging me to join him in this course of study, and Dr Joe Howard, for his moral support and cheer throughout my six years of candidacy. I was also much inspired by Dr. Lien Wen Sze, my ex-colleague and good friend, who continued to study in a different subject area after retirement.

The most thrilling part of my candidacy was the opportunity to study with my two beloved sons, Zhiyan and Neysan, at the same time though not the same materials. I must admit that I was stirred to action by their dedication to master their subjects, their single-minded focus, and their sense of cheer. It did help to prod me along when I was tired and when the study materials looked overwhelming.

Words are inadequate, but I still wish to express my abiding love and everlasting gratitude to my beloved wife, Dr Foo Mozhdeh Mohajer, for her quiet acquiescence and unquestioned support of my study during this long and difficult period.

Finally, I dedicate this thesis to both my late parents, Foo Fook Heng and Lin Yu Hua, who never had the opportunity to study when they were growing up in China. I hope their souls would be solaced by what their son had done late in his life.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

AAU	Assigned Amount Unit
ADP	Ad Hoc Working Group on the Durban Platform for Enhanced Action
AGBM	Ad Hoc Group on the Berlin Mandate
AGGG	Advisory Group on Greenhouse Gases
AIS	Antarctica Ice Sheet
AOSIS	Alliance of Small Island States
AOGCM	Atmosphere-Ocean Coupled General Circulation Model
AR	Assessment Report of IPCC
ASEAN	Association of South East Asian Nations
AWG-KP	Ad Hoc Working Group on the Kyoto Protocol
BAPA	Buenos Aires Plan of Action
BASIC	Brazil, South Africa, India and China
BIC	Baha'i International Community
BWNS	Baha'i World News Service
BRICS	Brazil, India, China and South Africa
Btu	British thermal units
CAS	Committee on Atmospheric Sciences
CBDR	Common but Differentiated Responsibilities
CBDR-RC	Common but Differentiated Responsibilities and Respective Capabilities
CCH	Common Concern of Humankind
CCSM	Community Climate System Model
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CFC	Chlorofluorocarbon
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CLS	Critical Legal Studies
CMP	Meeting of the Parties
CO_2	Carbon dioxide
COP	Conference of Parties
CORSIA	Carbon Offsetting Reduction Scheme for International Aviation
CPR	Common Pool Resource
°C	Degree Celsius
Dem	Democratic Party of the US

DOE	US Department of Energy
EAIS	East Antarctica Ice Sheet
EEAP	Environmental Effects Assessment Panel of the Montreal Protocol
EEZ	Exclusive Economic Zone
EIA	United States Energy Information Administration
EIT	Economies in Transition
EJ	exajoule
EMEP	European Monitoring and Evaluation Programme
ENSO	El Niño-Southern Oscillation (ENSO) Phenomenon
EPA	US Environmental Protection Agency
ETS	Emissions Trading Scheme
EU	European Union
EUC	Emissions Unit Criteria
EU-ETS	European Union Emissions Trading Scheme
ERU	Emission Reduction Unit
FAR	First Assessment Report of IPCC
FCC	Framework Convention on Climate Change
FGGE	First Global GARP Experiment
G8	Group of Seven plus Russia
G20	Group of Twenty
G-77	Group of 77 Developing Countries
GARP	Global Atmospheric Research Programme
GATT	General Agreement on Tariffs and Trade
GCM	General Circulation Model
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gases
GISS	Goddard Institute for Space Studies
GMBM	Global Market-Based Measure
GMSL	Global Mean Sea Levels
GMST	Global Mean Surface Temperature
GPG	Global Public Good
GrIS	Greenland Ice Sheet
GWP	Global Warming Potential
HCFC	Hydrochloroflourocarbon
HFC	Hydrofluorocarbon
HFO	Hydrofluoroolefin
IAD	Institutional Analysis and Development

IAEA	International Atomic Energy Agency
IBF	International Bunker Fuel
IC	Implementation Committee of CLRTAP
ICAO	International Civil Aviation Organization
ICS	International Commission on Stratigraphy
ICJ	International Court of Justice
ICSU	International Council of Scientific Unions
IEA	International Energy Agency
IGBP	International Geosphere-Biosphere Programme
IGO	Intergovernmental Organization
ILC	International Law Commission
IMF	International Monetary Fund
IMO	International Maritime Organization
INC	Intergovernmental Negotiating Committee
INDC	Intended Nationally Determined Contributions
IO	International Organization
IOC	Intergovernmental Oceanographic Commission
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
IR	International Relations
ISPO	Integrated Systemic Process-Oriented
ITCZ	Inter-Tropical Convergence Zone
IUGG	International Union of Geodesy and Geophysics
IUGS	International Union of Geological Sciences
IWC	International Whaling Commission
JGOFS	Joint Global Ocean Flux Study
JI	Joint Implementation Projects
JOC	Joint Organizing Committee
KP	Kyoto Protocol
LDC	Least Developed Countries
LoS	Law of the Sea
MAD	Mutual Assured Destruction
MCP	Multilateral Consultative Process
MEA	Multilateral Environmental Agreement
MLF	Multilateral Fund
MOP	Meeting of the Parties
MRV	Monitoring, Reporting and Verification

NATO	North Atlantic Treaty Organization
NCP	National Climate Program
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
NIEO	New International Economic Order
NOAA	National Oceanic and Atmospheric Administration of the United States
ODS	Ozone Depleting Substances
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of the Petroleum Exporting Countries
PA	Paris Agreement
PCIJ	Permanent Court of International Justice
PDSA	Plan, Do, Study and Act
PETM	Palaeocene-Eocene Thermal Maximum
PgC	Petagram of Carbon
pH	Logarithmic scale for acidity or basicity
PRISM	Pliocene Research, Interpretation and Synoptic Mapping Group
QELCRO	Quantified Emission Limitation and Reduction Objectives
RCP	Representative Concentration Pathways
REDD	Reducing Emissions from Deforestation and Forest Degradation
Rep	Republican Party of the US
RF	Radiative Forcing
RMU	Removal Unit
SAP	Scientific Assessment Panel of the Montreal Protocol
SAR	Second Assessment Report of IPCC
SBI	Subsidiary Body for Implementation
SBSTA	Scientific Body for Scientific and Technological Advice
SCOPE	Scientific Committee on Problems of the Environment
SDG	Sustainable Development Goal
SEP	Social-Economic-Political System
SES	Social-Ecological System
SMIC	Study on Man's Impact on the Climate Report
SID	Small Island Developing States
SQS	Subcommission on Quaternary Stratigraphy
SR1.5	IPCC Special Report on the impacts of global warming of 1.5°C
TAR	Third Assessment Report of IPCC
TEAP	Technology and Economic Assessment Panel of the Montreal Protocol
TNT	Trinitrotoluene
TOGA	Tropical Ocean and Global Atmosphere Programme

UAE	United Arab Emirates
UK	United Kingdom
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Desertification Convention
UNCED	United Nations Conference on Environment and Development
UNCHE	United Nations Conference on the Human Environment
UNCLOS	United Nations Convention of the Law of the Sea
UNCSD	United Nations Conference on Sustainable Development
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNOLA	United Nations Office of Legal Affairs
UNSC	United Nations Security Council
UNWTO	United Nations World Tourism Organization
US	United States of America
USGS	United States Geological Survey
USSR	Union of Soviet Socialist Republics
VCLT	Vienna Convention on the Law of Treaties
WAIS	West Antarctic Ice Sheet
WEF	World Economic Forum
WHO	World Health Organization
WCED	World Commission on Environment and Development
WCP	UNEP/WMO World Climate Programme
WCRP	World Climate Research Programme
WG	Working Group of IPCC
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization

LIST OF FIGURES

INTRODUCTION

1. BACKGROUND OF THE CLIMATE CHANGE PROBLEM

From every perspective, it is clear that the most important and most urgent task today, besides avoiding the existential threat of nuclear war, which requires mainly rational thinking and prudent action on the part of the leaders of nuclear power nation-States, is the abatement of the existential threat of systemic climate change, which must engage the rational thinking and prudent action not only of the leaders of nation-States but of every individual human being at every level of organization and in whatever sphere of endeavor (Chapter 1.1). More importantly, at this juncture in the evolution of climate change governance is the manifestation of sufficient political will by the international community of sovereign nation-States[1] and of strong moral volition on the part of each and every individual[2] to address the climate change problem. Hence, for the international law research student, "avoiding severe global catastrophe is a moral and legal imperative."[3] The keepers of the Doomsday Clock[4] had called upon "wise public officials" to "act immediately, guiding humanity away from the brink" and warned that

[1] Simone Rensch (2019) UN chief warns of insufficient political will on climate change, Public Finance International, 29 January 2019. Accessed on 31 July 2019 at: https://www.publicfinanceinternational.org/news/2019/01/un-chief-warns-insufficient-political-will-climate-change

[2] Simon Caney and Derek Bell (2011) Morality and Climate Change, The Monist, Volume 94, Number 3, July 2011, pp. 305-309.

[3] The "Oslo Principles on Global Obligations to Reduce Climate Change" and a detailed legal commentary that draw on the best joint interpretation of international law, human rights law, national environmental law and tort law, was put together by a group of law experts in response to the question as to whether in the absence of explicit treaties, nation-States have no legal obligations to curb their greenhouse gas emissions. Yet, if emissions continue on their present trajectory, the harms they cause will reach catastrophic proportions, putting the human rights of billions of people in jeopardy. International human rights law is legally binding on nation-States, which are, therefore, not free to continue business as usual [Hereinafter Oslo Principles]. It was announced on 30 March 2015. Accessed on 6 August 2018 at: https://globaljustice.yale.edu/oslo-principles-global-climate-change-obligations

[4] The decision to move the minute hand of the Doomsday Clock is made annually by the Science and Security Board of the Bulletin of the Atomic Scientists in consultation with its Board of Sponsors, which includes 15 Nobel laureates.

"… if they do not, [then] wise citizens must step forward and lead the way."[5]

The Earth's climate system has undoubtedly been since the beginning of the Holocene[6] an infinite 'public good', but in the Anthropocene[7] it has become more of a finite 'common sink' for excessive natural nutrients[8] to excessive artificial plastics,[9] from excessive heat[10] to excessive anthropogenic greenhouse gas (GHG) emissions.[11] Humankind is witnessing the likelihood of the Earth's climate system tipping over critical thresholds in this century with the consequential collapse of human civilization, as we know it.[12] Of the nine planetary boundaries identified,[13] the greatest challenge

[5] Bulletin of the Atomic Scientists (2017) It is Two and the Half Minutes to Midnight, 2017 Doomsday Clock Statement [John Mecklin (ed.)], Science and Security Board, Bulletin of the Atomic Scientists, USA, p. 8.

[6] The last ice age began about 110,000 years ago. About 19,000 years ago, the Earth started warming up because of changes in the Earth's orbit around the Sun and by about 11,700 years ago, these changes had brought about a transition from the glacial epoch to a "post-glacial" or "inter-glacial" epoch, known as the Holocene epoch. Since then, there have been small-scale climate shifts — notably the "Little Ice Age" between about 1200 and 1700 A.D. Generally, the Holocene epoch has been a relatively warm and climate-stable period, which enabled the development of global agriculture, sustained a vast population, and ushered in the modern civilization. A detailed description of the Holocene epoch is available at: http://paleobiology.si.edu/geotime/main/htmlversion/holocene3.html

[7] In 2000, the Nobel chemistry laureate Paul Crutzen and limnologist Eugene F. Stoermer coined the term 'Anthropocene' to describe the age in which humankind has been the cause of mass extinctions of flora and fauna, pollution of the oceans and alteration of the atmosphere. In 2018, the geophysical scientists proposed 'Anthropocene' as a new sub-division of geological time due to the highly significant human impact on the Earth's geology for the first time since the formation of the Earth four and the half billion years ago. Accessed on 21 May 2018 at: http://quaternary.stratigraphy.org/workinggroups/anthropocene/

[8] Eutrophication is the process that results in harmful algal blooms, dead zones, and fish kills due to the increased load of nutrients flowing into estuaries and coastal waters. Accessed on 31 July 2019 at: https://oceanservice.noaa.gov/facts/eutrophication.html

[9] Non-biodegradable plastic accumulating in our oceans and beaches has become a global crisis. Millions of tons of plastic are found in swirling convergences that make up about 40 percent of the world's ocean surfaces. At current rates plastic is expected to outweigh all the fish in the sea by 2050. Accessed on 31 July 2019 at: https://www.biologicaldiversity.org/campaigns/ocean_plastics/

[10] S. Levitus, J. I. Antonov, T. P. Boyer, O. K. Baranova, H. E. Garcia, R. A. Locarnini, A. V. Mishonov, J. R. Reagan, D. Seidov, E. S. Yarosh, and M. M. Zweng (2012) World ocean heat content and thermosteric sea level change (0–2000 m), 1955–2010, Geophysical Research Letters, Volume 39, 17 May 2012, L10603.

[11] National Geographic (2019) Cause of global warming, explained, National Geographic Society, 17 Juanary 2019. Accessed on 2 August 2019 at: https://www.nationalgeographic.com/environment/global-warming/global-warming-causes/

[12] National Research Council (2011) Understanding Earth's Deep Past: Lessons for Our Climate Future, National Academy of Sciences, USA, National Academic Press, Washington, D.C., pp. 63-65.

[13] The nine planetary boundaries identified by the Stockholm Resilience Centre includes climate change, biosphere integrity, land-system change, freshwater use, biogeochemical flows, ocean

confronting humankind today is to abate the adverse effects of climate change.[14]

In fact, the continual improvement in human life on this planet is no longer dependent only on the international community ensuring peace among its member States and the effective control of the weapons of mass destruction; it is now also dependent on the international community summoning the necessary political will to forge a binding global treaty and establish world institutions to coordinate the collective action of humankind to curb GHG emissions while each and every individual human being, as a member of a family, corporation, community, or as an agent of a nation-State or international organization, arising with moral volition to lead by example in cutting down GHG emissions in his daily life, voicing serious concern about the state of the climate in both private and public space, and dedicating his time and material resources for community efforts at concerted collective action to avoid the tragedy of the commons. For instance, every single individual should seriously consider following the recommendation of the IPCC in its latest report and transit with prudence to a balanced diet "featuring plant-based foods, such as coarse grains, legumes, fruits and vegetables, and animal-sourced food produced sustainably in low greenhouse gas emission systems". Such a mass movement in both developed and developing countries will have multiplier effects on the global food industry and national regulatory authorities, which "present major opportunities for adaptation to and limiting climate change."[15]

To ensure the sustainable use and maintenance of the climate global commons, the international community has established the international climate change regime, which is built around the core multilateral environmental agreements (MEAs) of the United Nations Framework Convention for Climate Change (UNFCCC),[16] Kyoto Protocol,[17]

---

acidification, atmospheric aerosol loading, stratospheric ozone depletion, and novel entities. Accessed on 31 July 2019 at: https://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html

[14] Antonio Guterres (2018a) Climate change: An existential threat to humanity, Keynote address to R20 Austrian World Summit, 15 May 2018, Vienna, Austria. Accessed on 29 April 2019 at: https://news.un.org/en/story/2018/05/1009782

[15] IPCC (2019) IPCC Press Release, 2019/24/PR, 8 August 2019. Accessed on 10 August 2019 at: https://www.ipcc.ch/2019/08/08/land-is-a-critical-resource_srccl/

[16] United Nations (1992a) United Nations Framework Convention on Climate Change, United Nations, New York, 9 May 1992. Accessed on 6 March 2017 at: http://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

[17] United Nations (1998) Kyoto Protocol to the United Nations Framework Convention on Climate Change, United Nations, Kyoto, 11 December 1997, United Nations Treaty Series, Volume 2303, p. 162 (No. 30822). Accessed on 6 March 2017 at: http://unfccc.int/resource/docs/cronvkp/kpeng.pdf

and Paris Agreement,[18] and based on the sources and practices of public international law to govern the climate global commons collectively. In fact, since the 1960s, the international community has been rapidly developing international environmental law to govern the broader system of global environmental commons. In specific instances, e.g. control of substances depleting the stratospheric ozone layer,[19] the use of the international regime approach had proven to be relatively successful. However, in the case of systemic climate change, this approach to drive concerted collective action has failed badly. Despite more than a quarter century of intense international diplomatic efforts and the establishment of three MEAs, the nation-States are still increasing their atmospheric GHG emissions as a whole.[20]

As the Earth system enters the Anthropocene, in which humankind has emerged as a significant bio-geophysical force, and the planetary systems are on the brink of human-induced ecological disaster that could change life on this planet, as we know it, it is timely to ask the central question, 'How we might live well together on planet Earth?'[21]

First, it is not controversial to claim that humankind has never quite manage to live together well[22] if one excludes the distant past in the calculus when humankind were living in very small groups very far apart from one another. Although at the mercy of a harsh environment, humankind then was able to sustain an affluent and egalitarian lifestyle for millennia, predicated on modesty of economic needs, circumscribed use of

[18] United Nations (2015a) Adoption of the Paris Agreement, Decision 1/CP.21, Annex to Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015, Addendum: Part two: Action taken by the Conference of the Parties at its twenty-first session, FCCC/CP/2015/10/Add.1, 26 January 2016.

[19] Kofi Annan (2003) "Perhaps the single most successful international agreement to date has been the Montreal Protocol". His views are shared widely in the international community. Accessed on 31 July 2019 at: https://www.un.org/en/events/ozoneday/background.shtml

[20] Nina Chestney (2019) Global carbon emissions hit record high in 2018: IEA, Reuters, 26 March 2019. Accessed on 31 July 2019 at: https://www.reuters.com/article/us-iea-emissions/global-carbon-emissions-hit-record-high-in-2018-iea-idUSKCN1R7005

[21] Jacques Derrida (2012) Avowing – the impossible: "Returns", repentance, and reconcilation: A lesson. In Living Together: Jacques Derrida Communities of Violence and Peace [Elisabeth Weber (ed.)], Fordham Scholarship (online). Accessed on 11 Augsut 2019 at: https://fordham.universitypressscholarship.com/view/10.5422/fordham/9780823249923.001.0001/upso-9780823249923-chapter-2

[22] Richard A. Falk (2012) Can We Overcome the Global Crisis: Obstacles, Options, and Opportunities, Keynote Address delivered at the Tanner Conference on Global Crisis, University of Utah, 2012. Accessed on 11 August 2019 at: http://climateproject.global.ucb.edu/publications/pdf/Richard,%20Falk.%20Can%20We%20Overcome%20the%20Global%20Crisis.pdf

violence, and constant balancing with the environment.[23] Second, it is not possible to go back to a world without nuclear weapons or systemic climate change. Third, we cannot continue with business-as-usual for it would only lead in time to severe catastrophic disruptions. Instead, we will need to find alternative ways of living together individually and collectively other than those ways associated with our modern society – linkage of security with overwhelming violence [threat of nuclear war], unlimited authority within borders [state sovereignty], unlimited freedom outside borders [tragedy of the commons], the pure pursuit of efficiency without justice and equality [economic neoliberalism], innovation to compete rather than cooperate [competitive markets], focus on the ballot box rather than on service to humankind [short-term popularism], and an individualistic ethos of being a completely rational self-interested short-term maximizer without any consideration for the interest of others [rational choice theory].

2. TRENDS IN CLIMATE CHANGE GOVERNANCE STUDY

There are three broad mainstream trends and one emerging critical trend in the study of climate change governance.

The first trend is the detailed study of its evolution to identify the success factors and the limitations of the governance process and its associated principles, norms, rules, institutions, and decision-making procedures.[24] Because climate change is a large and complex systemic problem, everything about climate change affects everything else and *vice-versa*,[25] it is possible to adopt a reductionist approach to the study of the climate change problem, from one of many different academic disciplines, which is the current analytical approach, e.g. science, economics, international law, or international relations. It is, therefore, essential for the international law research student to know the strengths and weaknesses of the current different analytical frameworks, theories and models used to address the climate change problem (Chapters 1.2 & 1.3).

[23] James Suzman (2017) Affluence without Abundance: The Disappearing World of the Bushmen, Bloomsbury, New Ork, NY, USA.

[24] Graduate Institute Geneva (2019) The Evolution of the International Climate Change Regime, News, International Climate Change Regime, Graduate Institute Geneva, 16 April 2019. Accessed on 31 July 2019 at: https://graduateinstitute.ch/communications/news/evolution-international-climate-change-regime

[25] Antonio Guterres (2018b) Secretary-General's press encounter on climate change [with Q&A], United Nations Secretary-General, United Nations, 29 March 2018. Accessed on 2 August 2019 at: https://www.un.org/sg/en/content/sg/press-encounter/2018-03-29/secretary-generals-press-encounter-climate-change-qa

Such a reductionist approach does present some theoretical, ideological and practical challenges, including, most importantly, how the scholar can avoid becoming overly descriptive in a narrow segment of reality and lose normative focus when it comes to the critical issue of finding viable solutions to the climate change problem.[26] Each discipline corresponds only to a narrow segment and scholars in that particular discipline develop theories and patterns of research activities, which yield satisfaction in understanding and insights for action that are appropriate only to that segment of the real world.[27] Hence, the complete knowledge, insights and action plan needed to solve the climate change problem is, therefore, fragmented among the academic spheres of science, economics, international law, international relations, and moral philosophy.[28]

However, a large and complex multi-factorial and multi-level systemic problem requires a multi-factorial and multi-level solution set that will "constrain and work with the dynamics of the system".[29] When dealing with a systemic problem, "we can never do merely one thing."[30] Hence, there is also a trend towards the development of a more "general system theory", "which lies somewhere between the highly generalized constructions of pure mathematics and the specific theories of the specialized disciplines" to deal with large and complex systemic problems such as climate change.[31]

The thesis is aligned with the more holistic trend in climate change governance study. Although no general system theory was proposed in this thesis to explain the evolution of climate change governance, this thesis did develop a general analytical framework associated with a holistic (integrated) systemic process-oriented approach for analysis of the climate change problem to gain insights on what should be the essentials elements of a better solution set. A better solution set needs to go beyond the current 'monocentric' solution of the international climate change regime in order to drive climate change governance towards the ultimate objective of "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent

[26] Kati Kulovesi (2013) Exploring the Landscape of Climate Law and Scholarship: Two Emerging Trends. In: Climate Change and Law [Erkki J. Hollo, Kati Kulovesi and Michael Mehling (eds.)], Springer, Dordrecht, pp. 31-62.

[27] Kenneth E. Boulding (1956) General Systems Theory – The skeleton of Science, Management Science, Volume 2, Number 3, pp. 197-208.

[28] Robert W. Cox (1981) Social Forces, States and World Orders: Beyond International Relations, Millennium – Journal of International Studies, Volume 10, Number 2, pp. 126 – 155.

[29] Robert Jervois (1997) System Effects: Complexity in Political and Social Life, Princeton University Press, Princeton, NJ, USA, p. 291.

[30] Garrett Hardin (1963) The Cybernetics of Competition: A Biologist's View of Society, Perspectives in Biology and Medicine, Volume 7 (Autumn 1963), p. 80.

[31] Kenneth E. Boulding (1956) supra note 27, p. 197.

dangerous anthropogenic (human induced) interference with the climate system."[32]

The second trend is the growing recognition that "climate change", a global problem requiring local action, "is governed and regulated at multiple levels" from the international to the regional and national, and from the local to transnational.[33]

The third and related trend is the deformalization of climate change law at the international and national levels. Currently, there is already a wide range of non-state actors' involvement in the process of climate change governance. There is also increasing reliance on the use of soft law instruments in enforcing compliance and informal collaboration in decision-making procedures.[34] The global cooperative efforts to address climate change include not only efforts at the international and national levels but also "encompasses a range of local and regional initiatives, cooperation between the public and private sectors, voluntary private sectors initiatives and activities by civil society."[35] The climate change problem is "multifaceted and multi-layered" and requires "effective policy at the level of both the nation-state and global governance"[36] as well as community arrangements of rules-in-use for local, community, and regional governance.

This thesis is similarly aligned to these two latter trends in proposing an urgent but transactional shift from a 'monocentric' to a 'polycentric' approach[37] in climate change governance, in which different groups of actors from the transnational down to the individual level making decisions about the appropriate rules-in-use in context and implement them at multiple levels to curb greenhouse gas emissions.

The one emerging trend is a critical attempt to answer the central question, 'How we might live well together on planet Earth? The dominant tradition of theorizing, as reflected in the above-mentioned three mainstream trends, has reconciled itself to the persistence of the state-centric world order "in which hopes are pinned on "cooperation

[32] United Nations (1992a) supra note 16, Article 2.

[33] Kati Kulovesi (2013) supra note 26, p. 32.

[34] Id., pp. 32-33.

[35] Harriet Bulkeley and Peter Newell (2010) Governing Climate Change, Routledge, London and New York, p. 106.

[36] David Held and Augus Hervey (2011) Democracy, Climae Change and Global Governance: Demoncratic Agency and the Policy Menu Ahead. In: The Governance of Climate Change: Science, Economics, Politics & Ethics [David Held, Augus Hervey and Marika Theors (eds.)], Polity Press, Cornwall, p. 89.

[37] Elinor Ostrom (2010) Polycentric systems for coping with collective action and global environmental change, Global Environmental Change, Volume 20, pp. 550-557.

for mutual benefit, countervailing or balanced power, and above all, the prudence on the part of the main power wielders."[38]

What is needed now is a set of structural and normative changes that cannot be brought about without a paradigm shift to a post-modern Anthropocene mindset and imagery. The Anthropocene mindset and imagery have been reinforced by the empirical evidences of the natural sciences and in turn have implications for its study. More importantly, the cultural implications of this new mindset and imagery are "destabilizing society's perceptions and expectations of the classical regulatory institutions that are situated in the humanities [social sciences] that we usually employ to mediate the human-environment interface."[39] In fact, "... the framing of world order by reference to a global crisis associated with a troublesome and highly dangerous transition from state-centric borders to globally allocated limits is a fundamental challenge that human society has never before faced on a global scale ... [for] the present crisis is mainly a product of the anthropocene [sic] activities: carbon emissions, population growth, nuclear weapons and nuclear energy, resource depletion."[40]

To do so humankind will have to collectively agree to direct human behavior by means of new social regulatory institutions. With the leitmotiv of a universally acceptable ethical [or moral] framework, such "regulatory institutions are a way of expressing responsibility toward human and non-human constituents and towards the Earth system, while simultaneously addressing vulnerability and socio-ecological insecurity."[41]

In this light, the thesis also proposes a paradigm shift from an international regime governance approach, with several specific regimes to address climate change, to a global constitutionalism approach.[42]

---

[38] Richard A. Falk (2012) supra note 22, p. 2.

[39] Louis J. Kotze (2017) Global Environmental Consittutionalism in the Anthropocene. In: Environmental Law and Governance for the Anthropocene [Louis J. Kotze (ed.)], Hart Publishing Co., Oxford, UK, p. 189.

[40] Richard A. Falk (2012) supra note 22, p. 12.

[41] Louis J. Kotze (2017) supra note 39, p. 189.

[42] The Global Constitutionalism Journal, according to its Editorial Board, offers an interdisciplinary space for addressing the foundations, limitations and contestations of the principles and norms of political order and their dynamics over time on a global scale. Submissions are invited from a broad range of disciplines including International Law, Political Science, International Relations, Comparative Constitutional Law, Comparative Politics, Political Theory and Philosophy. Accessed on 11 August 2019 at: https://www.cambridge.org/core/journals/global-constitutionalism

3. PURPOSE AND OBJECTIVES OF THESIS

The first requirement to avert the 'tragedy of the commons' problem of climate change is for humankind to understand the systemic nature of the climate change problem [right view]. The second is for humankind to recast its individual aspirations and collective social goals in the light of systemic climate change [right intent]. The third is for the international community to coordinate international cooperation to 'deliver' on the overall policy objectives of the international climate change regime [right action].

The large and complex climate change problem is a long-wave event that takes place over decades and centuries.[43] To have the right intent and do the right thing requires the right view from an evolutionary perspective.[44] To acquire the right view of the climate change problem, one should adopt an integrated systemic process-oriented perspective to understand the complexity of the natural biophysical climate system, the complexity of the human social-economic-political system, the tight interconnections between the two large and complex natural and human systems, as well as the history and context (evolution) of international climate change governance and the analyses of their success factors and the limitations of international law and politics (Chapters 2, 3 & 4).

The right intent is for the international community to take concerted collective action to avoid the likely catastrophic disruptions of climate change and for the individual to do his best to cut down on greenhouse gas emissions in his daily routine. The teological purpose of both intents is not for the good of a particular nation-State or an individual human being; it is for the common good of humankind.[45]

---

[43] Tony Barnett (2006) A long-wave event. HIV/AIDS, politics, governance and 'security': sundering the intergenerational bond? International Affairs, Volume 82, Number 2, p. 302.

[44] In my thesis, I have emphasized the evolutionary aspects of the social-ecological dilemma of climate change. Similar to the approach in the study of religious thought and practices, which also plays out over decades and centuries even to the millennium, understanding the historical context of the problem is essential. "Every age hath its own problem, and every soul its particular aspiration. The remedy the world needeth in its present-day afflictions can never be the same as that which a subsequent age may require. Be anxiously concerned with the needs of the age ye live in, and center your deliberations on its exigencies and requirements." Quotation from Baha'u'llah in Gleanings from the Writings of Baha'u'llah, Baha'i Publishing Trust, London, UK, p. 212.

[45] Aristotle says the end-point of all human activities is the chief good or common good "For even if the end is the same for a single man and for a state, that of the state seems at all events something greater and more complete whether to attain or to preserve; though it is worthwhile to attain the end merely for one man, it is finer and more godlike to attain it for a nation or for city-states." In the modern context, the chief good or common good would be that for the whole of humankind. See Aristotle (350 BCE) Nicomachean Ethics, Part I, Paragraph 2 [Translated by W. D. Ross], Internet Classic Archives. Accessed

Philosophers, both moral and political, from Thomas Aquinas to Thomas Hobbes have defended the central importance of intent, especially legislative intent.[46] The right intent is predicated on understanding the nature and impacts of systemic climate change (Chapter 2) as well as the latest assumptions of the nature and preferences of man as proxy to those of the nation-States [agent], the history and context (evolution) of their interactions [process] in the action situation arena of UN conferences [structure] and how this agent-process-structure system can facilitate or hinder intent (Chapter 3 & 4).

One aspect of global commons governance in general and climate change governance in particular requires the international law research student to analyze, explain and communicate in simple language, especially to the general public, is the fragmentation of international law. The study group of the International Law Commission (ILC) had emphasized the importance of the "principle of systemic integration".[47] The application of this principle is vital for a decentralized institutional environment, where the objectives, measures and policies are often ambiguous or poorly expressed. First, to hold these international regimes as fully isolated from each other and concerned only about their own objectives and preferences is to think of law only as an instrument for attaining regime objectives. Second, international law is above all about protecting rights and enforcing obligations in the public interest. Hence, without this principle it would be impossible to give keep alive the notion of the common good of humankind.[48]

The right view and intent advocated in this thesis clearly uphold the principle of systemic integration; similarly the proposed right action plan is derived from the same principle. Both the nation-State and the individual have to work at continuous improvement, which is the step-wise approach to solving a problem, based on the principle, in order to raise the level of good over time and to avoid losing by default our capabilities to act later when better knowledge and understanding are available because otherwise the gap between the good and the perfect would have opened up far too wide for humankind to bridge due to our inaction along the way.

Such an integrated step-wise or iterative approach requires a 'polycentric' rather a

on 2 August 2019 at: http://classics.mit.edu/Aristotle/nicomachaen.1.i.html

[46] Richard Ekins (2012) The Nature of Legislative Intent, Oxford University Press, Oxford, UK, p. 1.

[47] Campbell McLachlan (2005) The Principle of Systemic Integration and Article 31(3)(c) of the Vienna Convention, International and Comparative Law Quarterly, April 2005, pp. 279-319.

[48] ILC (2006) Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law, Report of the Study Group of the International Law Commission, UN Doc. A/CN.4/L.682.

'monocentric' approach to provide a solution set rather than a single solution, which can be implemented immediately across "many centres of decision-making that are formally independent of each other"[49] to cut GHG emissions and reduce it by 55% or 25% in 2030 as compared to 2017 in order to to put the world on a least-cost pathway and keep the rise in global average temperature to below 1.5°C or 2.0°C above the pre-industrial level respectively by 2100.[50]

Although free-riding does not go away at institutional arrangements at the lower levels, there is extensive empirical evidence generated by in-depth case studies, meta-analysis of cases, laboratory experiments and comparative field studies that a large number of these small- and medium-scale communities facing social dilemmas of collective action do cooperate as a community to avoid the tragedy of the commons.[51] The multiple benefits from the actions of many centers of decision-making to establish appropriate rules-in-use in context to govern the climate change commons will add up, albeit not optimally, to reduce the risks of catastrophic climate disruptions[52] at this critical juncture to create breathing space for humankind before moving to the next step in the evolution of climate change governance.

In fact, the evolution of international climate change governance from the top-down Kyoto Protocol to the bottom-up Paris Agreement is essentially a paradigm shift from a 'monocentric' to a 'polycentric' approach, with the use of voluntary nationally determined contributions (NDCs) to reduce GHG emissions and welcoming "the efforts of all non-Party stakeholders to address and respond to climate change, including those of civil society, the private sector, financial institutions, cities and other sub-national authorities" and inviting them to "scale up their efforts and support actions to reduce emissions and/or to build resilience and decrease vulnerability to the adverse effects of climate change and demonstrate these efforts via the Non-State Actor Zone for Climate Action platform."[53] Now that the 'rulebook' for the implementation of the Paris

[49] Vincent Ostrom, Charles M. Tiebout and Robert Warren (1961) The Organization of Government in Metropolitan Areas: A Theoretical Enquiry, American Political Science Review, Volume 55, Issue 4, pp. 831-842.

[50] UNEP (2018a) Emissions Gap Report 2018: Executive Summary, United Nations Environmental Programme, Nairobi, Kenya, p. 6.

[51] Elinor Ostrom (2009) Beyond Markets and States: Polycentric Governance of Complex Economic Systems, Nobel Memorial Prize in Economic Sciences Lecture, 8 December 2009. Accessed on 1 June 2019 at: https://www.nobelprize.org/uploads/2018/06/ostrom_lecture.pdf

[52] Elinor Ostrom (2010) supra note 37, p. 552.

[53] UNFCCC (2016) Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015, Addendum: Part two: Action taken by the Conference of the

Agreement has been agreed upon by the international community at the 2018 Katowice Conference,[54] the nation-States should focus on designing the appropriate institutional arrangements at the national and sub-national levels, at the regional, community, corporate, and local levels, to engender trust, reciprocity and reputation, which are the essential ingredients for concerted collective action at any level.[55]

The NDCs of GHG emissions reduction targets volunteered thus far by the Parties to the Paris Agreement are, however, far from the ambition level required to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" let alone for "pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change" as was agreed to by all nation-States in the 2015 Paris Agreement.[56] According to the latest UN Environment Emissions Gap Report 2018, it will require the current level of ambition with the NDCs to be roughly tripled for the 2°C scenario and to increase by around fivefold for the 1.5°C scenario by 2030.[57]

Therefore, the thesis (Chapter 4.3) advocates as the next step in the polycentric approach to climate change governance the immediate use of carbon tax legislation at the national governance level to ratchet up the NDCs to the required ambition level. A national carbon tax system, e.g. Baker-Schultz Carbon Dividends Plan,[58] is a pragmatic tool to restrain indiscriminate greenhouse gas emissions at the local, community, corporate, regional and national levels as well as to incentivize their efforts to strive for greater energy use efficiency and to switch to low-carbon energy sources. Both public and private enterprises at the national level will be incentivize to build the infrastructure associated with the extraction, storage, transportation, distribution, utilization and institutionalization of non-fossil energy sources needed for a full transition to a low-carbon economy in parallel to community actions at the different sub-national levels to

Parties at its twenty-first session, FCCC/CP/2015/10/Add.1, 26 January 2016, paragraphs 133 & 134, p. 19.

[54] Nathan Cogswell and Yamide Dagnet (2019) Why Does the Paris Climate Agreement Need a Rulebook? 7 Questions and Answers, World Resources Institute, 13 June 2019. Accessed on 10 August 2019 at: https://www.wri.org/blog/2019/06/why-does-paris-climate-agreement-need-rulebook-7-questions-and-answers

[55] Elinor Ostrom (1998) A Behavioral Approach to the Rational Choice Thoery of Collective Action, Presidential Address, American Political Science Association, 1997, American Political Science Review, Volume 92, Number 1 (March 1998), pp. 10-13.

[56] UNFCCC (2016) supra note 53, paragraph 17, p.4.

[57] UNEP (2018a) supra note 50, p. 4.

[58] Climate Leadership Council (2018) Exceeding Paris: How the Baker-Shultz Carbon Dividends Plan Would Significantly Exceed U.S. Paris Commitment, Climate Leadership Council, USA, 12 pp.

cut down on GHG emissions. If the countries of China [Asia], US [Americas], the EU [Europe] and India [Asia] with about 60% of the current total nominal GDP[59] and about 60% of the current total GHG emissions[60] were to introduce carbon tax legislation, it would have a domino effect on the rest of the world.[61]

Thereafter, functional integration, from the technological and economic perspectives, of these national communities and infrastructures can take place to create a world community before the introduction of a world political and legal authority with supranational legislative, executive and judicial powers for the global environmental commons as the long-term solution to systemic climate change problem.[62]

Climate change that takes place due to an increase in atmospheric GHG concentration is a largely irreversible phenomenon for the next 1,000 years even after GHG emissions have stopped.[63] It is a long wave event[64] with significant intergeneration impacts. If ever there would be a time for a critical look into a transformative regulatory intervention to halt, minimize or even reverse the ecological damage done to planet Earth as a result of human activities and to adapt to Earth system changes, it is now.[65]

The thesis highlights the limitations of international law and politics (Chapters 5.1 & 5.2) to solve the climate change problem and calls for a paradigm shift from the current international regime approach to a global environmental constitutionalism approach (Chapter 5.3). First, global constitutionalism fosters the progressive social ordering from an international anarchical system to a world system with "an apex form of law to improve a legal and political order for the common good" addressing the issue of fragmentation highlighted by the ILC.[66] Second, it provides a stable and legitimate framework to facilitate positive interactions among its world citizens to address the

[59] World Bank (2018) Gross Domestic Product 2018: GDP Ranking, World Bank Group. Accessed on 11 August 2019 at: https://datacatalog.worldbank.org/dataset/gdp-ranking

[60] UCS (2015) Each Country's Share of CO_2 Emissions, Union of Concerned Scientists, 11 October 2018. Accessed on 11 August 2019 at: https://www.ucsusa.org/global-warming/science-and-impacts/science/each-countrys-share-of-co2.html

[61] Robert Jervois (1997) supra note 29, pp. 165-166.

[62] Hans Morgenthau (1985) Politics Among Nations: The Struggle for Power and Peace, 6th Edition, [revised by Kenneth W. Thompson], McGraw-Hill, New York, USA, pp. 542-559.

[63] Susan Solomon, Gian-Kasper Plattner, Reto Knutti, and Pierre Friedlingstein (2009) Irreversible climate change due to carbon dioxide emissions, Proceedings of the National Academy of Sciences, Volume 106, Number 10 (10 February 2009), pp. 1704-1709.

[64] Tony Barnett (2006) supra note 43, p. 302.

[65] Louis J. Kotze (2017) supra note 39, p. 189.

[66] ILC (2006) supra note 48.

global challenges of carbon emissions, population growth, nuclear weapons and energy, and resource depletion.[67] Third, "as part of its elevated relative juridical position," global constitutionalism "provides guarantees of individual freedoms, democracy, representation, rights and participation, among others."[68] Fourth, it has also been argued that "[i]n the background, if not even at the foundations, of any constitutional system are reflections upon the very notion of morality."[69]

Hence global constitutionalism transcends the limitations of international law and politics. While there is still little consensus about the meaning and approach to global constitutionalism, it is clear that this paradigm shift will be from a state-centric to a geo-centric perspective [space] and a short-term to a long-term approach [time]. It should have a global constitution, in which fundamental norms are enshrined.[70] There will be also separation of global governance powers, i.e., legislative, executive, and judiciary.[71] The law-making process will take place only at the world level but the administrative, executive and adjudicative processes will adhere to the principle of subsidiarity.[72]

The overall purpose of the thesis is to review and critique past and current approaches in understanding and explaining the climate change problem as well as to propose new approaches for the continuous improvement of the climate change governance process. While it is true that even the latest updated scientific knowledge and understanding of systemic climate change are not perfect today the international law research student cannot let the perfect be the enemy of the good and do nothing. To do nothing is to "defeat the possibilities of substantial remedy in time" to avert an existential threat.[73]

In summary, the first objective of this thesis is to review and critique the current analytical frameworks, theories and models used to understand, explain, and solve the climate change problem (Chapter 1). The second objective is to review the latest scientific knowledge and understanding of the systemic interactions of the biophysical

[67] Richard A. Falk (2012) supra note 22, p. 12.

[68] Louis J. Kotze (2017) supra note 39, p. 191.

[69] G. Anastaplo (2003) Constitutionalism and the Good: Explorations, Tennessee Law Review, Volume 70, p. 738.

[70] Klaus Bosselmann (2017) The Imperative of Ecological Integrity: Conceptualising a Fundamental Legal Norm for a New 'World System' in the Anthropocene. In: Environmental Law and Governance for the Anthropocene [Louis J. Kotze (ed.)], Hart Publishing Co., Oxford, UK, pp. 241-265.

[71] Louis J. Kotze (2017) supra note 39, pp. 205-207.

[72] Eur-Lex (2019) Subsidiarity, Glossaries of Summaries, Summaries of EU Legislation, Access to European Union Law. Accessed on 11 August 2019 at: https://eur-lex.europa.eu/summary/glossary/subsidiarity.html

[73] Elinor Ostrom (2010) supra note 37, p. 550.

climate ecosystem and the human social-economic-political (SEP) system and the impacts of systemic climate change on the SEP system (Chapter 2). The third objective is to develop an "Integrated Systemic Process-Oriented" (ISPO) framework for the analysis of global commons governance in general and climate change governance in particular (Chapter 3). The fourth objective is to analyse the success factors and the limitations of current strategies and practices, predicated on the academic disciplines of science, economics, international law, international politics, and moral philosophy, to solve the climate change problem (Chapters 4.1 & 4.2). The fifth objective is to recommend alternative institutional arrangements, including a national carbon tax, in the form of polycentric governance for the short-term reduction of the risks of catastrophic climate disruptions (Chapter 4.3). The sixth objective is to reiterate the limitations of international law and international politics (Chapters 5.1 & 5.2) and to propose an alternative world order for the long-term continuous development towards the optimum world public order of the two social goals for the common good of humankind, namely the stabilization of "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" [74] and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations, which is a restatement of the Rio Declaration (Chapter 5.3).[75]

These social goals are not aspirational goals that humankind can take their time to achieve. Because climate change is a likely existential threat in the future and will affect everything else, these social goals are vital goals for the whole of humankind if we do not want our children to witness the collapse of human civilization, as we know it today.

4. GENERAL ANALYTICAL FRAMEWORK

To facilitate the attainment of the above-mentioned objectives, the ISPO analytical framework for understanding, explaining and solving the climate change problem was developed for this thesis. It is both holistic (integrated and systemic) and process-oriented. However, it is still a problem solving approach and not a critical approach.[76] The ISPO framework still takes the world with its prevailing order of social and power

[74] United Nations (1992a) supra note 16, Article 2.

[75] UNEP (1992a) Rio Declaration on Environment and Development, United Nations Conference on Environment and Development, Rio de Janeiro, June 3-14, 1992 [hereinafter Rio Declaration]. Accessed on http://www.unep.org/documents.multilingual/default.asp?documentid=78&articleid=1163

[76] Robert W. Cox (1981) supra note 28, pp. 128-130.

relationships, together with the institutions into which they are organized. However, unlike most problem solving approaches, the ISPO framework is process-oriented. It is not an ahistorical and static framework. It is a historical, contextual (evolutionary) and dynamic framework for gaining knowledge and taking action.[77]

The ISPO framework is a combination of the key elements of the integrated socio-ecological system (SES) approach, as developed by Elinor Ostrom and Vincent Ostrom, together with colleagues, in the Workshop in Political Theory and Policy Analysis of Indiana University,[78] the process approach of global governance as recommended by the Commission on Global Governance,[79] and the policy-oriented approach of the New Haven School of social jurisprudence to international law and politics, as developed by Myers S. McDougal and Harold D. Lasswell.[80]

The ISPO analytical framework is a modification of the IAD Framework[81] of the SES approach. The first box of the ISPO Framework comprises of the three building blocks of broad exogenous variables, namely the biophysical climate ecosystem, the SEP system, which includes science, economics, international law, international politics and moral philosophy, and the rules-in-use, which includes the design principles (critical success factors), which are derived from the general principles of international law. At the core of the ISPO framework is still the same second box, known as the "action situation arena" [structure], comprises of three inter-related building blocks of internal variables, namely, action situations, interactions and outcomes. This second box, in which the relevant actors find themselves in an action situation with interactions and outcomes of solving a particular social dilemma, is still affected by the first box of different exogenous variables [nested structure] and in turn affects the first box of different exogenous variables. The third box of the framework comprises of a specific set of evaluative criteria, which will be based on achieving the end-point or social goals, namely the stabilization of "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"[82] and balancing economic, environmental and social needs of contemporary society in order

[77] Id., p. 129.

[78] Elinor Ostrom (2009) supra note 51.

[79] Commission on Global Governance (1995) Our Global Neighbourhood: The Report of the Commission on Global Governance, Reprint 2005 [Ingvar Carlsson and Shridath Ramphal (co-chair)], Oxford University Press, Oxford, pp. 2-7.

[80] W. Michael Reisman, Siegfried Wiessner and Andrew R. Willard (2007) The New Haven School: A Brief Introduction, The Yale Journal of International Law, Volume 32, pp. 575-582.

[81] Elinor Ostrom (2009) supra note 51, pp. 413-416.

[82] United Nations (1992a) supra note 16, Article 2.

to ensure sustainable development for current and future generations.[83]

The schematic diagram of the ISPO framework for analysing the evolution of international climate change governance is as shown in Figure 1:

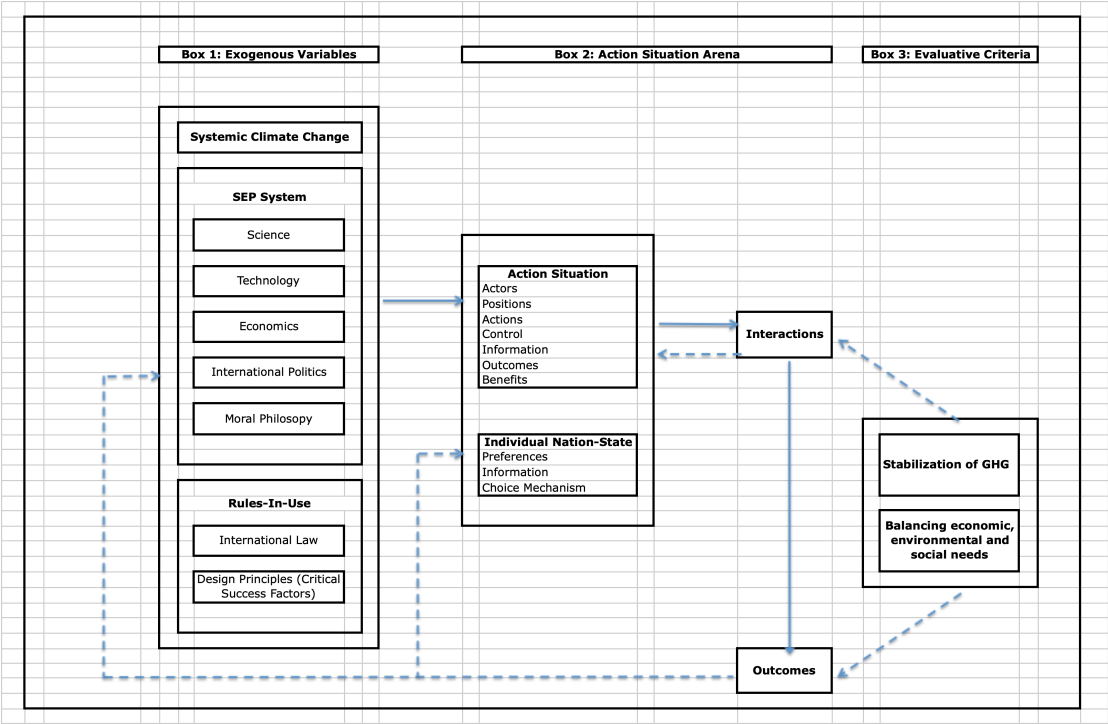

Figure 1: The ISPO Framework for the Analysis of the Evolution of International Climate Change Governance. Source: Adapted from Elinor Ostrom (2005).[84]

In summary, the ISPO general analytical framework associated with the integrated systemic process-oriented approach, with minor changes in the exogenous variables, internal variable and evaluative criteria, is used in this thesis as the framework for analyses or for framing of questions as follows:

(1) Evolution of the ocean global commons governance (Chapter 3.1)
(3) Evolution of international atmosphere global commons governance (Chapter 3.2)
(4) Evolution of international climate change governance (Chapter 3.3)
(5) Identify the critical success factors for effective governance (Chapter 4.1)
(6) Identify limitations of international law and politics (Chapters 5.1 & 5.2)

[83] UNEP (1992a) supra note 75, Article 3.

[84] Elinor Ostrom (2005) Understanding Institutional Diversity, Princeton University Press, Princeton, NJ, USA, p. 15.

5. RESEARCH METHODOLOGY

I did not conduct any laboratory experiment nor carry out any field study in writing my thesis. Similar to the approach of the Intergovernmental Panel on Climate Change (IPCC) but with a wider scope, I have, instead, carried out textual analysis of and reflection on the vast literature currently available, which is reflected by the numerous references cited in this thesis, in the scientific, technological, social, economic, political, legal, and moral academic spheres of knowledge, which are relevant to understanding and explaining as well as solving the systemic climate change problem.

The relevant knowledge according to the dichotomy of reductionist and holistic approaches, product (or rule) and process approaches, and problem solving and critical theories, is categorized in Chapter 1. Understanding interconnections between climate and the SEP system and their impacts in Chapter 2 provide "a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts."[85] The use of the ISPO analytical framework in Chapter 3.3 facilitates understanding and explanation of the evolution of climate change governance and in Chapter 4.1 to identify the critical success factors or design principles of international regimes. Questions were also framed with the ISPO framework to critique the limitations of international law and international politics in Chapters 5.1 & 5.2.

Chapter 4.3 recommends the immediate implementation of polycentric governance to cut GHG emissions worldwide, which is in line with the plan of the 2019 Climate Action Summit, called forth by the UN Secretary-General António Guterres. He is calling on all leaders to come to New York on 23 September 2019 with concrete and realistic plans to enhance their NDCs by 2020 in line with reducing GHG emissions by 45% over the next decade, and to net zero GHG emissions by 2050.[86] The Climate Action Summit with the theme, "A Race We Can Win", will bring together leaders of governments, the private sector, civil society, local authorities and other international organizations to develop ambitious solutions in six areas: (1) energy transition, (2) climate finance and carbon pricing, (3) industry transition, (4) nature-based solutions, (5) cities and local action, and (6) resilience and adaptation. A multi-factorial, multi-

[85] IPCC (2017a) Organization, Intergovernmental Panel on Climate Change, World Meteorological Organization and United Nations Environmental Programme. Accessed on 13 August 2017 at: http://www.ipcc.ch/organization/organization.shtml

[86] United Nations (2019) Climate Action Summit 2019: A Race We Can Win. Accessed on 10 August 2019 at: https://www.un.org/en/climatechange/un-climate-summit-2019.shtml

level solution set that will "constrain and work with the dynamics of the system"[87]is a necessary condition to reduce the catastrophic risks associated with GHG emissions.

A key pragmatic measure proposed in the thesis is the adoption by developed countries of an analogue of the Baker-Shultz Carbon Dividends Plan, which has been proposed in the US as a carbon tax legislation scheme for approval by Congress with the objective of exceeding US commitments to the Paris Agreement. The Baker-Shultz Plan will restrain indiscriminate GHG emissions at the local, corporate, community, and regional levels as well as incentivize their efforts to strive for greater energy use efficiency and to switch to low-carbon energy sources.[88]

Chapter 5.3 critiques, from a critical theory perspective, that merely reforming the current world order with its prevailing order of social and power relationships, together with the institutions into which they are organized, will only delay the climate system from tipping over critical thresholds in the immediate future. Because climate change due to GHG emissions is largely irreversible for 1,000 years after emissions have stopped, it is a long wave event with intergeneration impacts, the thesis proposes the introduction of global environmental constitutionalism to address the global climate change commons. It requires diplomatic efforts at the international level to initiate political negotiations after the implementation of the Paris Agreement to establish global environmental constitutionalism as part of the long-term solution to achieve the ultimate objective of "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system" and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations.[89] In the meantime, the United Nations General Assembly should call for a Summit of all nation-States and non-state actors to start the process of global civic education of the whole human race, under the auspices of UNESCO, as the process of education not only take much resources, it will also take much time to pervade every strata of global society.

[87] Robert Jervois (1997) supra note 29, p. 291.

[88] Climate Leadership Council (2018) supra note 58.

[89] The teological goals of global climate change governance.

CHAPTER 1: GLOBAL COMMONS

"Climate climate: An existential threat to humanity."

UN Secretary-General Antonio Guterres[90]

"As a rational being, each herdsman seeks to maximize his gain ... the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another ... But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit – in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all."

Garrett Hardin[91]

The greatest threats to the survival of humankind as depicted in popular fiction are the invasion of our planet by aliens from outer space[92] and the destruction of the planet from collision with a large extra-terrestrial body.[93] The cause of destruction in both cases would be due to externalities vis-à-vis planet Earth. There is a fast-growing public awareness today that the real existential threats are actually internal to our planet Earth, particularly due to the careless stewardship of its dominant species – humankind.

1.1. EXISTENTIAL THREATS

An existential threat or risk is one "where an adverse outcome would either annihilate Earth-originating intelligent life or permanently and drastically curtail its potential."[94] It would mean at least the catastrophic collapse of human civilization, as we know it today.

[90] Antonio Guterres (2018a) supra note 14.

[91] Garrett Hardin (1968) The Tragedy of the Commons, Science, Volume 162, Issue 3859 (13 December 1968), pp. 1243-1248.

[92] H. G. Wells (1898) Wars of the World, 1st Edition, William Heinemann, UK.

[93] Michael Bay (1998) Armageddon, Jerry Bruckheimer, Gale Anne Hurd & Michael Bay (Producers), Touchstone Pictures, USA.

[94] Nick Bostrom (2002) Existential risks: analyzing human extinction scenarios and related hazards, Journal of Evolution and Technology, Volume 9, Number 1, pp. 1-22.

Although systemic climate change is very unlikely to cause the extinction of the human species by itself, but through its multiplier effect,[95] it may yet lead to an all-out nuclear war because the nation-States most responsible for global warming, both in the past and present, are some of the world's most powerful nation-States with nuclear weapons.

The mid-20th century is accepted by a supermajority vote (>60%) of the Anthropocene Working Group, a component body of the Subcommission on Quaternary Stratigraphy (SQS), which is a constituent body of the International Commission on Stratigraphy (ICS), on 21 May 2019, as the base of the Anthropocene in the Working Group's proposal to formalize it as a chrono-stratigraphic unit defined by a Global boundary Stratotype Section and Point, known as a 'golden spike'. The sharpest and most globally synchronous marker is probably made by the artificial radionuclides spread worldwide by the thermonuclear bomb tests from the early 1950s. Analyses of the potential 'golden spike' locations are underway and the resultant proposal, when made, would require supermajority agreement successively by the Working, SQS and ICS, which then has to be ratified by the International Union of Geological Sciences (IUGS).[96] Success of the proposal is, however, not guaranteed. Hence, the Anthropocene is currently not yet a formally defined geological unit within the Geological Time Scale; humankind is still living within the Meghalayan Age of the Holocene Epoch.

The Anthropocene, however, is widely used as a popular scientific term to denote the present geological time interval, since its coining by Paul Crutzen and Eugene Stoermer in 2000,[97] by scientists, the engaged public and the media to designate a period of the Earth's history, in which many processes and conditions of planet Earth are profoundly affected by human activities. The impact of human activities on Earth's system has intensified markedly since the advent of industrialization, taking humankind out of the geological state typical of the Holocene Epoch, which had started at the close of the Paleolithic Ice Age about 12,000 years ago.[98] If the Anthropocene were to be ratified by

[95] United Nations Security Council (2019) Climate change recognized as 'threat multiplier', UN Security Council debates its impact on peace, UN News, 25 January 2019. Accessed on 11 August 2019 at: https://news.un.org/en/story/2019/01/1031322

[96] Anthropocene Working Group (2019) Results of binding vote by AWG: Released 21st May 2019, Working Group on the 'Anthropocene', Subcommission on Quarternary Stratigraphy. Accessed on 11 August 2019 at: http://quaternary.stratigraphy.org/working-groups/anthropocene/

[97] Paul J. Crutzen and Eugene F. Stoermer (2000) The ''Anthropocene'', Global Change Newsletter, Volume 41, pp. 17–18.

[98] Rhodes W. Fairbridge and Larry D. Agenbroad (2018) Holocene Epoch, Encyclopaedia Britannica (online), 7 December 2018 (updated). Accessed on 11 August 2019 at: https://www.britannica.com/science/Holocene-Epoch

the IUGS as an epoch of geological time, then it would bring to a close the Holocene Epoch. Currently, the use of the term 'Anthropocene' in a non-chronostratigraphic context to denote a broader interpretation of the anthropogenic impact on the planet.

The change phenomena already associated with the Anthropocene include an order-of-magnitude increase in erosion and sedimentation associated with urbanization and agriculture; abrupt perturbations of the biogeochemical cycles of carbon, nitrogen, phosphorus and various metals; disruptive environmental changes generated by these perturbations such as global warming, sea-level rise, and ocean acidification; rapid changes in the biosphere on land and in the sea in the form of habitat loss, spreading oceanic 'dead zones, predation, and species invasions due to the disruptive environmental changes and the explosive growth in human and domestic animal populations; the global dispersion of myriad 'technofossils', including concrete, fly ash and plastics;[99] the proliferation of permanent traces of lead from the combustion of leaded gasoline for modern transportation.[100] One distinctive 'golden spike' embedded in sediments and glacial ice, thus becoming part of the geological record, is the signal radioactive fallout across the face of the planet left by nuclear explosions since the first atomic bomb blasts in the 1940s.[101] The commencement of the Anthropocene could be optimally placed in the mid-20th century, coinciding with the array of geological proxy signals preserved within recently accumulated strata and resulting from the great acceleration in population growth, industrialization and globalization.

1.1.1. The Existential Threat of Nuclear War

In July 1945, Richard Feynman penned in a letter to his parents shortly after the first atomic explosion the following words: "The orange got deeper, but near the gadget it was still bright, a big orange flaming ball-like mass. This started to rise, leaving a

[99] Jan Zalasiewicz, Mark Williams, Colin N. Waters, Anthony D. Barnosky and Peter Haff (2014) The technofossil records of humans, The Anthropocene Review, Volume 1, Issue 1, pp. 34-43.

[100] Howard W. Mielke (1999) Lead in the inner cities: Policies to reduce children's exposure to lead may be overlooking a major source of lead in the environment, American Scientific, Volume 87, Issue 1 (Jan-Feb 1999), pp. 62-73.

[101] Jan Zalasiewicz, Colin N. Waters, Mark Williams, Anthony D. Barnosky, Alejandro Cearreta, Paul Crutzen, Erle Ellis, Michael A. Ellis, Ian J. Fairchild, Jacques Grinevald, Peter K. Haff, Irka Hajdas, Reinhold Leinfelder, John McNeil, Eric O. Odada, Clément Poirier, Daniel Richter, Will Steffen, Colin Summerhayes, James P. M. Syvitski, Davor Vidas, Michael Wagreich, Scott L. Wing, Alexander P. Wolfe, ZhiSheng An and Naomi Oreskes (2015) When did the Anthropocene begin? A mid-twentieth century boundary level is stratigraphically optimal, Quaternary International, Volume 383 (5 October 2015), pp. 196-203.

column of smoke much like the stem of a mushroom."[102] It marked the beginning of the iconic mushroom cloud, which is now etched in the collective memory of humankind.

1.1.1.1. The Effects of Nuclear War

On 6 August 1945, a 15-kiloton atomic bomb exploded over the centre of the Japanese city of Hiroshima, flattening the city, killing more than 100,000 people, and producing the mushroom cloud. Three days later, a second atomic bomb was exploded over the city of Nagasaki, resulting in the deaths of another 70,000 people. For months and years after the attacks, many survivors developed symptoms that puzzled medical doctors. It would eventually be revealed that these survivors were experiencing increased incidences of certain forms of cancer due to 'radiation fallout'.[103] Today the destructive power of a 15-kiloton atomic bomb (equivalent to 15,000 tons of TNT) is dwarfed by the hydrogen bomb of 9 megaton (equivalent to 9 million tons of TNT).[104]

An unweighted extrapolation from the 100,000 direct fatalities caused by a 15-kiloton atomic bomb in the Hiroshima bombing to the direct fatalities caused by 6000 megatons of hydrogen bombs in an all-out nuclear exchange is the extinction of the human race. Actual estimates of direct fatalities of a large-scale nuclear war from blast effects, from thermal radiation burns, and from ionizing radiation are in the order of several hundred millions lives.[105] The massive amount of blast particles and of smoke and ashes from the superfires thrown high up into the atmosphere in the aftermath of the large-scale nuclear war would completely block off the sun and induce a 'nuclear winter' for a long time. Even if a significant portion of humankind were to survive the direct impact of an all-out nuclear war, the effects of the 'nuclear famine' following the 'nuclear winter' could lead to the loss of one to four billion lives.[106]

---

[102] Stephen L. Carter (2018) Who Coined 'Mushroom Cloud'? It Didn't Matter to the Man Who Did, Bloomberg, 17 May 2018. Accessed on 17 May 2018 at: https://www.bloomberg.com/view/articles/2018-05-16/richard-feynman-and-the-true-story-of-the-mushroom-cloud

[103] Institute of Medicine (1986) Preface. In: The Medical Implications of Nuclear War [Fred Solomon and Robert Q. Marston (eds.)], Institute of Medicine, National Academy of Sciences, National Academy Press, Washington, DC, USA, p. xiii.

[104] Matthew B. Moury and Vahid Majidi (2014) (U) Declassified Determination that the total weapon yield of the B53/W53 Y1 was 9 Mt, Department of Energy and Department of Defense, USA. Accessed on 5 March at: https://fas.org/sgp/othergov/doe/decl/b53-yield.pdf

[105] S. Bergstrom, D. Black, N. P. Bochkov, S. Eklund, R. J. H. Kruisinga, A. Leaf, O. Obasanjo, I. Shigematsu, M. Tubiana, and G. Whittembury (1983) Effects of Nuclear War on Health and Health Services, Report of the International Committee of Experts in Medical Sciences and Public Health, World Health Organization, World Health Organization Pub. A36.12, Geneva, Switzerland.

[106] Mark A. Harwell and Christine C. Harwell (1986) The Nuclear Famine: The Indirect Effects of

In 1982, Paul J. Crutzen and John W. Birks did the calculation of the effects on the Earth's atmosphere of large-scale fires that would result from a major nuclear exchange. "As a result of a nuclear war vast areas of forests will go up in smoke-corresponding at least to the combined landmass of Scandinavia. In addition to the tremendous fires that will burn for weeks in cities and industrial centers, fires will also rage across croplands and it is likely that at least 1.5 billion tons of stored fossil fuels (mostly oil and gas) will be destroyed. The fires will produce a thick smoke layer that will drastically reduce the amount of sunlight reaching the earth's surface. This darkness would persist for weeks, rendering any agricultural activity in the Northern Hemisphere virtually impossible if the war takes place during the growing season."[107] A subsequent series of analyses expanded on the concept of a midday twilight or 'nuclear winter' that might follow in the weeks and months after a nuclear war, which led to a fundamental reassessment of post-war environmental conditions, especially those affecting food production.[108]

1.1.1.2. The Doomsday Clock

The Doomsday Clock complements the Mushroom Cloud as an icon of existential threats by taking in consideration the impact of human action. 2017 marks the 70th anniversary of the Doomsday Clock[109] that used the imagery of human time to signal the coming of the apocalypse (midnight) and the idiom of nuclear explosion (countdown to zero) to convey the seriousness of these threats to humankind and the planet, and to signal the urgent need for coordinated collective action by humankind.

It started its countdown to midnight on the first cover of the Bulletin of the Atomic Scientists in 1947 and has served as a globally recognized arbiter of our planetary health and security ever since. By 1947, humankind had already demonstrated that there was one technology man has discovered and recreated with the potential to destroy the planet – nuclear power. By the 1980s, there was global recognition of the threat of a nuclear war, which prompted the Board to set the Doomsday Clock at three minutes to midnight. Since the opening of the former Soviet Union archives,[110] we realized that it

Nuclear War. In: The Medical Implications of Nuclear War [Fred Solomon and Robert Q. Marston (eds.)], Institute of Medicine, National Academy of Sciences, National Academy Press, Washington, DC, USA, pp. 117-118.

[107] Paul J. Crutzen and John W. Birks (1982) Atmosphere after a Nuclear War: Twilight at Noon, Ambio, Volume 11, Numbers 2-3, pp. 114-125.

[108] Institute of Medicine (1986) supra note 103, p. xiii.

[109] Doomsday Clock can be accessed at: http://thebulletin.org/timeline

[110] Sheila Fitzpatrick (2015) Impact of the Opening of Soviet Archives on Western Scholarship on

was far more serious. We were at several points during that critical period literally minutes away from nuclear war.[111] The decision to move the minute hand of the Doomsday Clock is made annually by the Science and Security Board of the Bulletin of the Atomic Scientists in consultation with its Board of Sponsors, which includes 15 Nobel laureates.[112] Such a minute move triggers a huge global debate as to whether our planet is safer or more dangerous now as compared to the year before. The closer the minute hand ticks towards midnight, the greater the danger to humanity and our planet.

1.1.2. The Existential Threat of Systemic Climate Change

The first expression of concern was in 1957 when Roger Revelle and Hans Suess pointed out that it is humankind, and not natural geological forces, that were conducting an unprecedented large-scale geophysical experiment at an unprecedented speed. We were releasing into the atmosphere in a very short span of a few hundred years the same amount of organic carbon content that had been stored as fossil fuels underground for over hundreds of millions of years.[113] It is, therefore, not surprising that the geophysical scientists had recently proposed the term 'Anthropocene' as a new sub-division of geological time due to the highly significant human impact on the Earth's geology for the first time since the formation of the Earth four and the half billion years ago.[114]

By 1976, even a mainstream economist, William D. Nordhaus, who later won the Nobel Memorial Prize in Economic Sciences in 2018, for his work on climate change, wrote a paper on the problem of anthropogenic carbon dioxide emissions on the Earth's climate, and its impact on economic growth.[115] In 1988, the climate change problem finally caught the attention of the policymakers. James Hansen, in testifying before the U.S.

Soviet Social History, Russian Review, Volume 74 (9 June 2015), pp. 377-400.

[111] Amy Goodman (2016) Noam Chomsky: The Two Biggest Threats Facing the Survival of Humanity, Alternet, 16 May 2016. Accessed on 24 February 2017 at: http://www.alternet.org/world/noam-chomsky-climate-change-nuclear-proliferation-pose-worst-threat-ever-faced-humans

[112] Bulletin of the Atomic Scientists (2017) supra note 5.

[113] Roger Revelle and Hans E. Suess (1957) Carbon Dioxide Exchange between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO_2 during the Past Decades, Tellus, Volume 9, pp. 18-27.

[114] ICS (2018) Working Group on the 'Anthropocene', Subcommission on Quarternary Stratigraphy, International Commission on Stratigraphy (ICS), 9 March 2018. Accessed on 21 May 2018 at: http://quaternary.stratigraphy.org/workinggroups/anthropocene/

[115] William D. Nordhaus (1976) Economic growth and climate: The problem of carbon dioxide, Cowles Foundation for Research in Economics Discussion Paper No. 435, Yale University, New Haven, CT, USA.

Senate, emphasized that global warming, and not global cooling, was the observed trend, with the statement, "there is a 99 per cent probability that an intensified increase in the greenhouse effect is a reality and that it is already changing our climate here."[116,117]

By 1990, the international community had recognized that, although there was still much uncertainty of its extent, there were enough evidences of anthropogenic global warming that would adversely affect the planet and humankind. The international community decided to press for negotiation of an international treaty to reduce anthropogenic GHG emissions and mitigate the impact of climate change. The UN General Assembly approved the commencement of political negotiations through its Resolution 45/212[118] and the UNFCCC was finalized in 15 months and adopted on 9 May 1992.[119] 154 countries signed the Convention at the Earth Summit in June 1992.[120]

At the close of the 65th Lindau Nobel Laureate Meeting, some 36 Nobel Laureates in science signed the Mainau Declaration 2015 on Climate Change.[121] Nearly 60 years earlier, a similar gathering of Nobel Laureates issued a declaration of the dangers inherent in the newly found technology of nuclear weapons. The scientists who had gathered at the 2015 meeting believed that humankind today has to confront another existential threat of a comparable magnitude to that of nuclear war.

In 2016, the minute hand of the Doomsday Clock had stayed set at three minutes before midnight. However, in 2017, the Board, in deciding that the danger today is even greater, set the Clock at two and a half minutes to midnight. It warned that "the probability of global catastrophe is very high, and the actions needed to reduce the risks of disaster must be taken very soon" and called upon "wise public officials" to "act

[116] Cited in Eija Ritta Korhola (2014) The Rise and Fall of the Kyoto Protocol: Climate Change as a Political Process, Academic Dissertation, Faculty of Biological and Environmental Science, University of Helsinki, Helsinki, p. 24.

[117] James Hansen, Inez Fung, Andrew Lacis, David Rind, Serjei Lebedeff, Reto Ruedy, Gary Russell and Peter Stone (1988) Global climate changes as forecast by Goddard Institute for Space Studies three-dimensional model, Journal of Geophysical Research, Volume 93, pp. 9341-9364.

[118] UNGA (1990) Protection of Global Climate for Present and Future Generations of Mankind, United Nations General Assembly Resolution, A/Res/45/212, 71st Plenary Meeting, 21 December 1990. Accessed on 6 March 2017 at: http://www.un.org/documents/ga/res/45/a45r212.htm

[119] United Nations (1992a) supra note 16.

[120] UNFCCC (2014a) Status of Ratification of the Convention, United Nations Framework Convention on Climate Change. Accessed on 6 March 2017 at: http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php

[121] The 2015 Mainau Declaration was issued initially by a group of 36 Nobel Laureates on the occasion of the closing day of the 6th Lindau Nobel Laureate Meeting on 3 July 2015 on Mainau Island, Germany. As of 1 February 2016, 76 Nobel Laureates have expressed their support of the Declaration.

immediately, guiding humanity away from the brink" and warned that "… if they do not, wise citizens must step forward and lead the way."[122] In 2018, the Doomsday Clock was moved forward by 30 seconds, and today, it is still at two minutes to midnight.[123]

1.1.2.1. Ecological Problem of Spaceship Earth

It is noteworthy that the Board of the Doomsday Clock is so concerned about the catastrophic impacts of climate change that it is calling out to ordinary citizens, albeit those with wisdom, to take on the mantle of leadership if the policymakers of the international community are not to act immediately.

The improvement in the quality of human life on this planet used to be dependent on only the international community of nation-States ensuring peace among its members and the effective global control of weapons of mass destruction. It is now also dependent on the international community summoning the necessary political will to forge a binding international treaty and establish international institutions to coordinate the collective action of humankind, and each and every individual, as a member of a family, corporation, community, or as an agent of a nation-State or international organization, doing his or her best to cut down on GHG emissions in daily life.

Hence, the third iconic image is that of a small blue sphere drifting in the dark abyss of space.[124] It is a stark reminder that humankind inhabits an ecological niche of an isolated and fragile planetary spaceship. Humankind has now entered the Anthropocene when the impact of human activities on the life-supporting Earth's climate system is on a scale similar to those of geological forces. If the ecological capacity of spaceship Earth is irreversibly damaged due to our careless stewardship of the fragile climate system in the name of indiscriminate economic growth, planet Earth will not be able to carry the current human population numbers and maintain the current human quality of life with high carbon energy consumption. Collapse of human civilization is inevitable.

[122] Bulletin of the Atomic Scientists (2017) supra note 5, p. 8.

[123] Bulletin of the Atomic Scientists (2019) A new abnormal: It is still 2 minutes to midnight, 2019 Doomsday Clock Statement [John Mecklin (ed.)], Science and Security Board, Bulletin of the Atomic Scientists, USA.

[124] Andrew Chalkin (2018) Who Took the Earthrise Photo from Apollo 8:The mission returned to Earth with one of the most famous images in history, Smithsonian Magazine, January 2018, Smithsoninan.com. Accessed on 11 August 2019 at: https://www.smithsonianmag.com/science-nature/who-took-legendary-earthrise-photo-apollo-8-180967505/

1.1.2.2. Systemic Nature of Global Warming and Climate Change

It is the combination of industrial-scale fossil fuel combustion, the widespread deforestation and the large-scale changes in land-use to support a current population of 8 billion inhabitants in relentless pursuit of economic growth that has produced massive quantities of GHG, equivalent to about 375 million tons of carbon or about 1.4 trillion tons of carbon dioxide, which have been released into the atmosphere since the Industrial Revolution.[125] This substantive and rapid increase in the atmospheric GHG concentration is now the key external forcing (cause is human system) disrupting the Earth's energy flow and balance, which is predicated on the laws of thermodynamics and the interactions between energy and matter, enhancing the natural Earth's greenhouse effect (effect on climate ecosystem).

The systemic nature of the biophysical climate ecosystem means that the corresponding rapid increase in the average Earth's surface temperature, caused by the enhanced greenhouse effect, will induce significant changes in the cryosphere, e.g. sea-ice loss, melting of land ice (Section 2.2.1), in the hydrosphere, e.g. rising sea levels, ocean acidification, bleaching of coral reefs and significant impacts on planktonic and pelagic communities in the marine biological ecosystems, changes in tropospheric water vapor concentrations and concomitant changes in precipitation (Section 2.2.2), and in the atmosphere, e.g. pole-ward expansion and shift of atmospheric circulation (Section 2.2.3) because of the interactions and feedbacks among the components of the climate system (interactions and feedbacks within climate ecosystem).

1.1.2.3. Coupling of Climate Ecosystem to Social-Economic-Political System

Meanwhile, this large and complex natural climate ecosystem (cause is climate ecosystem) is tightly interconnected to the large and complex human social-economic-political system [hereinafter SEP system]. Hence, climate change will also directly affect the biosphere on land and in the sea where humankind resides and work, e.g. increase in the frequency and severity of extreme weather events, in the availability of freshwater resources, e.g. positive and negative impacts of changes in precipitation, and in the human food systems, positive and negative impacts of shifts in temperature and rainfall on fisheries, aquaculture, agriculture and livestock (effect on SEP system). Hence, a detailed analysis of the interactions between the physical climate sub-systems

[125] WMO (2012) WMO Greenhouse Gas Bulletin, Number 8, 19 November 2012, World Meteorological Organization, p. 1.

and the biosphere in terms of extreme weather conditions, freshwater resources, and food production sub-systems of the SEP system is described in Sections 2.2.4–7.

To complete the systemic loop, the tight interconnections of the energy, economy and population sub-systems of the large and complex SEP system to the biophysical climate ecosystem means that to reduce or alleviate the negative effects of climate change will require fundamental changes to the ways humankind first uses the different sources of energy for its activities, second regulates its economy, and third controls its population growth, as discussed in Chapter 2.1.

Both the large and complex climate ecosystem and SEP system have large inertia. They are resilient and self-correcting under normal stress conditions. Changes due to ordinary stress (external forcing) on these complex systems are slow to manifest because these complex systems tended to evolve towards homeostatis.[126] Hence, changes in the climate system are gradual, usually occurring over periods measured in decades, centuries and millennia, which provide fairly constant climate conditions of long duration for the gradual development of human civilization from families, to tribes, villages, towns, cities, nation-States, and to the current largest human grouping of the international community of nation-States with a population of 8 billion human beings.

1.1.2.3.1. Rates of Change in the SEP System

First, this evolution of the SEP system, which till recently was also measured in centuries, is now moving more rapidly with the exponential growth in technological innovation, economic wealth, and human population, which, as a consequence, may be stretching the biophysical earth beyond its the carrying capacity to support the current human population and their quality of life. In a recent survey of 65 different estimates of the Earth's carrying capacity, the majority of the estimates put the Earth's limit at or below 8 billion people.[127]

Second, it would still take the fossil fuel energy sub-system, which is a major sub-system of the SEP system, at least decades to transit from our present high-carbon to a future low-carbon energy system due to carbon lock-in, especially in the absence of a

[126] Ken Tregonning and Alan Roberts (1979) Complex systems which evolve towards homeostatis, Nature, Volume 281 (18 October 1979), pp. 563-564.

[127] UNEP (2012) One Planet, How Many People? A Review of Earth's Carrying Capacity, UNEP Global Environmental Alert Service (GEAS), June 2012, United Nations Environmental Programme.

rapid technological breakthrough in low-carbon energy system[128] and the lack of concerted global collective action.[129]

Meanwhile, the rapid growth in economic wealth, technological innovations and human population, under business-as-usual conditions, in a high-carbon energy system, means continual and rapid increase in atmospheric greenhouse gas concentrations, which will eventually put extraordinary stress on both the climate ecosystem and the SEP system. Both these large and complex systems are vulnerable to catastrophic disruptions in unexpected ways due to the unknown nonlinear and cascading effects when they are subjected to extraordinary stress, especially when they are in the non-equilibrium state of being stretched beyond their carrying capacities.[130]

For instance, the climate ecosystem today is been subjected to the stress of global warming by a much greater external forcing than in the past 3-5 million years due to the increasing concentrations of GHG, which are released into the atmosphere by human activities.[131] Meanwhile, the risks of anthropogenic climate changes crossing a critical threshold in any of the components of the climate ecosystem is compounded by further warming due to the amplifying effects of positive feedback mechanisms among the interconnected climate components, in which a change in one of the components leads to changes in other components that may eventually feedback positively onto the original component and amplifying the original warming effect. A classic example of the effects of the amplifying positive is the sea ice-albedo feedback mechanism, where decreases in the extent of the polar sea-ice surface reflectivity due to global warming will result in the polar sea trapping more radiation from the sun and inducing further loss of polar sea-ice extent, thereby amplifying the initial warming effect.[132] In some circumstances, crossing a critical threshold in one climate component may trigger critical threshold crossings in other climate components. For example, global warming

[128] Vaclav Smil (2010) Energy Transitions: History, Requirements, Prospects, Praeger, Santa Barbara, CA, USA, p. 155.

[129] UNFCCC Secretariat (2019) Foreword by Patricia Espinoza, Executive Secretary of UN Climate Change, Climate Action and Support Trends, United Nations Climate Change, p. iii.

[130] Sergey V. Buldyrev, Roni Parshani, Gerald Paul, H. Eugene Stanley and Shlomo Havlin (2010) Catastrophic cascades of failures in interdependent networks, Nature, Volume 464 (15 April 2010), pp. 1025-1028.

[131] WMO (2018) Greenhouse gas levels in atmosphere reach new record, Press Release Number 22112018, 20 November 2018, World Meteorological Organization. Accessed on 11 August 2019 at: https://public.wmo.int/en/media/press-release/greenhouse-gas-levels-atmosphere-reach-new-record

[132] Michael Winton (2008) Sea Ice-Albedo Feedback and Nonlinear Arctic Climate Change. In Arctic Sea Ice Decline: Observations, Projections, Mechanisms, and Implications, Geophysical Monograph Series 180 (2008), American Geophysical Union, pp. 111-131.

due to GHG emissions causes the loss of polar sea-ice extent, which in turn increases the average surface temperature of the Arctic permafrost region. This increase in the average Arctic permafrost surface temperature may induce the melting of the Arctic permafrost, which could result in the massive release from beneath the Arctic permafrost of trapped methane gas, a potent GHG, into the atmosphere, amplifying the warming effect on the permafrost through a positive feedback loop.[133] At the same time, the melting of the Arctic permafrost may in turn push other climate components, such as the polar ice sheets past their critical threshold points resulting in rising sea-levels.

1.1.2.3.2. Crossing Critical Thresholds

Third, once a critical threshold or tipping point of a component of the climate ecosystem is crossed, for most of the tipping points of the major climate components, it is irreversible in human time frames, principally due to the longevity of carbon dioxide, the main greenhouse gas, remaining in the atmosphere.[134] International political negotiations thus far have consistently disregarded the tail-end scenarios of low probability that could lead to abrupt and irreversible climate change, despite scientific evidences that the risks associated with tipping points "increase disproportionately as temperature increases between 1–2°C additional warming and become high above 3°C, due to the potential for a large and irreversible sea level rise from ice sheet loss."[135] Planet Earth could warm by another 4°C or so at the end of the 21st century if greenhouse gas emissions are not decisively reduced within the next decades.[136] In fact, greenhouse gas emissions are still on the rise in 2019.[137]

The abrupt and irreversible effects of climate change may result in the collapse of human civilization because the rate of transition, under business-as-usual conditions,

[133] Ellen Gray (2018) Unexpected future boost of methane possible from Arctic permafrost, NASA Global Climate Change, NASA's Earth Science New Team, 20 August 2018. Accessed on 11 August 2019 at: https://climate.nasa.gov/news/2785/unexpected-future-boost-of-methane-possible-from-arctic-permafrost/

[134] Susan Solomon, Gian-Kasper Plattner, Reto Knutti, and Pierre Friedlingstein (2009) supra note 63.

[135] IPCC (2014a) Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 12.

[136] World Bank (2014) Turn Down the Heat: Confronting the New Climate Normal, World Bank Group, Washington, DC, USA, p. xiv.

[137] Nina Chestney (2019) supra note 20.

from our present high-carbon to a future low-carbon energy system will not be rapid enough to prevent it. However, the extraordinary stress of catastrophic climate change may have multiplier effects, which might well lead to an all-out nuclear war among the major nation-States with nuclear weapons, which will definitely result in the collapse of human civilization if not the extinction of the human species from spaceship Earth.[138]

It is not surprising that António Guterres, the current UN Secretary-General, when addressing participants at the recent R20 Austrian World Summit in Vienna, Austria, on 15 May 2018, pronounced climate change as "an existential threat" to humanity.[139] In fact, so great is this perceived global threat that it has been described by leading authorities as "the most severe problem that we are facing today – more serious even than the threat of terrorism",[140] "a unique challenge for economics: it is the greatest and widest-ranging market failure ever seen",[141] "a serious and long-term challenge that has the potential to affect every part of the globe",[142] "one of the greatest challenges of our time"[143] and "the defining issue of our era."[144]

To say climate change is a challenge of the highest magnitude confronting humankind is not to say that there is no other equally pressing global challenges facing humanity today. The international community recognizes that one of the most pressing current global challenges is poverty eradication.[145] However, there are fundamentally only two

[138] Richard P. Turco (1986) Recent Assessments of the Environmental Consequences of Nuclear War. In: The Medical Implications of Nuclear War [Fred Solomon and Robert Q. Marston (eds.)], Institute of Medicine, National Academy of Sciences, National Academy Press, Washington, DC, USA.

[139] Antonio Guterres (2018a) supra note 14.

[140] David A. King (2004) Climate Change Science: Adapt, Mitigate, or Ignore? Science, Volume 303, Issue 5655, 9 January 2004, pp. 176-177.

[141] Nicolas Stern (2006) The Economics of Climate Change: The Stern Review, 1st Edition, [15 January 2007] Cambridge University Press, Cambridge, UK, p. 1.

[142] UNGA (2005) 2005 World Summit Outcome, United Nations General Assembly Resolution, A/Res/60/1, 24 October 2005, Paragraph 51. Accessed on 25 February 2017 at: http://www.ifrc.org/docs/idrl/I520EN.pdf

[143] UNFCCC (2009) Copenhagen Accord, Draft decision -/CP.15, FCCC/CP/2009/L.7, 18 December 2009, Paragraph 1. Accessed on 25 February 2017 at: http://unfccc.int/resource/docs/2009/cop15/eng/l07.pdf

[144] Ban Ki Moon (2007) High-Level Event on Climate Change with the Secretary General, President of Indonesia and the Executive Secretary of the UN Framework Convention on Climate Change, United Nations Secretary-General Press Conference, 24 September 2007. Accessed on 25 February 2017 at: https://www.un.org/sg/en/content/sg/press-encounter/2007-09-24/press-conference-high-level-event-climate-change-secretary

[145] UNGA (2012) The Future We Want, United Nations General Assembly Resolution, A/Res/66/288, 11 September 2012. Accessed on 22 May 2018 at: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang=E

known potential existential threats to the survival of humankind currently. Similar to the impact on humankind if an all-out nuclear war were to break out, the hard-earned social and economic gains from poverty eradication will also be rapidly eroded if the rising greenhouse gas emissions were to force the fragile climate ecosystem over its 'tipping points', and the damages to human civilization and humankind turned catastrophic.[146] Hence, climate change is a truly cross cutting issue affecting many SEP sub-systems and connected to many other global challenges. Hence, it cannot be isolated and solved separately from the other global challenges.

1.1.3. Differences in Approach to the Two Existential Threats

There is a fundamental difference in the approaches to the two existential threats because the nature, history and context of these two existential threats are different.

1.1.3.1. Approach to the Existential Threat of Nuclear War

The nation-States with nuclear weapons have responded well to the existential threat of nuclear war based on their own purely rational, self-interested strategy (international politics) of not using nuclear weapons to resolve national security (global commons) issues because the endpoint or outcome could well be the mutually assured destruction (MAD) of human civilization, if not of the human species. "The availability of nuclear weapons has fundamentally altered the traditional relationship between political aims and physical violence." Till 1945, a great power, such as the United States, "had a rational choice between violence and non-violence in achieving its ends vis-à-vis other nations. If it wanted a certain result badly enough, and could not achieve it by peaceful means, it might well resort to violence, provided a calculus of risk and advantage favored such a resort. Such a calculus a priori counsels against the use of nuclear weapons since their very destructiveness, in both the short- and long-term, eliminates all possible advantage. The use of nuclear weapons, even initially on a limited scale, is an unmitigated disaster, which in the end can only lead to the destruction of both sides."[147]

In other words, the fact that nuclear war has not broken out for the past 70 years is due not so much to the concerted collective action of the international community of

[146] Friedrich Soltau (2016) Common Concern of Humankind. In: The Oxford Handbook of International Climate Law [Cinnamon P. Carlarne, Kevin R. Gray and Richard G. Tarasofsky (eds.)], Oxford University Press, Oxford, pp. 203-204.

[147] Hans Morgenthau (1985) supra note 62, pp. 439-442.

sovereign nation-States to control nuclear weapons via top-down diplomatic negotiations to establish international treaties to prevent the proliferation of these nuclear weapons (international law). In fact, some nation-States without nuclear weapons are trying to acquire them based on their own rational self-interested strategy for national security reasons.[148] It is actually the rational choice of self-restraint shown by the nation-States with nuclear weapons not to use them that has actually prevented the advent of a nuclear war.

From a theoretical perspective, the understanding that a leader of a nation-State acts as a purely rational, self-interested, short-term maximizer, based on rational choice theory[149] has proven to be effective in explaining the successful outcome of self-restraint by the nation-State leaders with nuclear weapons to prevent the advent of a nuclear war. The same rational choice theory has also been successful in explaining the less effective outcome of the collective action by the international community of sovereign nation-States to prevent proliferation of nuclear weapons because the same purely rational, self-interested leader of a nation-State without nuclear weapons sees the acquisition of nuclear weapons as the ultimate military strategy for national security as it would act as the unsurpassed deterrent of military aggression from leaders of other nation-States.

1.1.3.2. Approach to the Existential Threat of Systemic Climate Change

However, in the case of the existential threat of systemic climate change, the nation-States have failed to respond adequately by reducing greenhouse gas emissions (global commons) based on their own purely rational self-interested strategy (international politics). Meanwhile, the collective action taken by the international community of sovereign nation-States via top-down diplomatic negotiations to establish legally binding international treaties (international law) has also failed to induce the nation-States to reduce greenhouse gas emissions.

From a theoretical perspective, the leader (aggregate man) of a nation-State acts as a completely rational, self-interested, short-term maximizer, based on rational choice theory, would have no incentive not to exploit the global commons, especially as there is no possibility of excluding others from its use or to charge others rent. The short-term

[148] Scott D. Sagan (1996) Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb, International Security, Volume 21, Number 3 (Winter, 1996-1997), pp. 54-86.

[149] Jonathan Levin and Paul Milgrom (2004) An Introduction to Rational Choice Theory. Accessed on 11 August 2019 at: https://www.semanticscholar.org/paper/Introduction-to-Choice-Theory-Levin-Milgrom/06cb6027bfbb124a0e4ce8452cc9e81953f6e88d

tendency is for him to free ride and to lay the burden on others and continue acquiring economic wealth and increase population growth, as a means to economic growth, without regard for the long-term consequences of systemic climate change. Hence, the search for a viable solution is a very difficult quest.

First, the focus of current social science research studies on the outcomes of different institutional arrangements for the governance of common-pool resources, the commons, or public goods, including climate change, at multiple levels, goes beyond solving such social dilemmas simply in terms of the dichotomous solutions of "market" and "state" based on classical micro-economics theory,[150] the sources of international law,[151] and the realist and rationalist theories of international relations.[152]

Second, the nature of the archetypal man has been found empirically to have more complex drivers of motivation than the assumption of the completely rational self-interested short-term maximizer of rational choice theory as well as the moral capacity for making ethical choices for the longer term and the capabilities to change the exogenous variables of social dilemmas to avoid the tragedy of the commons. Hence, the theory assumed in this thesis for the elaboration of frameworks, theories and models is a more general theory of the nature of the archetypal man in which that of rational choice theory is a limited case.[153]

Third, systemic climate change as an existential threat from the perspective of the problem source is compounded by the fact that it is a 'superwicked problem' from the perspective of the problem solution. Humankind is part of the climate change problem

[150] The founding father of classical microeconomic theory was Adam Smith (1776). The essential aspect of classical microeconomic theory was the 'invisible hand of the market.' When people act out of self-interest, free and competitive markets tend to provide goods and services without central price setting, but in respond to changes in demand and supply. David Ricardo (1817) developed the theory of comparative advantage to explain why countries engage in international trade. He demonstrated that if two countries capable of producing two commodities engage in the free market, then each country will increase its overall consumption by exporting the good for which it has a comparative advantage while importing the other good, provided there exist differences in labor productivity between the two countries. Another important development in the 19th century was the concept of utility maximisation by Jeremy Bentham and John Suart Mill. In microeconomic theory, it was believed a consumer would buy goods depending on the marginal utility (satisfaction) they get from the good. This theory assumes consumers are rational and seeking to maximise the satisfaction they get.

[151] ICJ (2019) Statute of the International Court of Justice (ICJ), Article 38 (1). Accessed on 11 August 2019 at: https://www.icj-cij.org/en/statute

[152] See Sections 1.3.3.1. & 1.3.3.2.

[153] See Section 1.2.4.2.

and also part of the climate change solution; the central authority needed in the SEP system to address the problem is practically non-existent; hyperbolic discounting pushes policy responses into the future when immediate actions are required to prevent the climate ecosystem from crossing the threshold; and the time to abate climate change is quickly running out. For the international law research student, "avoiding severe global catastrophe is a moral and legal imperative."[154]

Fourth, the international law research student must go beyond conventional thinking based on current economic, political, and legal theories and models to find the viable solution. He will have to shift from relying on frameworks, theories and models of simple systems to those of complex systems to understand better the complexity of issues and problems associated with both the climate ecosystem (Chapter 2) and human interactions in climate change governance (Chapter 3).

Fifth, the international community of nation-States will have to acknowledge the limitations of current theories and practices of international law and politics (Chapter 4), and make fundamental changes in their relationships to one another. The vision of such a change in world order goes beyond the anarchical system of sovereign nation-States.

Sixth, a wide range of private, governmental, and community institutional arrangements has been shown empirically and verified theoretically to operate at multiple scales to generate productive outcomes.[155] The thesis calls upon the international community of nation-States to shift focus now, in alignment with the 2015 Paris Agreement, from a 'monocentric' to a 'polycentric' approach in providing a solution set, which can be implemented immediately across "many centres of decision-making that are formally independent of each other" to cut greenhouse emissions and reduce it by 55% in 2030 as compared to 2017 level to keep the rise in GMST to below 1.5°C above the pre-industrial level by 2100[156] in order to forestall the Earth's climate system from tipping over the critical thresholds, leading to catastrophic disruptions.

It essentially proposes a multi-factorial, multi-level solution set to cope with a multi-factorial, multi-level problem.[157] As part of the polycentric approach, the thesis advocates, at the national governance level, the use of carbon tax legislation as an effective tool to ratchet up national carbon dioxide emissions reduction commitments to

[154] Oslo Principles (2015) supra note 3.
[155] Elinor Ostrom (2009) supra note 51.
[156] UNEP (2018a) supra note 50, p. 6.
[157] Robert Jervois (1997) supra note 29, p. 291.

hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels.[158] At the global governance level, the thesis proposes that the international community initiates diplomatic negotiation to establish a world legal authority for the atmosphere global commons with supreme legislative powers for the long-term solution to the existential threat of systemic climate change (Chapter 5.3).

1.2. THE COMMONS PROBLEM

Indeed, climate change has proven to be an intractable problem. Almost everything about global warming and global climate change has been and is vigorously debated: whether global warming is actually occurring,[159] whether the cause of global warming is anthropogenic,[160] whether the methods used for processing proxy climate data are valid,[161] whether the projected sensitivity of the climate system to a given level of greenhouse gases is valid,[162] whether the negative effects of global warming are real,[163] whether climate change should be considered a problem in the first place,[164] and if so whether there is a viable solution,[165] whether we should mitigate, adapt or ignore, and if

[158] Climate Leadership Council (2018) supra note 58.

[159] Christopher Booker (2008) Global warming: Reasons why it might not actually exist, The Telegraph, 30 December 2008. Accessed on 26 January 2017 at: http://www.telegraph.co.uk/news/earth/environment/globalwarming/4029837/Global-warming-Reasons-why-it-might-not-actually-exist.html

[160] Roy W. Spencer (2010) The Great Global Warming Blunder: How Mother Nature Fooled the World's Top Climate Scientists, Encounter Broadsides, New York.

[161] Eugene R. Wahl and Caspar M. Ammann (2007) Robustness of the Mann, Bradley, Hughes reconstruction of Northern Hemisphere surface temperatures: Examination of criticisms based on the nature and processing of proxy climate evidence, Climate Change, Volume 85, Issue 1, November 2007, pp. 33-69.

[162] The Economist (2013) Climate Science: A Sensitive Matter, The Economist, 30 March 2013. Accessed on 26 February 2017 at: http://www.economist.com/news/science-and-technology/21574461-climate-may-be-heating-up-less-response-greenhouse-gas-emissions

[163] IPCC (2014b) Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, pp. 2-31.

[164] Graham Readfearn (2013) Climate sceptics more likely to be conspiracy theorists and free market advocates, study claims, The Guardian, 2 October 2013. Accessed on 26 February 2017 at: https://www.theguardian.com/environment/planet-oz/2013/oct/02/climate-change-denial-skeptics-psychology-study-conspiracy-theories

[165] UCS (2011) Climate Hot Map, Union of Concerned Scientists, Cambridge, MA, USA. Accessed on 26 February 2017 at: http://www.climatehotmap.org/global-warming-solutions/

mitigation or adaptation is the way forward, what should our collective action be.[166] It has been difficult for humankind even to arrive at a common understanding of what climate change is, let alone act collectively, and more so to coordinate collective action effectively in order to solve the climate change problem.

1.2.1. Different Approaches to Solving the Commons Problem

Because climate change is a large and complex systemic problem, and everything about climate change affects everything else and *vice-versa*,[167] there are many different ways to understand and explain the climate change problem based on one's academic discipline and expertise. One simple way to classify these different approaches is to group them into three broad binary categories: (1) reductionist and holistic approaches, (2) product or rule and process approaches, and (3) problem solving and critical theories.

1.2.1.1. Reductionist and Holistic Approach to Solving the Commons Problem

The reductionist approach is the conventional approach to problem solving where one breaks down the seamless whole of the world system into simpler parts or spheres, usually by academic convention – ecological, economic, political, social, legal and moral – to gain understanding and practical knowledge which can be put into action.[168] Hence, a particular sphere of knowledge must remain partial or fragmentary. Whether the parts remained as limited, separated spheres of knowledge and action, or become "the elements for constructing a structured and dynamic view of larger wholes [holistic approach] is a major question of method and purpose."[169] Either way, the starting point of the conventional approach to problem solving is some division of seamless reality, which is usually dictated by academic convention. However, it is essential to bear in mind that such a conventional cutting up of reality is just a convenience of the human mind. The parts that are derived from reality are actually the responses of human consciousness to the pressures of reality. The partial or fragmented spheres of knowledge correspond to the ways in which human affairs are organized in particular space-time. Therefore, they may appear to be arbitrary when changes take place.

Climate change is both an existential threat to humankind in the Anthropocene and a

[166] David A. King (2004) supra note 140, pp. 176-177.
[167] Antonio Guterres (2018b) supra note 25.
[168] Robert W. Cox (1981) supra note 28, pp. 126 – 128.
[169] Id., p. 126.

multi-factorial, multi-level global commons problem. Hence, the systemic climate change problem should not be viewed and analyzed from a reductionist perspective of separate spheres of conventional academic knowledge and action but rather from a holistic perspective of an integrated systems process-oriented approach.

In such a holistic approach, the preferences due to both nature and nurture of the archetypal man [agent] as well as the complexity of human interactions [process] are accorded serious consideration. The main action situation arena for human interactions to establish principles, norms, rules and decision-making procedures to govern climate change is currently the annual series of conferences under the auspices of the United Nations Framework Convention for Climate Change [structure]. The ecological part of this broader integrated system, in which the action situation arena is nested [nested structure], comprises of the complex biophysical climate ecosystem while the social part comprises of the academic spheres of economics, international and domestic politics, international law, and moral philosophy of the SEP system.[170]

Only by viewing and analyzing through a holistic lens with equal emphasis on agent-process-structure will the international law research student discover a multi-factorial, multi-level solution set to the systemic climate change problem and to reduce the risks of the complex climate ecosystem from tipping over critical thresholds in the near future.

1.2.1.2. Product or Ruled-Based and Process Approaches

The product or rule approach is based on the technical perspective of solving a problem. The solution to a technical problem is to invent a product or a tool. For instance, the technical solution to the climate change global commons problem is to stop immediately the use of fossil fuels. However, to transit to a low-carbon energy system takes time. Time that humankind does not have as the climate system is likely to tip over critical thresholds and cause catastrophic disruptions in the next few decades. The expected time delay is because such a major energy transition involves considerations of technological, economic, political, legal and moral implications, and will require strong concerted collective action.[171]

From the political economy perspective to governing the global commons, the conventional product or rule approach is to rely either on the ‘market’ or ‘state’ as

[170] See Section 1.2.3.

[171] Vaclav Smil (2010) supra note 128, p. viii.

espoused by numerous schools of political-economic thought that has a long and rich tradition stretching back many centuries.[172] The alternate process approach, which is a recent manifestation, is the integrated socio-ecological system (SES) approach, as developed by Elinor Ostrom and Vincent Ostrom, together with colleagues, in the Workshop in Political Theory and Policy Analysis of Indiana University.[173]

From the international law perspective, the conventional product or rule approach is to rely on the sources of international law[174] as championed by Georg Schwarzenberger as one example[175] while the alternate process approach is the New Haven School of social jurisprudence developed by Myers Douglas S. McDougal and Harold D. Lasswell.[176]

From both domestic and international political science perspectives, the conventional product or rule approach is to focus on the types of 'government' while the alternate process approach focuses on the types of 'governance'.[177] The work of the Commission on Global Governance is noteworthy.[178]

1.2.1.3. Problem Solving Theory and Critical Theory

Theory is a product of the human mind. It is always for someone and for some purpose. All theories, therefore, have a perspective derived from a specific point in space-time, which is time in a specific technological-ecological-economic-social-political-legal-

[172] Adam Smith (1723-1790) is generally regarded as the father of political economy and of classical economics.

[173] Elinor Ostrom (2005) supra note 84, p. xiii.

[174] ICJ (2019) supra note 151.

[175] Georg Schwarzenberger and E. D. Brown (1976) A Manual of International Law, 6th Edition, Professional Books, Milton, UK.

[176] W. Michael Reisman, Siegfried Wiessner and Andrew R. Willard (2007) supra note 80.

[177] Commission on Global Governance (1995) supra note 79, pp. 2-7.

[178] Commission on Global Governance was established in 1992. Willy Brandt, the former West German Chancellor, invited Ingvar Carlsson, former Swedish prime minister, and Shridath Ramphal of Guyana, former secretary-general of the Commonwealth of Nations, to cochair the commission. Together they presented the proposal for the commission to United Nations Secretary-General Boutros Boutros-Ghali, who assured them of his support for their project of reassessing multilateral action. The purpose of the Commission was to suggest new ways in which the international community might cooperate to further an agenda of global security. Consulting past reports and international experts, the commission analyzed global change with the intention of mobilizing political collaboration on an international level. It hoped that its evaluation of the strengths and weaknesses of global governance would provide a framework for more effective policies and inspire nations to adopt a more global perspective. The Commission on Global Governance's greatest contribution to international affairs was its report entitled "Our Global Neighborhood." Extracted from Encyclopaedia Britannica (online). Accesssed on 11 August 2019 at: https://www.britannica.com/topic/Commission-on-Global-Governance

moral setting. Of course, a sophisticated theory is never just the expression of a perspective; it transcends its own perspective. However, the initial perspective is always contained within a theory and is relevant to its explication. Starting with a problem, theory serves two distinct purposes. One purpose is, first, to explain the problem within the terms of the particular perspective, which is the point of departure, and, second, to serve as guide to the problem solution. The other purpose is, first, to understand the perspective of the theory and, second, to consider choosing a different perspective, in which the problem requires an alternative solution.[179]

According to critical theorist Robert W. Cox, the first purpose gives rise to problem-solving theory. Problem-solving theory takes the world with its prevailing order of social and power relationships, together with the institutions into which they are organized, as the ahistorical and static framework for gaining knowledge and taking action. Since the framework of relationships and institutions is not called into question, particular problems can then be solved within the specialized spheres of knowledge in which they arise. Thus problem-solving theories first assume there is stability in the other spheres and that dynamic changes only take place within the specific sphere of knowledge. Hence, the strength of the problem-solving theories lies in its ability to fix limits or parameters to a problem area and to reduce the problem statement to a limited number of variables. It is possible then to arrive at statements of regularities (laws), which appear to have general validity.[180]

The second purpose gives rise to critical theory. It is critical in the sense that the theory stands outside the prevailing order of the world and asks how that order came about. Hence, critical theory, unlike problem-solving theory, questions the framework of relationships and institutions with regards to its origins and how and whether they might be in the process of change. The study of the whole framework is, therefore, historical and evolving. In practice, critical theory, like problem-solving theory, also starts with theorizing in a particular sphere of knowledge. But whereas problem-solving theory leads to further analytical sub-division and limitations of the issue to be dealt with, critical theory leads to the construction of a larger whole, of which the initial part is just one element, and seeks to understand the process of change in which both the parts and the whole are involved. The strength of critical theory, therefore, is that while it allows for a normative choice in favor of an alternative worldview it also limits the range of choices to alternative worldviews, which are feasible transformation of the existing

[179] Robert W. Cox (1981) supra note 28, p. 128.
[180] Id., pp. 128-129.

order,[181] which serves well the intent of the international law research student.

1.2.2. Political Economy (Product or Rule) Approach

The term 'commons' is associated with the notion of a shared common resource, such as a common grazing ground for animal husbandry. The enduring metaphor of the inevitable negative consequences of human activities on the commons in the long-term due to man acting rationally in the short-term was coined by the American ecologist Garrett Hardin as the 'tragedy of the commons'.[182] It was a rework of a notion, which was first expressed by the Scottish philosopher David Hume.[183]

Hardin recognized that there are two top-down solutions to solve the tragedy of the commons problem: (1) government can establish a system of private property rights to designate ownership of the shared resource (Law) and then leave it to the market exchange mechanism to allocate access and use rights, and efficient management of the shared resource over time (Market), and (2) government can constrain overexploitation by directly regulating the use of the shared resource (State). Both these approaches essentially eliminate the commons. Individuals, therefore, no longer have free choice on how to manage the commons, for such freedom brings ruin to us all.

1.2.2.1. Definition of the Commons

A commons is 'a resource to which no single decision-making unit holds exclusive title'.[184] It is not private property. The criterion is non-exclusion. A commons is 'open access'. The resources in the commons are available for use by everyone for free. From a law perspective, it is *res nullius* – the property of none. As defined, the 'commons' would include the atmosphere, oceans, Antarctica and outer space.[185] The spatial scale of the atmosphere and oceans, and the fact that they are interconnected as integral parts of the Earth's climate system would merit the use of the qualifier, 'global'. Hence, for

[181] Id., pp. 129-130.

[182] Garrett Hardin (1968) supra note 91, pp. 1243-1248.

[183] David Hume (1739) Section VII: On the Origin of Government. In A Treatise on Human Nature: Being an Attempt to introduce experimental Method into Moral Subjects, eBook@Adelaide. Accessed on 11 August 2019 at: https://ebooks.adelaide.edu.au/h/hume/david/treatise-of-human-nature/B3.2.7.html

[184] P. M. Wijkman (1982) Managing the Commons, International Organization, Volume 36, Number 3, pp. 511-536.

[185] John Vogler (2000) The Global Commons: Environmental and Technological Goverannce, 2nd Edition, John Wiley & Sons, Ltd., Chichester, UK, p. 2.

the purposes of this thesis I have termed them specifically as 'atmosphere global commons', 'ocean global commons' or generally as 'global commons'.

From the climate change perspective, the atmosphere and the oceans are not only 'common resources' but also 'common sinks' for the capture of heat and carbon dioxide, which are the major 'pollutants' involved in climate change.[186] The nexus of the climate change problem has to do with the use of the atmosphere and oceans by humankind as a 'common sink' for heat and carbon dioxide. The Antarctic would also be considered as a 'global commons' as it is also a vital natural 'common sink' for frozen water. The frozen discharge from Antarctica in the form of liquid water into the oceans due to global warming would lead to global mean sea-level rise, which is one of the most significant impacts of climate change on the socio-economic system.[187]

The global commons of atmosphere and deep oceans are considered to be both non-excludable and non-rivalrous, and are known as international or global 'public goods' (GPGs).[188] In subsequent analyses on the commons problem or solution to the commons problem, reference to the term 'commons' would also include the 'global commons'.

From a mainstream economic perspective, besides non-exclusion, there is another criterion of 'non-rivalrous' for the classification of economic goods into two types by Paul Samuelson, who was the winner of the Nobel Memorial Prize in Economic Sciences for 1970.[189] Private goods are both excludable, meaning an individual can be excluded from consuming private goods unless the individual has paid for them, and rivalrous, meaning whatever that individual consumes no one else can consume. Public goods or commons are both non-excludable, meaning that it is impossible to keep those who have not paid for the public goods from consuming them, and nonrivalrous, meaning whatever that individual consumes does not limit the consumption by others.

This binary division of economic goods fits into the simple dichotomous academic specialization model of private goods exchange in a Market as recommended by the

[186] Id., p. 3.

[187] See Section 2.2.2.7.

[188] Inge Kaul (2004) Providing Global Public Goods: Managing Globalization, Oxford University Press, Oxford, UK.

[189] Paul A. Samuelson (1970) Maximum Principles in Analytical Economics, Nobel Memorial Prize in Economic Sciences Lecture, 11 December 1970. Accessed on 1 June 2019 at: https://www.nobelprize.org/uploads/2018/06/samuelson-lecture.pdf

Scottish political economist Adam Smith in mainstream market economics[190] and public goods being regulated by the sovereign State or Hobbes's Leviathan as recommended by the English political philosopher Thomas Hobbes in political science.[191]

James McGill Buchanan Jr, winner of the Nobel Memorial Prize in Economic Sciences for 1986, added a third category of economic goods, which he called "club goods." It is common practice for groups of individuals to create clubs to provide themselves with nonrivalrous but small-scale goods and services that they could enjoy while excluding those who are not members from participating and consuming these benefits. Examples of club goods include encrypted television programmes or intellectual property rights.[192]

Meanwhile, Elinor Olstrom, winner of the Nobel Memorial Prize in Economic Sciences in 2009, from a political economy perspective has introduced another term, "common pool resources" (CPRs) for goods that are difficult to exclude like public goods (non-exclusion) but share the attribute of subtractility (rivalry of consumption) with private goods (rivalrous). It is also know as a common good.[193] Hence, the classification of the four categories of economic goods in terms of the dimensions of non-excludability and non-rivalry is as illustrated in Figure 2 below:

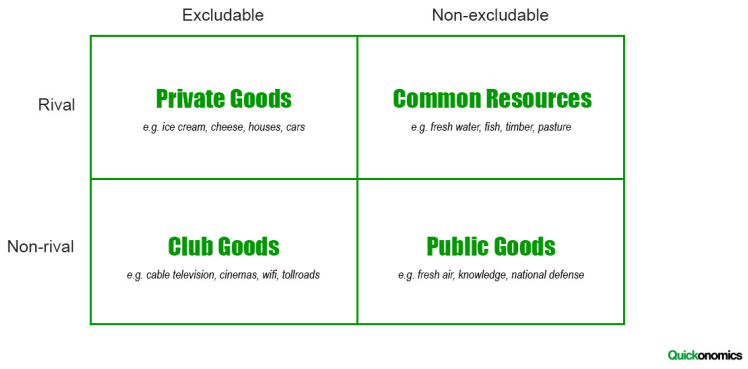

Figure 2: Four Categories of Economic Goods

A common pasture is such a common good in an agrarian economy, which may be used

[190] Adam Smith (1776) An Enquiry into the Nature and Caufes of the Wealth of Nations, Volume 1 [in Two Volumes], W. Strahan, London, UK.

[191] Thomas Hobbes (1651) Leviathan or The Matter, Forme and Power of a Common-Wealth Ecclesiasticall and Civil [Oxford World's Classics Edition (1996)], Oxford University Press, Oxford, UK.

[192] James M. Buchanan (1965) "An Economic Theory of Clubs", Economica, New Series, Volume 32, Number 125, pp. 1-14.

[193] Elinor Ostrom (2009) supra note 51.

by all members of a community, but when one of them will allow their animals to graze there, others have no possibility of grazing their animals any longer, due to the lack of pasture. In our current highly industrialized world, Ostrom had also included forests, water systems, fisheries and the global atmosphere as examples of common pool resources or common good, which are of immense importance for the survival of humankind on this planet.[194]

1.2.2.2. Rational Choice Theory of the Nature of the Archetypal Man

Much of current micro economic and formal political science theories are based on the rational choice theory of humans as self-interested, short-term maximizers and its concomitant thin models of completely rational individuals. This concept is predicated on the principle that rational people act according to their preferences. More precisely, a rational individual chooses A rather than B because he or she (hereinafter as he) prefers A to B. As long as the individual's preference is a binary, complete and transitive relation over alternative courses of action, a utility function can be defined that represents the individual's preferences so that when he is acting rationally in accordance with his preferences he acts as if he were maximizing his utility.[195]

In the process, the completely rational man has (1) all possible strategies available in a particular situation, (2) which outcomes are linked to each strategy given the likely behavior of others in a situation, and (3) a rank order for each of these outcomes in terms of the individual's own preferences as measured by utility. The rational strategy for such an individual in every situation is to maximize expected utility. The term 'utility' was originally conceived as a way to combine a set of personal external values on a single internal scale. In practice, it has come to be equated with expected profits. This model of the rational self-interested individual has generated useful and validated predictions about outcomes in the exchange of specific goods in a competitive market but the same is not true in a diversity of social dilemmas. Hence, there is a need for a modified rational choice theory of the nature of archetypal man, which is empirically grounded, as discussed in Section 1.2.4.2.

1.2.2.3. Market Exchange Mechanism for Managing Private Goods

[194] Vincent Ostrom and Elinor Ostrom (1977) Public Goods and Public Choices. In: Alternatives for Delivering Public Services [E. S. Sava (ed.)], Westview Press, Boulder, CO, USA, pp. 7-49.

[195] Jonathan Levin and Paul Milgrom (2004) supra note 149.

The effective use of the market can be traced back to Adam Smith, who published "An Inquiry into the Nature and Causes of the Wealth of Nations" in 1776. Smith described the "invisible hand" of the market as the means to channel the pursuits of the rational self-interested individual working for expected profit towards unintended socially desirable outcomes.[196] The hypothesis of the "invisible hand" is based on the notion that a complex system will tend towards equilibrium. In a competitive market, the amount that the sellers want to sell just equals to the amount that buyers want to buy at the market price, which when communicated will ensure that the demand will just equal the supply of that commodity, and equilibrium in the competitive market will be realized.

Because market equilibrium is defined in terms of the price and quality of the products, their producing units (firms) are constantly in jeopardy. With free market competition, the inefficient firms are driven to bankruptcy while the efficient firms survive and profit from the market, thereby attracting new firms into the market. Although each firm seeks to promote its own interest, the constructive results of free market competition transcend the self-interest of the separate firms. The elimination of the inefficient firms, forced by the 'invisible hand' of the free market system, is a necessary condition for the good performance of the free market economy. Hence, the study of the structural dynamics of economics is the study of the logic of large numbers.

While the market model explains how market economies allocate resources, it remains silent about how efficient is the allocation of these resources. As resources are scarce, allocating them improperly is costly. To answer this question, market economists introduce a very specific concept of efficiency, known as Pareto efficiency, which was first introduced by the 19th century Italian economist Vilfredo Pareto.[197] If an allocation of resources is such that one can still find a way to make one or more persons better off without making another person worse off, which is Pareto-inefficient, one can still improve the situation until there is no way to make one or more persons better off without making another person worse off, which is Pareto-optimum. Although the Pareto-efficiency criterion is a useful tool for evaluating whether or not an allocation of resources is efficient, it has its limits. If two allocations were both Pareto-efficient, the criterion is unable to evaluate which of the two allocations is to be preferred.

[196] Adam Smith (1776) supra note 190.

[197] Vifredo Pareto, in his *Manuale d'economia politica* (1906), laid the foundation of modern welfare economics with his concept of the so-called Pareto Optimum, in which the optimum allocation of the resources of a society is not attained so long as it is possible to make at least one individual better off in his own estimation while keeping others as well off as before in their own estimation. Extracted from Encyclopaedia Britannica (online). Accessed on 11 August 2019 at: https://www.britannica.com/biography/Vilfredo-Pareto

The Nobel laureate and Indian economist Amartya Sen explicitly critiqued the concept of Pareto-efficiency: "[E]ven when some people are rolling in luxury and others are near starvation, as long as the starvers cannot be made better off without cutting into the pleasures of the rich... [A]n economy can be Pareto optimal and still be perfectly disgusting."[198] This criterion of Pareto-efficiency can only determine whether a society is allocating resources wastefully or not; it does not help society identify which of the Pareto-optimal allocations will optimize justice or equality.

It is also important to note that it is the unique characteristics of heterogeneity and randomness in the freely competitive market and the effects of its feedback mechanisms, which make decentralized decision-making so effective. In 1954, Kenneth Arrow and Gerard Debreu provided a formal proof of Smith's hypothesis that under certain conditions of general equilibrium there exists a set of prices under which a rational individual – out for his or her own gain – will want to buy or sell just enough of each commodity to equilibrate prices and maximize society's benefits from the exchange.[199]

1.2.2.4. Failure of the Market System to Solve the Commons Problem

There is also agreement among the market economists that the voluntary free market exchange mechanism, associated with microeconomic behavior, do not work well with the commons or public goods, e.g. climate change global commons, resulting in market failure,[200] because there is no incentive for the rational individual not to exploit the commons based purely on self-interest, since there is no possibility of excluding others from its use or to charge others rent as the commons is an open access resource. In addition, the climate change global commons is a negative externality.

In the case of environmental issues, the market exchange mechanism can still be effective in providing a solution by creating the incentive to produce substitutes in exchange for the goods of a depleted common pool resource (CPR). Such a depleted CPR has the characteristics of low non-excludability and some rivalry usually at the

[198] Amartya Sen [1970] Collective Choice and Social Welfare, Holden Day, San Francisco, CA, USA, p. 22.

[199] Kenneth Arrow and Gerald Debreu (1954) Existence of an Equilibrium for a Competitive Economy, Econometrica, Volume 22, Number 3 (July 1954), pp. 265-290.

[200] UNCTAD (2016) Module 3: The Economics of Climate Change. In: Trade, the Environment and Sustainable Development: Transition to a Low-Carbon Economy, Virtual Institute Teaching Material, United Nations Conference on Trade and Development, UNCTAD/GDS/2016/2, pp. 63-81.

local or regional levels, e.g. fishery. From the perspective of providing a solution, such a depleted local or regional CPR has a more likely probability of being excluded by the provision of rules of use established by the community of users and there is the incentive of profit for the rational self-interested user or the aggregated community if the substitution (or exchange) were carried out successfully.

The same market exchange mechanism, however, is far less effective in regulating the disposal of waste into the CPRs acting as common sinks, e.g. atmosphere and oceans, which are also practically non-excludable. Hence, the atmosphere and ocean are differentiated in this thesis as CPRs that cannot be excluded, from the perspective of solution provision, and hence are closer to global public goods (GPGs) or 'global commons' and will be termed as GPGs, global commons or commons in this thesis.

First, there is no incentive for the rational self-interested individual not to exploit the global commons, especially as there is no possibility of excluding others from its use or to charge others rent. Second, waste is a cost that every rational individual tries to pass on. Hence, the short-term tendency is to free ride and to lay the burden on others in the case of the global commons. Third, in the case of a depleted CPR at the local or regional levels, the effects of the depleted resources, e.g. fishery, are directly and immediately apparent to human sense and sensibility. In the case of the atmosphere and ocean global commons, because of their large inertia, the systemic effects are indirect and not immediately apparent to human sense and sensibility.

Fourth, which is at the crux of the environmental issue, is that in the case of a depleted CPR is not an existential threat as there are substitutes, e.g. plant proteins for fish proteins, while in the case of climate change, it could well end up as an existential threat because there is no viable substitute for the atmosphere and deep oceans as large-scale common sinks. It is not a problem when the common sink, e.g. the atmosphere, is infinite in capacity and the changes in the state of the atmosphere with increasing GHG concentration are infinitesimal. On the contrary, the atmosphere is highly sensitive to small perturbations of increasing GHG concentrations, and the systemic effects of such an external forcing on the complex Earth's biophysical climate system are non-linear and cascading, which through the chains of consequences, have wide-ranging effects extending over space and time, known as the Butterfly effect.[201]

[201] At the 139th meeting of the American Association for the Advancement of Science in 1972, the meteorologist Edward Lorenz posed a question: "Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?" The purpose of his provocative question was to highlight the idea that some complex dynamical systems exhibit unpredictable behaviors, in which that small variances in the initial conditions

For example, the accelerated and substantial surface warming with indiscriminate GHG emissions may result in melting of the Arctic permafrost with concomitant release of methane, a potent GHG, which will further enhance surface warming and set in motion a upward spiral of GMST into a existential threat. Even the oceans as a global commons is not infinite in its capacity to absorb waste heat and carbon dioxide, and overshooting its holding capacity may result, albeit a very small probability, in the oceans 'throwing back' the heat energy and carbon dioxide into the atmosphere,[202] which in turn forces the Antarctica to 'throw back' the frozen water into the oceans in the form of liquid water, and producing a catastrophic rise in sea levels.[203]

The increase in economic wants and concomitant drive for technological innovations, and the increase in population, have clearly resulted in the overexploitation of some CPRs, e.g. whales and fish stocks, leading to their depletion and possible collapse yet it is not an existential threat. However, the forcings of the same three external factors on the atmosphere and oceans global commons may have resulted in these common sinks approaching their limits as common sinks for waste heat and carbon dioxide leading to the Earth's climate system tipping over and becoming an existential threat.

1.2.2.5. Tragedy of the Commons

Garrett Hardin was not the first to describe the tragedy of the commons. Aristotle had already made the observation that "what is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest".[204] Thomas Hobbes had described the condition of man in the state of nature as one type of tragedy of the commons: "The condition of man ... is a condition of war of everyone against everyone."[205] David Hume had used the same dynamics as Hardin to

---

could have profound and widely divergent effects on the system's outcomes. This idea became the basis for a branch of mathematics known as chaos theory. Extracted from American Scientific (online). Accessed on 11 August 2019 at: https://www.americanscientist.org/article/understanding-the-butterfly-effect

[202] Cheryl Katz (2015) How Long Can Oceans Continue to Absorb Earth's Excess Heat? Yale Environment 360, Yale School of Forestry and Environmental Studies, 30 March 2015. Accessed on 11 August 2019 at: https://e360.yale.edu/features/how_long_can_oceans_continue_to_absorb_earths_excess_heat

[203] See Section 2.2.2.7.

[204] See Aristotle (350 BCE) Politics, Book 2, Part III [Translated by Benjamin Jowett], Internet Classic Archives. Accessed on 2 August 2019 at: http://classics.mit.edu/Aristotle/nicomachaen.1.i.html

[205] Thomas Hobbes (1651) supra note 191, Chapter 14.

describe the tragic consequences of draining a common meadow.[206] More than a decade before Hardin's classic article, H. Scott Gordon had clearly described the same dynamics in another classic article in the Journal of Political Economy.[207]

Now if only the 'commons' were just a few grazing grounds or fisheries, the tragedy of the commons would have been of little general interest. That it is not the case is because Hardin in his article was actually using the common grazing grounds as a metaphor for the general problem of overpopulation.[208] Because much of human activities in this modern world is highly dependent on the limited common resources, humankind today are very likely to be subjected to the social dilemma of the tragedy of the commons. It is used in this thesis to describe the social dilemma of the climate change global commons.

The ocean global commons is such a commons in Garrett Hardin's conception of the tragedy of the commons. For instance, only a handful of nation-States are actively engaged in hunting whales in the ocean. However, because of the freedom of the ocean global commons, because of accelerated population growth, increase in economic wants and the drive for technological innovations in the hunting for whales, the interconnected systems, over time, has created intense rivalry among the few nation-States for the limited stocks of whales in the ocean, which threatened to make whales go extinct.[209]

The same logical process prevails in the case of the atmosphere global commons. In this case, it is not only a few nation-States but all nation-States are actively 'polluting' the atmosphere with carbon dioxide by the industrial combustion of fossil fuels and the clearing the forests for economic development, resulting in global warming and consequent climate change, albeit to widely differing extent, which also differs over time. Meanwhile, the impacts of the resultant climate change also bring widely differing benefits and costs to the nation-States,[210] especially in the short- and medium-terms.

---

[206] David Hume (1739) supra note 183.

[207] H. Scott Gordon (1954) The Economic Theory of a Common-Property Research: The Fishery, Journal of Political Economy, Volume 62 (April 1954), pp. 124-142.

[208] Garrett Hardin (1968) supra note 91, p. 1243.

[209] Sarah Kaplan (2018) These whales will be extinct in 25 years, scientists say — unless we act now to save them, The Washington Post, 20 April 2018. Accessed on 11 August 2019 at: https://www.washingtonpost.com/national/health-science/these-whales-will-be-extinct-in-25-years-scientists-say--unless-we-act-now-to-save-them/2018/04/20/57bf89b2-4320-11e8-8569-26fda6b404c7_story.html?noredirect=on

[210] IPCC (2014c) Summary for Policymakers. In: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, p. 13.

This 'tragedy of the commons' effect on the ocean and atmosphere global commons is not due to their legal status of non-excludability; this effect is due mainly to the fact that they are global commons yielding finite flows of benefits (whales, common sink) and hence are partially rivalrous but these global commons are difficult and costly to exclude potential users as the whales swimming in the oceans could move over vast distances beyond legal boundaries[211] and the global atmospheric circulations would spread the greenhouse gas emissions evenly to all parts of the planet. It is their transnational nature that determines the tragedy of the commons effect.

Each individual's use of such a commons subtracts resource units from the quantity of units available to others, as Hardin so aptly described. Individual users are assumed, based on rational choice theory, to be short-term, profit-maximizing actors, who are homogeneous in terms of their assets, skills, discount rates and cultural views. In this theory, anyone can enter a resource and take resource units. Hardin thought of these users as trapped in a social dilemma largely because Hardin did not envision that these users could self-organize and devise institutional arrangements to get out of the trap of tragic overexploitation. Meanwhile, Hardin's model of the tragedy of the commons has been formalized as a Prisoner's Dilemma game.[212]

1.2.2.6. The Prisoner's Dilemma

The tragedy of the commons as depicted by Hardin is based on the notion of the rational self-interested individual falling into a kind of social trap, which is modeled by the theoretical game of the Prisoner's Dilemma.[213] It is a noncooperative game in which all players possess complete information about the full structure of the game tree and the payoffs attached to the outcomes but communication among the players is forbidden as part of the rules of the game. Since players do not know the moves of other players, the rational self-interested player can only choose to defect, regardless of the strategies of other players, as he or she will always better off choosing such a strategy.

The paradox that rational self-interested individual strategies in such social dilemmas

[211] Ocean Institute (2019) Whales of the World: Blue Whale, Ocean Institute, Dana Point, CA, USA. Accessed on 11 August 2019 at: https://www.ocean-institute.org/whales-world

[212] R.M. Dawes (1973) The Commons Dilemma Game: An N-Person Mixed-Motive Game with a Dominating Strategy for Defection, Oregon Research Institute Research Bulletin, Volume 13, pp. 1-12.

[213] Elinor Ostrom (1990) Governing the Commons: The evolution of institutions for collective action, Cambridge Univeristy Press, Cambridge, UK, pp. 3-5.

lead to collectively undesirable outcomes challenges the fundamental faith that rational self-interested individual strategies using the invisible hand of the market exchange mechanism will always achieve collectively desirable outcomes.[214]

Hence, although a rational self-interested farmer know that it is in his own interest to cooperate and exercise restraint as users of the common grazing ground so that it will be protected from depletion in the shorter term and will be replenish in the longer term to their mutual benefit, yet he would fail to do so because of the lack of trust in other users and the belief that the other users would exploit his restraint by taking more than their fair share and laying the burden on him, as aptly depicted by David Hume.

Even when there are the opportunities to self-organize the users by creating rules that specify who is an authorized user and who is not, as well as the rights and duties of the authorized users, there is still a second-order social dilemma in such a self-organized institutional arrangement. Because all the authorized users of the commons will benefit, whether they take on the burden of contributing to the management of commons or not, the tendency is for even the authorized users to free ride, which is at the heart of the social dilemma, when collective action is used to solve the commons problem. Hence, there is still the need for further rules to monitor the users and the resources, sanctions for rule violations, and mechanisms for conflict resolutions. The self-organization by communities to avoid the tragedy of the commons is analyzed in detail in Section 1.2.4.

1.2.2.7. The Logic of Collection Action

This social trap of the Prisoner's Dilemma is amplified as the size of the user group increases because it is now impossible for the rational self-interested individual to know the true intention of the many others, when he is planning to take action to avoid the tragedy of the commons, as described by Hume.

"Two neighbours may agree to drain a meadow, which they possess in common: because 'tis easy for them to know each other's mind; and each must perceive that the immediate consequence of his failing in his part, is the abandoning of the whole project. But 'tis very difficult and indeed impossible, that a thousand persons shou'd agree in any such action: it being so complicated a design, and still more difficult for them to execute it; while each seeks a pretext to free himself of the trouble and expence [sic],

[214] Richmond Campbell (1985) Background for the Uninitiated. In: Paradoxes of Rationality and Cooperation [Richmond Campbell and Lanning Sowden (eds.)], University of British Columbia Press, Vancouver, Canada, p. 3.

and wou'd lay the whole burden on others."[215]

The rational self-interested individual has to assume the worst. There is then no logical reason for this individual to alone pay for the public goods or commons, which is open access to all. The rational individual will instead be led to 'free-riding', as described by Mancur Olson.[216] Hence, the issue of 'free-riding' is the crux of the second-order social dilemma in solving the public goods or commons problem.

Hence, the provision of public goods or commons problem, the tragedy of the commons, the prisoner's dilemma, the free-rider problem, and the moral hazard are all social dilemmas that occur "whenever individuals in interdependent situations face choices in which the maximization of short-term self-interest yields outcomes leaving all participants worst off than feasible alternatives."[217]

Because there have been many cases of CPRs or global commons experiencing the tragedy of overuse and, sometimes even, destruction, many international law scholars and practitioners have therefore relied upon the conventional political economy analysis to justify the need for the top-down control of all CPRs or global commons.[218]

1.2.2.8. Central Subject of Political Science

In fact, one of the purposes of the State is to mobilize collective action of its citizens to avoid the tragedy of the commons problem. Hence, the theory of collective action is "the central subject of political science" as described by the political economist Elinor Ostrom, winner of the 2009 Nobel Memorial Prize in Economic Sciences.[219]

"It is the core of the justification for the existence of the State." The logic of collective action is at the core of the "citizen control of governments in a democracy" and the "explanation of voting". Collective action problems often confront legislators when they establish the rule of law, bedevil public servants in their policy planning, and beset

[215] David Hume (1739) supra note 183.

[216] Mancur Olson (1965) The Logic of Collective Action: Public Goods and the Theory of Groups, Harvard University Press, Cambridge, MA, USA.

[217] Elinor Ostrom (1998) supra note 55, p. 1.

[218] Simone Schiele (2014) Evolution of International Environmental Regimes, Cambridge Univeristy Press, Cambridge, UK, pp. 17-19.

[219] Elinor Ostrom (1998) supra note 55, p. 1.

judges when they have to adjudicate in settling disputes.[220] It also pervades international relations due to the anarchical system of sovereign nation-States in the international system in the form of international institutional frameworks – international treaties in the early periods and complex international regimes in the later periods – to ensure cooperation among the independent nation-States.[221]

1.2.2.9. Conventional (Product or Rule) Approach to the Commons Problem

There are two top-down solutions to avoid the tragedy of the commons. The first top-down solution is for the relevant government authorities to dissect the commons, parcel them into distinct segments and exclude them as private goods. In essence, it means using the law to carve out completely the commons into distinct private properties with clear boundaries. Once privatization of the dissected commons is successfully implemented, the individual owners can then use the market mechanism to manage the distinct private properties for profit.[222]

The second solution is to exclude the public goods or global commons as a whole by having Hobbes's Leviathan[223] hover over the commons and establishing rules to regulate its use. When the commons problem of resource exploitation or waste disposal is local in scope, it is within the jurisdiction of the sovereign nation-State. The national government will at least has the potential to regulate the commons in the collective interest of its citizens, which is one of the main justifications for the State's existence. Both of these top-down solutions of 'market' and 'state', also known as the product or rule approach, had been used to govern the commons.

However, for the global commons of the atmosphere and the oceans, there is currently no superordinate authority or world government to act as Hobbes's Leviathan in regulating them in the collective interest of the international community of sovereign nation-States. Hence, the governance of the global commons is still a social dilemma for the international community, especially in this time of the Anthropocene.

From the perspective of climate change governance, this thesis has proposed, as a long-term solution, a world system of governance [state] with a global constitution, in which

[220] Id., pp. 1-2.
[221] Simone Schiele (2014) supra note 218, pp. 18-19.
[222] Id., p. 18.
[223] Thomas Hobbes (1651) supra note 191.

fundamental norm/s is/are enshrined.[224] There will be separation of global governance powers, i.e., legislative, executive, and judiciary.[225] The law-making process will take place only at the world level but the administrative and adjudicative processes will adhere to the principle of subsidiarity.[226]

1.2.3. Social-Ecological (Process) Approach

However, the current focus of social science research studies on the outcomes of different institutional arrangements for the governance of common-pool resources, the commons, or public goods, at multiple levels, to solve social dilemmas is based on a more general theory of the nature of the archetypal man than rational choice theory and goes beyond the dichotomous solutions of "market" and "state", which are based on the classical general equilibrium theory of micro-economics,[227] the classical sources of international law,[228] and the 3R classical theories of international relations or politics.[229]

First, social researchers have gradually shifted from using theories and models of simple systems to those of complex systems to understand better the complexity of issues and problems associated with human interactions in contemporary societies.[230] It parallels the approach of the climate change researchers to understand better the complexity of the climate ecosystem and concomitant climate change, as analyzed in Chapter 2.

Second, the nature of the archetypal man has been found empirically to have more complex drivers of motivation than the assumptions of the completely rational self-interested man of rational choice theory. Hence, the nature of the archetypal man assumed in this thesis for the elaboration of frameworks, theories and models is not that of the completely rational self-interested man of rational choice theory.[231]

Third, a wide range of private, governmental, and community institutional arrangements has been shown empirically to operate at multiple scales to generate productive and

[224] Klaus Bosselmann (2017) supra note 70

[225] Louis J. Kotze (2017) supra note 39, pp. 205-207.

[226] Eur-Lex (2019) supra note 72.

[227] See Section 1.2.2.

[228] See Section 1.3.2.1.

[229] See Section 1.3.3.4.

[230] Douglass North (2005) Understanding the Process of Institutional Change, Princeton University Press, Princeton, NJ, USA.

[231] Elinor Ostrom (2009) supra note 51, pp. 429-431.

innovative as well as destructive and perverse outcomes.[232] The thesis advocates the immediate need for a polycentric approach to reduce greenhouse gas emissions in order to forestall the climate ecosystem crossing the critical threshold, leading to catastrophic disruptions. It essentially proposes a multi-factorial, multi-level solution set to cope with a multi-factorial, multi-level problem.

1.2.3.1. The Process Approach to Managing Common Pool Resources

The interest in alternative solutions to the commons problem beyond 'market' and 'state' stems also from a fundamental shift from a 'product or rule' to a 'process' approach. The process approach is not characterized by 'what are the properties of the goods', e.g. private goods, club goods, public goods or CPRs, but by 'how the goods are organized and processed' to achieve the desired outcomes. As opposed to the conventional product or rule approach of 'state' to solving the social dilemma of CPR systems, there is also the process approach, which emphasizes the organizing processes that accompanies the creation of a common good. The common good in the process approach is a product, service or knowledge, which are created on the initiative of a community of users by means of bottom-up processes, not imposed by institutions representing the state (regardless of the level). The essence of the process approach is the bottom-up decisions that accompany the management of a specific CPR by the community of users.[233]

First, the change in approach is mainly because social science researchers now realized that social dilemmas are complex systems of human interactions in ways similar to the realization of climate science researchers that the climate ecosystem is a complex system of interconnections, interactions, feedback mechanisms, emergent phenomena, system structure effects, and have wide-ranging effects extended over space and time. In the case of simple systems, the source or input is key because the source-outcome process or the input-output function is simple and therefore the outcome or output is predictable. In the case of complex systems, the process or function is highly complex. The outcomes or output can be non-linear and cascading, and hence unpredictable.

Second, the process approach refutes the arguments put up by Hardin for the inevitable outcome in the form of the tragedy of the commons. The basic premise of Hardin's arguments was based solely on the operation of property rights (source), while the essence of the process approach is, inter alia, the provision of institutional arrangements

[232] Douglass North (2005) supra note 230.

[233] Konrad Prandecki (2017) Common Goods and Sustainable Development, European Journal of Sustainable Development, Volume 6, Number 3, p. 155.

to establish rules of use in the commons to differentiate between the authorized users and the nonusers; rules of appropriation and provision congruent to local social and environmental conditions, where there is fair distribution of costs proportional to the distribution of benefits; rules of participation for the authorized users in making and modifying the rules; rules for monitoring both the users and the commons; provision of graduated sanctions for rule violations by the users; and provision of rapid, low-cost conflict resolution mechanisms for resolving disputes among users (process).[234]

Third, the change of approach is partly due, to a greater extent, the difficulties encountered in the practical distinction between public goods and CPRs, and, to a lesser extent, the difficulties with practical distinction between private goods, club goods and CPRs. The process approach, which is in essence a bottom-up approach in the management of CPRs, enables better distinction between these goods.[235]

Fourth, the process approach also resolves the vexing issue of proprietary rights. Nowadays, it is believed that proprietary rights are of secondary importance, as CPRs may be both private and public properties.[236] Even using the criterion of proprietary rights to distinguish between CPRs and public goods may no longer be valid due to the growing group of private public goods, i.e. goods generated by private entities to satisfy the public needs and under supervision of the state, for example, prison service.[237]

Fifth, the product or rule approach to solving social dilemmas is essentially ahistorial; one takes the world as one finds it, without consideration for how the world has evolved to its current state, "with the prevailing social and power relationships and the institutions in which they are organized, as the given framework for action" Since the framework of institutions and relations is not called into question, a particular problem is analyzed in relation to the specialized sphere of action in which it has arisen. Hence, the ahistorial product or rule approach to solving social dilemmas is fragmented into multiple specialized spheres of action. The other spheres of action are assumed to be relatively stable except for the specific sphere of action in which the problem has arisen.

1.2.3.2. Integrated Social-Ecological System

[234] Elinor Ostrom (2009) supra note 51, pp. 418-423.

[235] Konrad Prandecki (2017) supra note 233, p. 157.

[236] David Fenney, Fikret Berkes, Bonnie McCay and James M. Acheson (1990). The Tragedy of the Commons: Twenty-two Years Later, Human Ecology, Volume 18, Number 1, pp. 1–19.

[237] Konrad Prandecki (2017) supra note 233, p. 157.

Elinor Ostrom and Vincent Ostrom, together with other colleagues, had done the most work with this process approach. At the Workshop in Political Theory and Policy Analysis of Indiana University in Bloomington, USA, the Workshop group started in the late 1950s with extensive meta-analyses of numerous existing cases studies of communities with CPR issues. Finding that a large number of such CPR cases in which the community of users associated with the CPR had overcome their CPR dilemma and sustained its long-term use therefore posed a valid challenge to the presumption that to avoid the tragedy of the commons is not possible beyond 'market' and 'state'.[238]

In the process of examining the outcomes from the extensive meta-analysis of diverse institutional arrangements for governance of these CPRs at multiple scales, the Workshop group developed "a social-ecological system (SES) framework to address multiple ecological problems in a variety of settings", "better theories [or models] to understand institutional diversity" as well as "databases that collect the same [types of] data in multiple places over time so that they can test those theories."[239] The group then followed up with experiments in the laboratory based on game-theoretical models as well as field experiments to verify the key design principles of CPRs for community collective action to avoid the tragedy of the commons.[240] These empirical studies over 50 years have helped the group to develop new models of community collective action that do not fit into the dichotomy of 'market' and 'state'.[241]

More importantly, from the perspective of this thesis, is that the Workshop group has combined both ecological and social systems as an integrated social-ecological system (SES) for understanding and research because the group considers "this approach is essential for understanding dynamic processes that lead to, mitigate, or to avoid ecological and human disasters and move toward achieving sustainability of both ecological and social systems."[242]

One of primary challenges in achieving sustainability in a SES system is to overcome the 'Panacea Trap' of one solution, such as government control, private or community ownership, as 'the' universal solution. A single solution may be useful for some socio-

[238] Elinor Ostrom (2009) supra note 51, pp. 408-423.

[239] Elinor Ostrom (2012a) Challenges for Achieving Conservation and Development. In: Annual Proceedings of the Wealth and Well-Being of Nations [Jennifer Kodl and Emily Chamlee-Wright (eds.)], Beloit College Press, Beloit, WI, USA, p. 22.

[240] Elinor Ostrom (2009) supra note 51, pp. 421-429.

[241] Id., p. 408.

[242] Elinor Ostrom (2012a) supra note 239, p. 21.

ecological settings but it is rarely the panacea for all the socio-ecological settings,[243] which is a key finding of this thesis. The evolution of climate change governance from a monocentric to a polycentric approach of a multifactorial, multilevel solution set to solve the climate change problem is discussed in Chapter 4.3.

1.2.3.3. Institutional Analysis and Development (IAD) Framework

In examining the evolution of SESs over time and for many different cases in their meta-analyses, the Workshop group discovered many cases, where the communities have developed very successful systems for centuries, which provided them with a wealth of information about the robustness of the rules of use developed by these communities to overcome the tragedy of commons of CPRs. The Workshop group then developed based on these findings an Institutional Analysis and Development (IAD) Framework, consistent with game theory, which enabled them to undertake empirical studies in the laboratory as well as in the fields to confirm the validity of the design principles identified from the meta-analysis study.

1.2.3.3.1. The IAD Framework as General Analytical Framework

The terms 'frameworks, theories, and models' are often used interchangeably by social scientists. The Workshop group, however, used these terms in a precise hierarchical manner, similar to the way climate scientists used the structure of a 'hierarchy of climate models' to bridge observation, theory and projections in climate science.[244]

First, the IAD Framework, situated at the highest level, contains the most general set of variables that a social scientist may use to examine a wide range of institutional arrangements for human interactions, which includes markets, private firms, families, communities, organizations, legislatures as well as governmental administrative agencies. Hence, the Framework contains a cluster of nested variables in the form of building blocks that social scientists can use in their studies to probe and understand systemic human interactions, outcomes and feedbacks across the diverse arrangements. Second, at the lower level of theory, a social scientist selects only the relevant set of nested variables from the IAD Framework and unpacks the nested set of variables, which are considered useful to explain the outcomes and how the variables relate to one

[243] Id., p. 22.

[244] Isaac M. Held (2005) The Gap between Simulation and Understanding in Climate Modeling, Bulletin of the American Meteorological Society, Volume 86, November 2015, pp. 1609–1614.

another. Third, at the lowest level of model, a social scientist then makes precise assumptions about a limited number of variables, which he or she deem necessary for determining the formal consequences of these specific assumptions about the motivation of the actors and the action situation they have to confront to solve a particular social dilemma.

The schematic diagram of the original IAD Framework is shown in Figure 3 below:

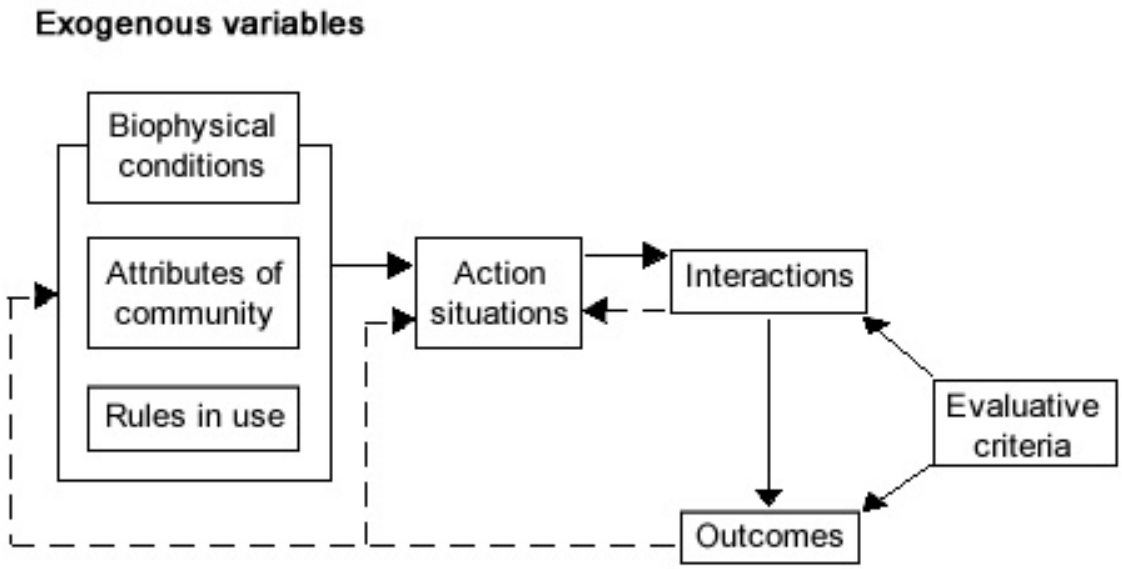

Figure 3: The Internal Structure of the IAD Framework. Source: Adapted from E. Ostrom (2005), p. 15.[245]

The first box of the Framework comprises of three building blocks of broad exogenous variables, which includes biophysical characteristics, community attributes, and "rules-in-use" (or governance mechanisms). For instance in an irrigated agriculture CPR, the biophysical characteristics might include rainfall patterns, soil types, etc; the attributes of the community of farmers would include the size and stability of the community, the existence of familial relationships, and the skill sets needed for irrigated agriculture; and the rules-in-use would be both the formal and informal rules that govern irrigated agriculture in that community.[246]

[245] Elinor Ostrom (2005) supra note 84, p. 15.

[246] Elinor Ostrom (2008) Developing a Method for Analyzing Institutional Change. In: Alternative Institutional Structures: Evolution and Impact [Sandra Batie and Nicholas Mercuro (eds.)], Routledge, London, UK, pp. 48-76.

At the core of the Framework is the second box, known as the "action situation arena" [structure], comprises of three inter-related building blocks of internal variables, namely, action situations, interactions and outcomes. The action situation arena "refers to the social space where actors [agent] with diverse preferences interact, exchange goods and services, solve problems, dominate one another, or fight (among the many things that individuals do in action arenas)" [process].[247] This second box, in which the relevant actors find themselves in an action situation with interactions and outcomes of solving a particular social dilemma, is affected by the first box of exogenous variables [nested structure] and in turn affects the first box of exogenous variables.

The third box refers to the set of evaluative criteria, which would be different for different CPRs, used to assess the effectiveness and efficiency of the institutional arrangements established for the governance of the CPRs.[248]

1.2.3.3.2. The IAD Framework as Meta-Language for Analysis

The IAD Framework provides a meta-theoretical language to enable social scientists to discuss a specific theory or model or to compare different theories or models.[249] The meta-language of the IAD Framework basically comprises of agents with diverse preferences, due to differences in their nature and nurture, actively engaging each other in processes within the structure of the action situation arena to produce interactions and consequent outcomes, which feedback into the action situation arena. The structure of the action situation, interactions and outcomes are nested in a broader structure of exogenous variables, which includes biophysical conditions, attributes of the community and rules-in-use. The broader structure affects the action situation arena and is in turn affected by the action situation arena.

1.2.3.3.3. Use of IAD Framework for Analysis of CPR

The IAD Framework is not a theory but a framework of structures, agents and processes to identify potential relevant variables for building and testing theories. The workshop uses this IAD framework to address three broad questions in the analysis of CPRs.[250]

[247] Elinor Ostrom (2011) Background on the Institutional Analysis and Development Framework, Policy Studies Journal, Volume 39, Number 1, pp. 7-27.

[248] Id., pp. 14-17.

[249] Elinor Ostrom (2009) supra note 51, p. 414.

[250] Elinor Ostrom (2007) Sustainable Social-Ecological Systems: An Impossibility? Presented at the 2007 Annual Meetings of the American Association for the Advancement of Science, "Science and

The first type of questions is to ascertain the patterns of interactions and outcomes, e.g. overuse, conflict, collapse, or stability, that are likely to result "when a *particular* set of rules [rules in use] governs the use of a *particular* resource system [biophysical conditions] in a *particular* socio-economic and political environment [attributes of community]?" More specifically, what are the rules that will generate sustainable outcomes for specific types of CPR in specific socioeconomic environments? Within this broad question, a wide variety of different rules have emerged as relevant factors in generating sustainable outcomes. Hence, the focus of further analysis is to identify the specific rules associated with success within these different CPRs.

The second type of questions is how likely it is, in a specific CPR, that the community of users will be able to design their own systems? Is it likely that such a community will be able to develop endogenous governance arrangements in the absence of externally imposed rules or financing for instance? Hence, should such a community accept institutional arrangements imposed from the outside? Or, are effective rules of use likely to evolve from within the community itself? It will obviously depend on the autonomy of the users and the history and evolution of rules within the specific CPR.

The third type of questions has to do with how robust is a particular configuration of rules, especially in a rapidly changing environment? In other words, what kinds of disturbances do we need to worry about in a specific CPR setting? In some settings, there are forest and water systems that have experienced tremendous stability for 200 years. But in the face of dramatic external changes, some of these systems are no longer resilient. Hence, within this broad question, there is the question as to how likely are such significant external or internal changes expected to occur? Knowing the likely impacts of such changes is essential to promote the sustainability of these CPRs.

1.2.3.3.4. Identification of Design Principles

A brief updated list of the design principles developed by Cox, Arnold, and Villamayor-Tomás,[251] who had carried out meta-analysis of over 100 studies by researchers that had used these design principles in their studies as explanation for the success or failure of

Technology for Sustainable Well-Being," 15–19 February, San Francisco, CA, USA, p. 8.

[251] Michael Cox, Gren Arnold and Sergio Villamayor Tomás (2010) A review of design principles for community-based natural resource management, Ecology and Society, Volume 15, Issue 4, Article 38. Accessed on 11 August 2019 at: http://www.ecologyandsociety.org/vol15/iss4/art38/

the CPR systems, is as follows:

1A. **User Boundaries**: Clear boundaries between legitimate users and nonusers are established and locally understood by the users.

1B. **Resource Boundaries**: Clear boundaries are established to separate a specific common pool resource from the larger social-ecological system.

2A. **Congruence with Local Conditions**: Both appropriation and provision rules are congruent with the local social and environmental conditions.

2B. **Appropriation and Provision**: Appropriation rules are congruent with provision rules such that the distribution of costs is proportional to the distribution of benefits.

3. **Collective Choice Arrangements**: Most users affected by the governance system of a resource are authorized to participate in making and modifying its rules.

4A. **Mutual Monitoring by Users**: Users mutually monitor appropriation and provision levels.

4B. **Monitoring the Resource**: Users also monitor the condition of the resource.

5. **Graduated Sanctions**: Sanctions for rule violations start with very low penalties but penalties become increasingly stronger with repeated violations.

6. **Conflict-Resolution Mechanisms**: Rapid and low-cost local means are provided for resolving conflicts among users or users with officials.

7. **Minimal Recognition of Rights**: Rights of the users to make their own rules for the specific resource are recognized by the relevant government authorities.

8. **Nested Enterprises**: When a common pool resource is closely connected to a larger social-ecological system, the governance activities at the multiple levels are nested.

1.2.3.3.5. Game-Theoretical Modeling Experiments

The SES group then developed a game-theoretical model of a generic CPR situation in order to ascertain the theoretical outcomes of the set of variables that were observed to be significant in that generic CPR situation from the above-mentioned meta-analysis of field studies. First, the findings show that the predictions of the non-cooperative Prisoner Dilemma game are roughly supported only when the players in a game-theoretical model study do not know the reputation of the other players involved in the same model study and cannot communicate with them. Second, on the other hand, when the players of the game-theoretical model study are allowed to communicate face-to-

face, they frequently agree on joint strategies and keep to their agreements, which substantially increasing their net returns in the outcomes. Third, further communication by the players involved in deciding and designing a mutually agreed sanctioning system enables the players to achieve outcomes even closer to the optimal returns.[252]

Although social scientists have questioned the value of such laboratory experiments for testing predictions of major theories in the social sciences, these experiments do use of experimental design to limit study to a practical number of the most important variables, and deploy modeling studies to ascertain how changes in the design of institutional arrangements can affect human interaction outcomes,[253] similar to the way climate scientists utilize climate modeling studies with different representative scenarios to ascertain the likely future outcomes of climate change respectively.

With reference to the second question, it is clear from the outcomes of these laboratory experiments with game-theoretical models that the community of users in a particular CPR is able to develop their own endogenous governance system in the absence of externally imposed rules when users are able to communicate effectively in setting up their own rules of use and set up a mutually agreed sanctioning system.[254]

First, the general findings of these laboratory experiments "represent a strong rejection of the predictions derived from a complete model of rationality."[255] They essentially show that individuals in CPR are able to obtain results that are substantially "better than rational". [256] Second, simple cheap talk provides the individuals in CPRs with opportunities "to make conditional promises to one another and potentially to build trust that others will reciprocate."[257] Third, the individuals in the CPRs have the capacity to solve the second-order dilemmas of free riding by designing and implementing "clear mechanisms for monitoring rule conformance and graduated sanctions for enforcing compliance" that change the structure of the first-order dilemma.[258]

---

[252] Elinor Ostrom (2009) supra note 51, pp. 423-425.

[253] Armin Falk and James J. Heckman (2009) Lab Experiments are a Major Source of Knowledge in the Social Sciences, Discussion Paper No. 4540 (October 2009), The Institute for the Study of Labor (IZA), Bonn, Grmany, p. 2.

[254] Elinor Ostrom (2000) Collective Action and the Evolution of Social Norms, The Journal of Economic Perspectives, Volume 14, Number 3, pp. 137-158.

[255] Elinor Ostrom (1998) supra note 55, p. 6.

[256] Leda Cosmides and John Tooby (1994) Better than Rational Evolutionary Psychology and the Invisible Hand, American Economic Review, Volume 84 (May 1994), pp. 327-332.

[257] Elinor Ostrom (1998) supra note 55, p. 6.

[258] Id., p. 8.

1.2.3.3.6. Studying Common Pool Resource Problems in the Fields

After having conducted extensive meta-analyses of existing case studies to identify the design principles and having carried out laboratory experiments with game-theoretical models to verify the design principles in theory, the SES Workshop group then undertook field studies where they could draw on the IAD framework to ask the third question in order to elicit consistent information about the practical effectiveness of the design principles in various CPR sites.

In a large-scale field study of irrigation systems in Nepal, Lam had developed three performance measures that could be applied to all irrigation systems examined: (1) the physical condition of irrigation systems, (2) the quantity of water available to farmers at the tail end of a system at different seasons of the year, and (3) the agricultural productivity of the systems. By controlling for environmental differences among systems, Lam found that irrigation systems managed by farmers themselves performed significantly better on all the three measures. In the farmer-managed irrigation systems, the farmers communicated formally at annual meetings and informally on a regular face-to-face basis; they developed their own mutual agreements, established monitoring systems, and sanctioned those who do not conform to the rules. Consequently, these farmer-managed irrigation systems kept their systems in better repair, distributed water more equitably, and grew more rice than the government-managed systems. Although the farmer-managed systems did vary in their performances, few, however, performed as poorly as the government-managed systems.[259]

A long-term collaborative research network on the forests of the world, known as the International Forestry Resources and Institutions (IFRI) research program, was established with centers now located in Bolivia, Colombia, Guatemala, India, Kenya, Mexico, Nepal, Tanzania, Thailand, Uganda, and the United States, with new centers being added in Ethiopia and China.[260] It is a unique program as it is the only inter-disciplinary long-term monitoring and research program for studying forests in multiple countries, which are owned by governments, private organizations, and communities.

Various studies conducted under the IFRI research program have found that a major variable affecting forest conditions is the investment by local users in monitoring. There

[259] Lam Wai Fung (1998) Governing Irrigation Systems in Nepal: Institutions, Infrastructure, and Collective Action, ICS Press, Oakland, CA, USA.

[260] Amy Poteete and Elinor Ostrom (2004) In Pursuit of Comparable Concepts and Data about Collective Action, Agricultural Systems, Volume 82, Issue 3, pp. 215-232.

was a strong correlation between a forester's assessment of forest density and the level of monitoring, especially when local communities also had high levels of rule-making autonomy. In addition, when local users were given harvesting rights, they were more likely to monitor illegal uses themselves. Detailed field studies of monitoring and enforcement on the ground showed the difficulties in achieving high levels of forest regrowth without the active involvement of local forest users. The legal designation of a forest as a protected area is not by itself related to forest density. In fact, when government authorities adopted top-down decentralization policies without consulting local officials and users, stable forests became vulnerable to deforestation. In general, these field studies show that it is not the type of forest governance – government, private or community – that is crucial in determining the condition of the forest; rather, it is how a particular governance arrangement fits the local ecological and social conditions, how the specific rules of use are developed and adapted over time, and whether the users themselves consider the system to be legitimate and equitable.[261]

1.2.3.4. Process Approach to the Commons Problem

The essence of the process approach is the bottom-up decisions by the community of users in the specific CPR in the form of institutional arrangements to establish rules of use in the commons to differentiate between the authorized users and the nonusers; with rules of appropriation and provision congruent to local social and environmental conditions, where there is fair distribution of costs proportional to the distribution of benefits; and rules of participation for the authorized users in making and modifying the rules; and rules for monitoring both the users and the commons; and with the provision of graduated sanctions for rule violations by the users, and of rapid, low-cost conflict resolution mechanisms for resolving disputes among users.

1.2.3.4.1. Process Approach between Market and State

The process approach is in-between the end poles of 'market' and 'state'. The process approach neither relies on the impersonal invisible hand of the free market exchange mechanisms nor on the impersonal rules established by the legislature of the state. The rules of use established by the community in the CPR are flexible and not fixed, and adapted to the local social and environmental conditions; the authorized users are personally involved in the establishment of the rules of use to ensure the rules are fair

[261] Elinor Ostrom (2012b) Why do we need to protection institutional diversity? Keynote Lecture, European Political Science, Voume 11, pp. 137-139.

and in the monitoring of users and the commons; the sanctions starting very low and becoming stronger with repeated violations and the provision of rapid and low-cost conflict resolution mechanisms are user-centric and, hence, more personalized.

The process approach to manage CPRs is a viable alternative solution to avoiding the tragedy of the commons. However, it is only a complementary, rather than a basic, solution to the political economy. Solutions to overcome the tragedy of the commons will still mainly rely on the 'market' for private goods and the 'state' for public goods. However, in many cases, at the smaller-scale community level, the process approach with the substantive involvement of the authorized users of a specific CPR to establish rules of use for the joint management of the CPR may bring additional benefits.

1.2.3.4.2. From the Perspective of Climate Change Governance

From the perspective of climate change governance, this thesis has proposed, based on the process approach, an urgent but transactional shift from a 'monocentric' to a 'polycentric' approach[262], in which different groups of actors from the transnational down to the individual level making decisions about the appropriate rules-in-use in context and implement them at multiple levels to curb greenhouse gas emissions.

1.2.4. Integrated Systemic Process-Oriented (ISPO) Approach

I have developed the integrated systemic process-oriented (ISPO) approach as the general analytical framework to understand systemic climate change from "a structured and dynamic view of larger wholes".[263] The focus of such a holistic approach is not only the product at the source or at the end-point but the structured and dynamic process of interactions among the diverse elements of the larger whole.

1.2.4.1. ISPO General Analytical Framework

In developing such a general analytical framework for the analysis of the evolution of climate change governance, I have adopted, merged and modified the following three process-oriented approaches, namely:

(1) Integrated socio-ecological system (SES) approach of Elinor Ostrom,

[262] Elinor Ostrom (2010) supra note 37.

[263] Robert W. Cox (1981) supra note 28, p. 126.

(2) Policy-oriented process approach of the New Haven School of social jurisprudence to international law and politics developed by McDougal and Lasswell, and

(3) Process approach to global governance of the Commission of Global Governance.

1.2.4.1.1. Characteristics of the ISPO General Analytical Framework

The schematic diagram of the ISPO general analytical framework for analysing the evolution of international climate change governance is as shown in Figure 5:

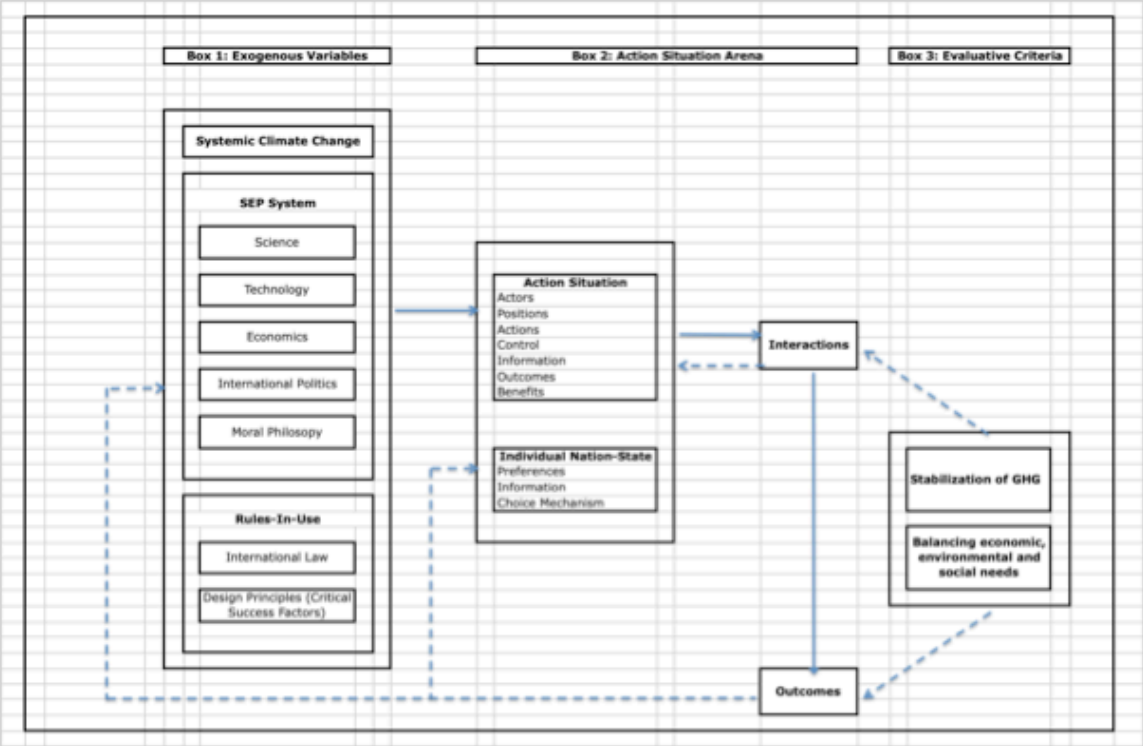

Figure 4: The ISPO General Analytical Framework for the Analysis of the Evolution of International Climate Change Governance (Figure 1 repeat)

The first box of the ISPO general analytical framework comprises of the three building blocks of broad exogenous variables, namely the biophysical climate ecosystem, the SEP system (which includes the science, technology, economics, international politics and moral philosophy of the international community), and the rules-in-use, which includes international law and the design principles (critical success factors).

At the core of the ISPO framework is still the same second box, known as the "action situation arena" [structure], comprises of three inter-related building blocks of internal variables, namely, action situations, interactions and outcomes. This second box, in which the relevant actors find themselves in an action situation with interactions and outcomes of solving a particular social dilemma, is still affected by the first box of different exogenous variables [nested structure] and in turn affects the first box of different exogenous variables.[264]

When using the ISPO general analytical framework for analysis of international climate change governance [CPR] the agents are the nation-States and international institutions set up by the nation-States [agent] and the action situation arena is the series of UN conferences [structure], called for by the United Nations General Assembly [scientific-technological-social-economic-political-moral attributes of the international community] to establish multilateral environmental agreements [rules-in-use] for abating the adverse effects of changes in the Earth's climate system [biophysical conditions]. The domestic politics of the nation-States [agent preference] have a significant influence on the position of the nation-States in the UN parliamentary negotiation process [process] while the history [evolution] and context [scientific-technological-social-economic-political-moral attributes of the international community] affect significantly the interactions and outcomes of the multilateral diplomatic negotiations and *vice-versa*.

The third box of the ISPO framework comprises of a specific set of evaluative criteria, which will be based on achieving the end-point or social goals, namely the stabilization of "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"[265] and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations.[266] These are not aspirational goals. Climate change is an existential threat. It will affect everything else. Hence, these social goals are vital goals for the whole of humankind if we do not want our children to witness the collapse of human civilization, as we know it today.

The ISPO general analytical framework was used for the analysis of the evolution of international climate change governance (Chapter 3.3). It was also used, with minor changes to the exogenous variables and the evaluative criteria due to slight differences

[264] Elinor Ostrom (2011) supra note 247.
[265] United Nations (1992a) supra note 16, Article 2.
[266] UNEP (1992a) supra note 75.

in social goals, to the evolution of ocean global commons governance (Chapter 3.1) as well as the evolution of the broader SES of international environmental governance, specifically those of the atmosphere global commons (Chpater 3.2). Meanwhile, the same framework was used for framing the questions in the comparative analysis of the atmosphere global commons regimes (Section 4.1) and on the longitudinal analysis of the MEAs of the climate change regime (Chapter 4.2).

1.2.4.1.2. Differences from the Foundational Process-Oriented Approaches

The integrated SES approach does not have specific teological purposes while the New Haven School has the specified teological intent of continuous development towards an optimum world public order of human dignity in the universe of human aspirations, which find expression in the shared values of power, wealth, enlightenment, respect, wellbeing, skill, rectitude, and affection (social goals)[267] and the process approach recommended by the Commission on Global Governance has the specified teological intent of continuous development towards an ideal state of global governance, which comprised of sixteen endpoints (social goals).[268] Although there might be slight differences in the specified end-point or social goals, both the New Haven School and the Commission on Global Governance did emphasize the process of continuous improvement towards the ideal end-points or social goals.

The ISPO framework is still a problem solving approach and not a critical approach. It still takes the world with its prevailing order of social and power relationships, together with the institutions into which they are organized. However, unlike most problem solving approaches, the ISPO approach is process-oriented. Hence, it is not an ahistorical and static analytical framework but a historical and contextual (evolutionary) and a dynamic analytical framework for gaining knowledge and taking action.

1.2.4.2. A More General Theory of the Nature of Archetypal Man

The current social science theories based on the rational choice theory of man as self-interested, short-term maximizer and its concomitant thin models of the completely rational individual has been highly successful in predicting marginal behavior in which selective pressures in the process screen out individuals who do not maximize profits in

[267] Myres S. McDougal (1956) Law as a Process of Decision: A Policy-Oriented Approach to Legal Study, Faculty Scholarship Series, Paper 2464, Yale Law School, New Haven, CT, USA, p. 56. Accessed on 11 August 2019 at: http://digitalcommons.law.yale.edu/fss_papers/2464

[268] Commission on Global Governance (1995) supra note 79, pp. 4-5.

a competitive market or the probability of electoral success in party competition. These assumptions about completely rational individuals in society, however, mask the potentially productive collective efforts of individuals and groups to organize and solve social dilemmas, e.g. over-exploitation of common-pool resources. The classic view is that these individuals, as depicted in a Prisoner's Dilemma game, are trapped always in an action situation arena without the capabilities to change the exogenous variables and avoid the tragedy of the commons.[269]

Yet, thin models of completely rational individuals have been shown to be unsuccessful in explaining or predicting human behavior even in one-shot or finitely repeated game-theoretical models of social dilemmas. While, in infinitely repeated game-theoretical models of social dilemmas, these models have predicted a diverse range of equilibria ranging from the best to the worst of outcomes but without any hypothesized process as to how the completely rational individuals might achieve more productive outcomes.[270] Experimental evidences show that the individuals "are not involved in or capable of backward induction."[271] The evidences also point out that the individuals do not learn Nash equilibrium strategies in social dilemmas.[272] Meanwhile, field studies have shown that individuals can engage in collective action to manage common-pool resources without an external authority to offer inducements or impose sanctions. Whether the individuals have the capacities to transform the exogenous variables affecting their action situation may vary from one situation to the next.[273]

Hence, the above-mentioned thin models of complete rationality should be viewed as the limiting case of the more general theory of bounded or incomplete rationality. In other words, the rational choice theory of the nature of the archetypal man as a completely rational, self-interested, short-term maximizer is at one extreme of the more general theory of the archetypal man with bounded rationality.[274] Hence, consistent with all models of rational choice theory is a general theory of the nature of the archetypal man as a complex, fallible learner, who seeks to do as well as he can given the constraints that he faces and who is able to learn heuristics, norms, rules and how to design rules to improve outcomes. The main assumptions about such a boundedly

[269] Elinor Ostrom (2009) supra note 51, p. 416.

[270] Elinor Ostrom (1998) supra note 55, p. 2.

[271] Ammon Rapoport (1997) Order of Play in Strategically Equivalent Games in Extensive Forms, International Journal of Game Theory, Volume 26, Number 1, pp. 113-136.

[272] Elinor Ostrom, Roy Gardner and James Walker (1994) Rules, Games, and Common-Pool Resources, University of Michigan Press, Ann Arbor, MI, USA.

[273] Elinor Ostrom (1998) supra note 55, p. 8.

[274] Elinor Ostrom (2009) supra note 51, p. 429-431.

ratonal individual is that he has (1) the capacity to increase learning and understanding of information in repeated situations when reliable feedback is available (2) the ability to use heuristics in making daily decisions, and (3) preferences that not only benefits his own self but also preferences for moral norms and rules that benefit others.[275]

This more general bounded rationality theory of the nature of archetypal man is utilized in this thesis as it correlates well with the assumptions of the nature of archetypal man as expressed by both the New Haven School of social jurisprudence and the process approach of the Commission on Global Governance, in which the archetypal man has preferences for moral norms and rules that benefit his own self and others and therefore understand teological intent, and is capable of learning to use heuristics to make daily decisions for continuous improvement towards the ideal end-points or social goals.

1.3. GOVERNANCE OF THE GLOBAL COMMONS

From the 17th century onwards the constitutive political and legal principle of the modern international system has been national sovereignty over territory, coastal waters, and more recently, airspace. The global commons were essentially the areas beyond nation-State jurisdiction because they were impossible to reach (Antarctica and deep seabed) or they were beyond scientific understanding (radio frequency spectrum and the atmosphere commons). The oldest of these global commons is the ocean, or, more correctly, the high seas, which lies outside the territorial sea limits.

All these global commons were however dramatically affected by the quantum leap in science and technological knowledge from the mid-19th century, which propelled the Industrial Revolution. Both the Antarctica and the deep seabed were reached physically. The gaps in the understanding of the radio frequency spectrum and its usefulness for communications and of the atmosphere commons and its importance to climate change were quickly closed by the same scientific and technological advancement. However, with increase in the human population and the quality of human life, these global commons though non-excludable were becoming rivalrous with each passing day (common pool resources). The governance of these global commons in order to avoid the tragedy of the commons became a central issue for the international community of independent sovereign nation-States in the mid-20th century.

[275] Id., p. 430.

In the absence of a world government, there is a *prima facie* case for some sort of international or global governance to address the global commons or GPG, e.g. ocean, atmosphere and the Antarctica. In the case of the Antarctica, any attempt at exclusion by privatization would generate irresolvable political conflicts. Hence, instead of acceding to the territorial claims, the international community of nation-States made arrangements to govern the activities on Antarctica and parts of the surrounding Southern Ocean under the Antarctic Treaty System.[276] The 1959 Antarctic Treaty itself, however, categorically states that contracting to the treaty is not a renunciation of any previous territorial claim, does not affect the basis of claims made as a result of activities of the signatory nation-State within Antarctica, and does not affect the rights of a nation-State under customary international law to recognize (or refuse to recognize) any other territorial claim.[277] Hence, it is essentially a temporary stopgap solution to the Antarctica global commons and further diplomatic negotiations will be needed upon expiry of the treaty. In the case of the ocean and atmosphere global commons, the international community has developed specific international regimes for its regulation, as analyzed in Chapter 3 with the ISPO framework.

1.3.1. The Process Concept of Governance

The most basic characteristic of the term 'governance' is that it is not synonymous with a world government. The concept of governance has been widely applied to both the domestic and international political systems and the extensive connections between them. Formal government authority cannot account for all the ways in which human activity is regulated and coordinated in the world. Hence, governance is considered as a more encompassing process than the formal governmental processes and would include the informal non-governmental processes as well. Hence, the widely accepted notion of governance is as stated in the report of the Commission on Global Governance:

"Governance is the sum of the many ways individuals and institutions, public and private, manage their common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and co-operative action may be taken. If includes formal institutions and regimes empowered to enforce compliance, as

[276] SCAR (2017) The Antarctic Treaty System, Scientific Committee on Antarctic Research (SCAR), Committee of International Science Council, Cambridge, UK. Accessed on 11 August 2019 at: https://www.scar.org/policy/antarctic-treaty-system/

[277] ATS (2013) Antarctic Treaty, 1 December 1959, Article IV.1, Antarctic Treaty Secretariat, Buenos Aires, Argentina. Accessed on 11 August 2019 at: https://www.ats.aq/e/ats.htm

well as informal arrangements that people and institutions either have agreed to or perceive to be in their interests."[278] The Commission also emphasized that "any adequate system of governance must have the capacity to control and deploy the resources necessary to realize its fundamental objectives. It must encompass actors who have the power to achieve results, must incorporate necessary controls and safeguards, and must avoid overreaching."[279] In essence, 'governance' is the 'process' approach while 'government' is the 'product or rule' approach.

1.3.1.1. International Governance

It is true that the Commission highlighted the same notion in that although global governance has been viewed primarily as intergovernmental relationships in the past, "it must now be understood as also involving non-governmental organizations (NGOs), citizens' movements, multinational corporations, and the global capital market. Interacting with these are global mass media of dramatically enlarged influence."[280] The Commission in recognizing the systemic nature of many global issues also emphasized that the actors involved in any area of global governance "must promote systemic approaches in dealing with them."[281] However, the Commission also acknowledged that the development of global governance is a "part of the evolution of human efforts to organize life on the planet, and the process will always be going on."[282] Therefore, global governance of climate change is an ideal state of affairs and humankind today despite the vigorous efforts of the international community of nation-States for the past 60 years is still far from attaining the ideal state of global governance.

It had instead focused mainly on the use of the multilateral diplomatic process to establish multilateral environmental agreements to mitigate climate change and is far from promoting systemic approaches in dealing with climate change. Hence Section 2.3 is still more appropriately entitled, "International Climate Change Governance". The major actors in the evolution of climate change governance thus far have been the nation-States and, to lesser extent, the international organizations and institutional arrangements set-up by the nation-States, and the major activity had been the negotiation and adoption of multilateral international agreements as the core legal instruments of international governance to solve the climate change problem.

[278] Commission on Global Governance (1995) supra note 79, p. 2.
[279] Id., p. 4.
[280] Id., p. 3.
[281] Id., p. 4.
[282] Id., p. xvi.

The thesis, however, moved on by taking a normative approach to advocate curbing GHG emissions at the national governance level through carbon tax legislation in Chapter 4 and to propose as the long-term solution to the climate change problem the establishment of a world legal authority for the atmosphere global commons with supreme legislative powers at the global governance level in Chapter 5.

1.3.1.2. A Global Civic Ethic

The Commission on Global Governance in its report, "Our Global Neighbourhood", did not specifically address the nature of archetypal man. The report did, however, talk about the high importance of "the broad acceptance of a global civic ethic to guide action within the global neighbourhood [planet Earth], and courageous leadership infused with that ethic at all levels of society."[283] The core values of such a global civic ethic included "respect for life, liberty, justice and equity, mutual respect, caring and integrity."[284] The Commission on Global Governance in stating these core values must assume that the nature of the archetypal man is one with the moral capacity to make ethical choices for the long term and capabilities to change exogenous variables of social dilemmas and avoid the tragedy of the commons.[285]

1.3.2. International Law Approach to Global Commons Governance

International law has been used as one of the means, although not the only means, at our disposal for the regulation of human activities pertaining to the global commons.[286] It provides the framework for the development of legal binding rules for international cooperation and the resolution of differences among the nation-States in the international community.[287] However, the international legal system lacks a legislature, an executive body and a system of courts with powers comparable to those of the national legal system.[288] Hence, international law fulfils its role in international climate

[283] Id., p. 46.

[284] Id., p. 49.

[285] See Section 1.2.4.2.

[286] Patricia Birnie, Alan Boyle and Catherine Redgwell (2009) International Law and the Environment, 3rd Edition, Oxford Univeristy Press, Oxford, UK, p. 1.

[287] Philippe Sands (2003) Principles of International Environmental Law, 2nd Edition, Cambridge University Press, Cambridge, p. 12.

[288] Malcolm N. Shaw (2008) International Law, 6th Edition, Cambridge University Press, Cambridge, UK, p. 3.

change governance via institutional arrangements that replicate the legislative, administrative and adjudicative functions of the national legal system.[289]

Since there is no international legislature and no established 'code of international law', the legal norms for governance of the international community are created largely on a decentralized basis by the decisions and actions of the 192 nation-States, which make up the international community.[290] It essentially reflects the doctrine of consensus as the majority in the international community is influential in the creation of the new norms of international law and there is acceptance by the other nation-States of these new norms. In a broad sense, nation-States accept or consent to the general system of international law although they may from time to time object to specific rules.[291]

1.3.2.1. The Sources of International Law (Product or Rule Approach)

The classical approach, which is the product or rule approach, to international law is to rely on the sources of international law. Article 38 (1) of the Statue of the International Court of Justice (ICJ), which is one of the principal organs of the United Nations,[292] identifies the four main sources of international law. The Statue was drafted originally for the Permanent Court of International Justice (PCIJ) in 1920, which served as the principal adjudicative organ of the League of Nations.[293] The PICJ was the predecessor of the ICJ. Although the Statue of the ICJ is only applicable to the Court itself, this list of the four main sources of international law listed in the Article 38 (1) are still widely accepted as creating legally binding rules on the nation-States:[294]

(a) International conventions, whether general or particular, establishing rules expressly recognized by the contesting states;
(b) International custom, as evidence of a general practice accepted as law;
(c) General principles of law recognized by civilized nations;

[289] Philippe Sands (2003) supra note 287, p. 12.

[290] Christopher Greenwood (2008) Sources of International Law: An Introduction, United Nations Audiovisual Library of International Law. Accessed on 18 August 2019 at: http://legal.un.org/avl/pdf/ls/greenwood_outline.pdf

[291] Malcolm N. Shaw (2008) supra note 288, pp. 10-11.

[292] ICJ (2019) supra note 151, Article 38(1).

[293] The International Court of Justice (ICJ), which has its seat in The Hague, is the principal judicial organ of the United Nations. Accesssed on 11 August 2019 at: https://www.icj-cij.org/

[294] Ian Brownlie (2003) Principles of Public International Law, 6th Edition, Oxford Unversity Press, Oxford, UK, p. 5.

(d) Subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law.

1.3.2.1.1. Customary International Law

Customary international law, as stated in Article 38 (1)(b), is derived from the practice of nation-States. It is the oldest but an unwritten source of international law. Customary international law generates rules binding on all nation-States. One of the purposes for the modern doctrine of sources in international law is tell the international law lawyers and law students where he or she can find the law in an objective manner – first, the concreteness of the law and not to accept any norms as simply given, either by virtue of state sovereignty or some anterior normative code, and second, the normativity of the law by detaching it from the momentary views and interpretations which nation-States might hold of its content.[295] A rule of customary international law, e.g., requiring States to grant immunity to a visiting Head of State, is said to be both concrete and normative. First, it is a widespread and consistent State practice, which means that the States must already have such a practice of according immunity to a visiting Head of State (concrete). Second, there must be '*opinio juris*', usually translated as 'a belief in legal obligation', which means that the States must accord immunity because they believe they have a legal duty to do so (normative). "Not only must the acts concerned be a settled practice, but they must also be such, or be carried out in such a way, as to be evidence of a belief that this practice is rendered obligatory by the existence of a rule requiring it … The States concerned must feel that they are conforming to what amounts to a legal obligation."[296]

A new rule of customary international law cannot be created unless both these elements are present. Practice alone is not enough, e.g. the Case of the SS Lotus (1927),[297] and a new rule cannot be created by *opinio juris* without actual practice, e.g. the Advisory Opinion on Nuclear Weapons (1996).[298] Hence, there are only a few customary international rules because of the twin requirements of concreteness and normativity. It also means that these rules require time to evolve. Meanwhile, the intensification of inter-State relationships and the growth in the number of nation-States in the

[295] Martti Koskenniemi (2005) From Apology to Utopia: The Structure of International Legal Argument [Reissue with a new Epilogue], Cambridge University Press, Cambridge, UK, p. 17.

[296] Christopher Greenwood (2008) supra note 290, p. 1.

[297] *PICJ (1927) Case of the SS Lotus, Series A, 10, 1927.*

[298] *ICJ (1996) Threat or Use of Nuclear Weapons, Reports, 1996.*

international community during the 20th century had led to the replacement of the slower lawmaking process via custom by the much faster lawmaking process via treaty as the primary source of international law.

1.3.2.1.2. Treaties Between Nation-States

Treaties (also called agreements, conventions, or protocols) between States, or between States and international organizations, have become the main source of international law. Strictly speaking, a treaty is not a source of law so much as a source of obligations under law. A treaty is only binding on the nation-States that become parties to the treaty. The choice of whether or not to become a party to a treaty is entirely a decision for the nation-State to make. There is no compulsion to sign up to a treaty. Once a nation-State becomes a party to a treaty, then as a party, it is bound to the obligations in the treaty provisions because of a rule of customary international law – *pacta sunt servanda* – that requires all States to honor their treaties. That is why treaties are more accurately described as sources of obligations under international law.[299]

Treaties Codifying Customary International Law

Many treaties are also important as authoritative statements of customary international law. A treaty, which is freely negotiated and adopted among many nation-States, is often regarded as writing down what were previously the unwritten rules of customary international law. This is the case where a treaty provision is intended to codify the existing law, e.g. Vienna Convention on the Law of Treaties.[300] Although less than half the nation-States in the world are parties to the Vienna Convention but every court that has to adjudicate on matters related somewhat to the Vienna Convention has treated its main provisions as codifying customary international law and has therefore treated them as applying to all nation-States whether they are parties to the Vienna Convention or not. In theory, where a treaty provision codifies a rule of customary international law the source of law is the both original practice and *opinio juris* and the treaty provision is merely evidence. More importantly, when the treaty provision becomes a rule of customary international law, the rule is binding on all nation-States. Even where a treaty provision is not intended to be codificatory but is an innovation designed to change an existing rule, it can become a new rule of customary international law if it is accepted in

[299] Christopher Greenwood (2008) supra note 290, p. 2.

[300] United Nations (1969) Vienna Convention on the Law of Treaties, Vienna, 23 May 1969, Article 31 (3) (c), pp. 12 -13. Accessed on 21 August 2018 at: http://legal.un.org/ilc/texts/instruments/english/conventions/1_1_1969.pdf

practice, e.g. the North Sea Continental Shelf cases (1969):[301]

"Although the passage of only a short period of time is not necessarily, or of itself, a bar to the formation of a new rule of customary international law on the basis of what was originally a purely conventional rule, an indispensable requirement would be that within the period in question, short though it might be, State practice, including that of States whose interests are specially affected, should have been both extensive and virtually uniform in the sense of the provision invoked; - and should moreover have occurred in such a way as to show a general recognition that a rule of law or legal obligation is involved."

In reality the fact that a large number of nation-States agree upon a treaty provision is itself an important piece of State practice. If those and other nation-States subsequently apply the treaty provision – especially where they are not parties to the treaty – then it can quickly become part of customary international law. Hence, although all treaties are contractual between their parties, some have an effect on general international law.

The flip side of writing down a rule that was previously unwritten is that it changes the rules of interpretation. For it is the written rule to which everyone will look at. The debates about the extent of the rule will then largely revolve around the interpretation of the written text rather than an analysis of the underlying practice.[302]

Creation of International Organizations by Treaties

A significant milestone in the development of international law by treaty via the multilateral diplomatic process was the creation of the League of Nations in 1919 by the Treaty of Versailles [303] after the First World War. Although this international organization failed to achieve its goal of maintaining peace in the international

[301] *ICJ (1969) North Sea Continental Shelf, Reports, 1969, p. 3.*

[302] Christopher Greenwood (2008) supra note 290, p. 3.

[303] After the First World Wat, US President Woodrow, who was one of the most ardent advocates of the League of Nations, chaired the Peace Conference in Paris in 1918. He was made Chairman of the Committee, which was established to formulate the rules and regulations for an international organization whose purpose was to preserve world peace through open diplomacy and global consensus. On 29 April 1919, the final version of the Covenant of the League of Nations was adopted, and it became Part I of the Treaty of Versailles. The League of Nations was officially inaugurated on 10 January 1920 after the Peace Treaty of Versailles came into effect. Extracted from UNOG Library, Registry, Records and Archives Unit (online). Accesssed on 11 August 2019 at: https://www.unog.ch/80256EDD006B8954/(httpAssets)/36BC4F83BD9E4443C1257AF3004FC0AE/%24file/Historical_overview_of_the_League_of_Nations.pdf

community for the Second World War broke out soon after in 1939, it was the forerunner of the United Nations, which was established by the Charter of the United Nations on 26 June 1945 at the San Francisco Conference.[304] The United Nations has at least succeeded in preventing a Third World War from breaking out for the past 75 years. Today, the United Nations System, which consists of the United Nations and the six principal organs of the United Nations, the specialized agencies, and affiliated international organizations, provide the bulk of the legislative, administrative and adjudicative functions for the international legal system.

With the establishment of the United Nations System, the treaty making process for governing the global commons was further accelerated. The international organizations under the United Nations System as legal persons were able to initiate the multilateral diplomatic process of negotiating and adopting a treaty in an international forum.

Multilateral Environmental Agreements as Treaties

Against this background of treaty between nation-States as a source of international law and the use of the multilateral diplomatic process to negotiate and adoption a framework/protocol international agreement provided a quick process for the nation-States to cooperate in addressing global environmental problems generally, and the climate change problem specifically. The overall intent of using international law for the governance of the global commons may be described as the maintenance of peace among nation-States by deliberately avoiding the tragedy of the global commons, which is apt in the case of climate change, for it has been considered as the most important existential threat to humankind next to that of nuclear war.

Agreements negotiated and adopted via the multilateral diplomatic process in inter-governmental negotiation fora, which are legally binding between the multiple nation-States for the purpose of regulating specific environmental issue areas respectively, are termed as multilateral environmental agreements (MEAs). MEAs fall under the source category of "general or particular international conventions".[305] The provisions in the Vienna Convention on the Law of Treaties (VCLT), which codifies in most parts

[304] The United Nations is an international organization founded in 1945, after the Second World War, by 51 countries. As an international organization and with the powers vested in its founding Charter, the United Nations can take action on a wide range of issues as well as provide a forum for its 193 Member States to express their views, through the General Assembly, the Security Council, the Economic and Social Council, and other bodies and committees. Extracted from United Nations: Seventieth Anniversary (online). Accessed on 11 August 2019 at: https://www.un.org/un70/en/content/history/index.html

[305] ICJ (2019) supra note 151.

customary international law, govern these international conventions or treaties under international law.[306] MEAs, as written agreements, are intended to create, to varying degrees, rights and obligations between consenting parties meeting the definition of Article 2 (1)(a) of the VCLT, which defines a treaty as "an international agreement concluded between states in written form and governed by international law, whether embodied in a single instrument or in two or more related instruments and whatever its particular designation". [307] These MEAs are the main source of international environmental law,[308] intended ultimately to "change state behavior to mitigate harmful environmental degradation".[309]

Common Characteristics of Multilateral Environmental Agreements

The first characteristic of MEAs is that the each agreement generally focuses on one specific international environmental issue. This characteristic is based on the notion that there is no 'one-size-fits-all' approach to solving international environmental issues.[310]

The second characteristic is that there are provisions in the MEAs to establish international institutions, including international organizations, which are "relatively stable sets of related constitutive, regulative, and procedural norms and rules that pertain to the international system, the actors in the system, and their activities".[311]

From the notion of no 'one-size-fits-all' approach to solving problems is derived the third characteristic of MEAs, namely that there are different regulatory approaches and these regulatory approaches can be broadly classified into three categories.

The first category of MEAs involves comprehensive regulation of a certain problem

[306] Christopher Greenwood (2008) supra note 290, pp. 2-3.

[307] VCLT (1969) Vienna Convention on the Law of Treaties (VCLT), Vienna, 23 May 1969, No. 18232, United Nations Treaty Series, Article 2(1)(a).

[308] Catherine Redgwell (2000) Multilateral environmental treaty-making. In: Multilateral treaty-making: the current status of challenges to and reforms needed in the international legislative process [V Gowland-Debbas (ed.)], Nijhoff Law Specials, Martinus Nijhoff, The Hague, The Netherlands, p. 89.

[309] Daniel Bodansky, Jutta Brunee and Ellen Hey (2007) International environmental law: mapping the field. In: The Oxford Handbook of Envrionmental Law [Daniel Bodansky, Jutta Brunee and Ellen Hey (eds.)], Oxford University Press, Oxford, UK, p. 8.

[310] S. Cumberlege (2009) Multilateral environmental regimes: from Montreal to Kyoto. A theoretical approach to an improved climate change regime, Denver Journal of International Law and Policy, Volume 37, p. 307.

[311] John S. Duffield (2007) What are International Institutions? International Studies Review, Volume 9, Issue 1 (May 2007), pp. 7-8.

area, e.g. UNCLOS, which establishes a broad code of obligations covering the whole spectrum of issue-areas associated with the ocean global commons. If there were new scientific knowledge, economic or political circumstances that require making changes to the treaty, parties to UNCLOS would have to agree either on wide-ranging amendments or on a new treaty.[312]

The second category of MEAs combines substantive obligations with some provisions to allow for dynamic adaptation of treaty obligations, e.g. International Convention for the Regulation of Whaling,[313] which attaches to the main text of the treaty a 'schedule' that could be amended with simplified amendment procedures.[314]

The fourth characteristic of MEAs, especially for the most frequently used category of MEAs, is its ability to evolve dynamically to changing circumstances, whether scientific or technological, economic or political.[315] International issues are already difficult to address via international law due to their political nature, but international environmental issues, including climate change, are more challenging as these issues evolve with the rapidly advancing scientific and technological knowledge about its nature, causes and effects. These issues become even more challenging as policy-makers are confounded by scientific uncertainties, and the interconnections between the natural and human systems further exacerbate the problem because human activities is now both part of the problem as well as part of the solution. Hence, it can be said that it is a common characteristic of MEAs to have the means to evolve the treaty provisions in order to address the relevant yet rapid changes due to new scientific or technological changes, economic or political circumstances.

1.3.2.1.3. General Principles of Law Recognized by Civilized Nations

General principles of law recognized by civilized nations are seldom mentioned in the judgments or opinions of the ICJ or international tribunals. They are most often employed where the ICJ or an international tribunal wants to adopt a legal concept. For instance, the legal personality of corporations, which is a widely accepted general principle in national legal systems, was cited in the Barcelona Traction Company

[312] Simone Schiele (2014) supra note 218, pp. 28-29.

[313] International Convention for the Regulation of Whaling (1946) United Nations Treaty Series, Volume 161, No. 2124, 2 December 1946.

[314] Thomas Gehring (2007) Treaty-making and treaty evolution. In: The Oxford Handbook of Envrionmental Law [Daniel Bodansky, Jutta Brunee and Ellen Hey (eds.)], Oxford University Press, Oxford, UK, p. 477.

[315] Simone Schiele (2014) supra note 218, pp. 31-32.

case.[316] But the ICJ or international tribunals seldom adopt in its entirety a legal concept from a particular national legal system. They usually search for a principle, which in one form or another, is recognized in a wide range of national legal systems.[317]

1.3.2.1.4. Judicial Decisions and Teachings of Most Highly Qualified Publicists

In contrast to the doctrine of binding precedence in the common law countries, there is no equivalent doctrine in international law. In fact, Article 59 of the Statute of the ICJ expressly states that a decision of the Court is not binding on anyone except the parties to the case in which that decision is given and even then only in respect of that particular case.[318] However, Article 38(1)(d) of the Statute of the ICJ refers to judicial decisions as a subsidiary means for the determination of the rules of law. In fact, ICJ does refer frequently to its own past decisions and most international tribunals make use of past cases as a guide to the content of international law. Hence, judicial decisions "as a subsidiary means" do not mean that they lack importance.[319]

Article 38(1)(d) also does not distinguish between decisions of the international and national courts. The international court decisions are generally considered the more authoritative evidence of international law on most topics (except those that are more commonly handled by national courts, e.g. law on sovereign immunity). However, judicial decisions of a State's court are part of the practice of that State, and these decisions can contribute to the formation of customary international law.[320]

The writings or commentaries of international lawyers may be a persuasive guide to the content of international law but these writings do not create law. There is also the danger of both lawyers and students taking an isolated passage from a law book or a legal article and assume without substantiating evidence that it accurately reflects the content of international law.[321]

1.3.2.1.5. Other Sources of International Law

The list of the four main sources of international law as specified in Article 38(1) of the

[316] *Barcelona Traction (Second Phase), Reports, 1970, p. 3.*
[317] Christopher Greenwood (2008) supra note 290, pp. 3-4.
[318] ICJ (2019) supra note 151, Article 59.
[319] Christopher Greenwood (2008) supra note 290, p. 4.
[320] Id., p. 4.
[321] Id., p. 4.

Statute of the ICJ is frequently criticized for being incomplete. In particular, it makes no mention of the decisions of the United Nations System. Today, there is little doubt of the importance of these decisions in shaping international law, although they do not fit neatly within the list of sources specified in Article 38(1).

First, although the United Nations General Assembly (UNGA) has no power to legislate for the international community and its resolutions are not legally binding, yet many of these resolutions have an important effect on the international law-making process. The positions that member-States take in the United Nations are part of their respective practices. Hence, a resolution or a series of resolutions that commands widespread acceptance and is regarded by the member-States as embodying a rule of international law can have an important effect on the development of customary international law, so long as it is not contradicted by what member-States actually do elsewhere. Some UNGA resolutions are part of the treaty negotiation and adoption process. One example is the inclusion of the resolution in the treaty text negotiated under the auspices of the United Nations and recommended to its member-States by the UNGA, e.g. Convention against Torture case.[322] While it is true that it is the treaty that creates the legal obligations and that the treaty provisions are binding only to the nation-States that choose to become parties to the treaty, the importance of the UNGA in the process of creating that treaty should not be underestimated.[323]

Second, the studies of international law produced by the International Law Commission (ILC) for the UNGA, especially if adopted by the General Assembly, may also have an important effect on customary international law, even if they are not turned into treaties, e.g. the ILC Articles on State Responsibility adopted in 2001.[324]

Third, the decisions taken by the Security Council under Chapter VII of the United Nations Charter and framed in mandatory terms are legally binding on all States according to Article 25 of the UN Charter.[325] Moreover, under Article 103 of the Charter the duty to carry out a decision of the Security Council prevails over obligations under all other international agreements. However, the Security Council does not create new laws but rather obligations in relation to specific issues and it is not a legislature.[326]

[322] Id., pp. 4-5.

[323] Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (1984), New York, 10 December 1984, No. 24841, United Nations Treaty Series, Volume 1465, p. 85.

[324] Christopher Greenwood (2008) supra note 290, p. 5.

[325] United Nations (1945) Charter of the United Nations, San Francisco, CA, USA, 26 June 1945, Article 25.

[326] Christopher Greenwood (2008) supra note 290, p. 5.

1.3.2.1.6. From the Perspective of Climate Change Governance

From the perspective of climate change governance, the major contribution to the law-making process has been international treaties negotiated under the auspices of the United Nations and initiated by the United Nations General Assembly via its resolutions.

These multilateral environmental agreements (MEAs) of the United Nations Framework Convention for Climate Change (UNFCCC),[327] Kyoto Protocol,[328] and Paris Agreement,[329] form the legal core of the international climate change regime, which is the current approach to climate change governance.

1.3.2.2. The New Haven School of International Law (Process Approach)

The New Haven School of sociological jurisprudence, pioneered by Myres S. McDougal and Harold D. Lasswell of Yale University, is a process approach, which is policy-oriented (international politics), to international law. Starting with the premise that law, both domestic and international, is carried out by human beings to serve human beings[330] in community processes.[331]

1.3.2.2.1. Teological Goals of the New Haven School Approach

The primary jurisprudential tasks of international law are the prescription and application of policies to achieve and maintain the best possible approximation to the social goals of the international community. Hence, the teological purpose of international law as a system is for the continuous development towards an optimum world public order of human dignity in the universe of human aspirations, which find expression in the shared values of power, wealth, enlightenment, respect, wellbeing, skill, rectitude, and affection (social goals).[332]

1.3.2.2.2. Decision-Making of the New Haven School Approach

[327] United Nations (1992a) supra note 16.

[328] United Nations (1998) supra note 17.

[329] United Nations (2015a) supra note 18.

[330] Myres S. McDougal, Harold D. Lasswell and Lung-Chu Chen (1980) Human Rights and World Public Order: The Basic Policies of an International Law of Human Dignity, Yale University Press, New Haven, CT, USA.

[331] Myres S. McDougal (1956) supra note 267, pp. 55-56.

[332] Id., p. 56.

The most important general question is: How does one identify the authoritative and controlling rules in any given community, whether local, national or international?[333]

More specifically, who in a given community prescribes what rules, with respect to what values, for whom, and by what procedures? Taking it one level down, the pertinent question becomes: who makes the recommendations to these authoritative prescribers, and upon what intelligence, and by what procedures? Once, these rules are prescribed, then the question becomes: who, and how may one invoke the application of what rules, with respect to whom, in what arenas? It would be followed by the corollary question: who, for the promotion of what policies, applies what prescriptions to whom, by what procedures? The final question of the whole process would be: who appraises the prescribed rules and abrogate them when they cease to serve the community purposes?

Other pertinent questions outside of the decision-making process itself would be:

(1) What are the factors of the environment and which are the pre-dispositions of the decision-makers that will affect the above-mentioned decisions?
(2) What is the impact of the community culture, class, personality, skill, affiliation, etc., upon the expectations of the decision-makers?
(3) Upon what expectations of improving what value propositions of what individuals and groups do decision-makers in what particular contexts choose between alternatives for action?

From the light of all these above-mentioned questions, even without knowing their answers, it should be clear that of primary concern is not the mere set of rules [rules of use] but with the whole process of decision-making taking place [action situation arena: interactions and outcomes] within the context of, and as a response to, a larger community process [broader social, economic, and political settings].[334]

The easiest way for the international law research student to understand this conception of international law and politics is to think of it as a process of decision-making within the larger context of a international community process; the context that provide the issues to which the decisions made are the responses, the context that conditions the decisions made, and the context that receives the impact of the decisions made.[335]

[333] Id., pp. 55-56.
[334] See Section 1.2.4.
[335] Myres S. McDougal (1956) supra note 267, p. 56.

1.3.2.2.3. Cultural Anthropology-Based Analytical Framework

The New Haven School defines the general conception of law as that "of the process of decision in which authority is conjoined with effective control, in which decisions [rules of use] are both authoritative and controlling."[336] The essential aspect of this conception is the explicit focus on patterns of both authority and control [design principles]. Hence, international law reflects the expectations of the international community about stable patterns of state behavior, which are created through the assertions of control by legal authorities in the nation-States.

In general, the community process is of individual actors [users] interacting in many particular communities, of varying degrees of comprehensiveness, from local through regional to national and international [resource system and unit]. The individuals interact in these communities in both organized and unorganized forms [governance system].[337] The actors [users] in any decision process include those formally endowed with decision competence, such as actors endowed with formal legislative, judicial, executive and administrative functions, and all those other actors, though not endowed with formal competence, may nevertheless play important roles in influencing decision outcomes. In the international community, the actors are those from state agencies, international governmental organizations, non-governmental organizations, pressure groups, interest groups, business associations, corporations, and individuals, who act on behalf of other actors and on their own.[338]

Besides the inventory of the relevant actors in a particular community process, of equal importance are the perspectives of these actors. "These perspectives include their specific patterns of identification and disidentification, their matter-of-fact expectations of past and future, and the value demands they project." Hence, in the highly complex arena of international politics, the perspectives of the various actors in decision-making often diverge greatly in critical ways.[339]

Situation [action situation arena] refers generally to 'where' decisions are made and the distinctive properties of that 'where'. Conventional legal analysis generally looks primarily at the courts, and secondarily at the executive branches and legislatures. The

[336] W. Michael Reisman, Siegfried Wiessner and Andrew R. Willard (2007) supra note 80, p. 576.
[337] See Section 1.2.4.
[338] Myres S. McDougal (1956) supra note 267, p. 56.
[339] W. Michael Reisman, Siegfried Wiessner and Andrew R. Willard (2007) supra note 80, p. 578.

New Haven School, however, adopts a more functional approach and focuses on the situation arena in which decisions are actually taken, which ranges from centralization to decentralization, with varying degrees of organization and formality, extents of specialization, and with decisions ranging from continuous to episodic.[340]

The resources, which the actors draw upon, is termed as the "bases of power" [resource unit and resource system], which incorporate both effective power and symbols of authority. The ways in which these resources are manipulated or the strategies used by the different actors to manage these resources are aimed at optimizing preferred outcomes. The strategic modes or practices deployed include diplomatic (agreements), propagandistic (mass communications), economic (exchange of goods and services), and military (deployment of armed forces), and the different combinations of these practices [interactions], to effect from maximum persuasion to maximum coercion in order to achieve the desired outcomes [outcomes] of particular interactions.[341]

The New Haven School places the decision-making process in the illuminating light of both environmental and predispositional conditioning factors [context]; it appraises decision trends for their compatibility [evaluative criteria] with the ultimate purpose of an optimum world public order of human dignity in the universe of human aspirations, which find expression in the shared values of power, wealth, enlightenment, respect, wellbeing, skill, rectitude, and affection (social goals); it also provides the conceptual tools [framework] for inventing alternative decisions, constitutive arrangements, and courses of action under the guiding light of such a preferred future world public order, and it appraises the alternative future decisions and their consequences.[342]

The authorities of community processes designated under "the headings of intelligence-serving, recommending, prescribing, invoking, applying, appraising, and terminating are more conventionally described as legislative, judicial, executive, and administrative" functions [governance system].[343] These decisions that are taken in accordance with the expectations and processes of community authorities are distinct from other community decisions [rules of use]. When these decisions are taken such that severe deprivations, or threats of such deprivations, are marshalled (with control) to support demands or choices without due regard for authoritative community prescription (without

[340] W. Michael Reisman (1992) The View from the New Haven School of International Law, Proceedings of the Annual Meeting (American Society of International Law), Volume 86 (April 1992), p. 122.

[341] W. Michael Reisman, Siegfried Wiessner and Andrew R. Willard (2007) supra note 80, p. 578.

[342] Myres S. McDougal (1956) supra note 267, p. 56.

[343] Id., p. 57.

authority), such decisions are not law but naked power or unlawful coercion. On the other hand, when effective power is not at the disposal of authority (without control), and expectation of decision in accordance with community prescription lacks realism [without context], such authority (with authority) is also not law but illusion.[344]

1.3.2.2.4. From the Perspective of Climate Change Governance

From the perspective of climate change governance, one of the two main contributions from the New Haven School, together with the SES approach, is the process-oriented analytical framework. The other contribution is of the more general theory of the nature of the archetypal man with bounded rationality, which it shares with both the SES and the Commission on Global Governance approaches. In addition, both the New Haven School and the Commission on Global Governance approaches have the notion of the continuous development towards a social goal.

Equivalent Process Approaches with Equivalent Analytical Frameworks

Both process approaches have the same equivalent elements in their analytical frameworks [The elements from the SES analytical framework are expressed in square brackets next to the equivalent elements of the analytical framework of the New Haven School in the above-mentioned section.]

First, at the core of both analytical frameworks is the 'action situation arena', which refers to the social space where actors with diverse preferences or perspectives interact in the form of diplomatic (agreements), propagandistic (mass communications), economic (exchange of goods and services), or military (deployment of armed forces) strategies, or different combinations of these strategies to effect from maximum persuasion to maximum coercion in order to achieve the desired particular outcomes.

Second, the actors in both frameworks in coping with the social dilemma draw on the "bases of power" or resource units from the resource system, which incorporate both effective power and symbols of authority, to make decisions or rules of use that are both authoritative and controlling. Decisions or rules of use that are both authoritative and controlling are equivalent to the 'design principles' or broader institutional regularities that have been empirically identified in CPR systems that had been able to sustain over

[344] Id., pp. 57-58.

long periods but were not found in the failed CPR systems.[345]

Third, in the New Haven School framework, the authorities for the seven community processes of intelligence serving, recommending, prescribing, invoking, applying, appraising, and terminating are more conventionally described as the legislative, judicial, executive, and administrative functions of the community governance system. In the SES framework, the equivalent functions are rules making, conflict resolution, sanctions application, and monitoring and verification.

Fourth, in both frameworks, the interactions in the 'action situation arena' are affected by and affect exogenous variables of the biophysical ecosystem as well as the social, economic, and political settings.

The ISPO general analytical framework used to understand, explain and solve the climate change problem in this thesis is a combination of the key elements of the SES and the New Haven School analytical frameworks.

Equivalence in the Nature of the Archetypal Man

Besides the equivalence in the constitutive elements of their analytical frameworks, both the Ostrom's SES and McDougal and Lasswell's New Haven School approaches, together with the Commission on Global Governance approach, are based on a more general theory of the nature of archetypal man with bounded rationality, who is a complex, fallible learner, who seeks to do as well as he can given the constraints that he faces and who is able to learn heuristics, norms, rules and how to design rules to improve outcomes.[346]

The nature of the archetypal man operating in the New Haven School framework has the propensity for continuous development, which is equivalent to that of the SES framework of the capacity to increase learning and understanding of information in repeated situations when reliable feedback is available. The eight shared values of the New Haven School framework is also equivalent to the preferences that not only benefits his own self but also preferences for moral norms and rules that benefit others of the SES framework. The ability of the archetypal man to use heuristics in making daily decisions in the SES framework is not directly mentioned in the New Haven

[345] See Section 1.2.3.3.

[346] See Section 1.2.4.2.

School framework. However, the ability of the archetypal man with diverse preferences or perspectives in the New Haven School framework to interact in the form of diplomatic, propagandistic, economic, or military strategies, or different combinations of these strategies to effect from maximum persuasion to maximum coercion in order to achieve the desired particular outcomes would imply that such an archetypal man would have the ability to use heuristics.

All three approaches are predicated on the nature of the archetypal man being one with the moral capacity to make ethical choices for the long term and capabilities to change exogenous variables of social dilemmas and avoid the tragedy of the commons is of utmost importance. Otherwise, the quest to find a viable solution to the climate change problem is doomed from the onset, and humankind should do nothing except to await its fate for the completely rational man will inevitably fall into the social trap of the tragedy of the commons. Hardin himself called for a "fundamental extension of morality",[347] to solve the tragedy of the commons. Hulme similarly called for humankind to recasting its individual aspirations and collective social goals in the light of systemic climate change,[348] and Gardner and many others have described "climate change as fundamentally an ethical issue."[349]

Social Goal of the New Haven Approach

There is the specified teological intent of continuous development towards an optimum world public order of human dignity in the universe of human aspirations, which find expression in the shared values of power, wealth, enlightenment, respect, wellbeing, skill, rectitude, and affection (social goals)[350] in the New Haven School approach. The process approach recommended by the Commission on Global Governance also has the specified teological intent of continuous development towards an ideal state of global governance, which comprised of sixteen endpoints or social goals.[351] From the perspective of climate change governance, the teleological intent is of great importance for the effectiveness of current and future approaches to solving the climate change problem will be assessed based on the ultimate objective of "stabilization of greenhouse

[347] Garrett Hardin (1968) supra note 91, p. 1243.

[348] Mike Hulme (2009) Why We Disagree About Climate Change, Cambridge University Press, Cambridge, p. xxviii.

[349] Stephen M. Gardiner (2004) Ethics and Global Climate Change, Ethics, Volume 114, Number 3 (April 2004), pp. 555-600.

[350] Myres S. McDougal (1956) supra note 267, p. 56.

[351] Commission on Global Governance (1995) supra note 79, pp. 4-6.

gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system."[352]

1.3.2.3. Chicago School of Law and Economics (Problem Solving Theory)

The Chicago School of law and economics jurisprudence, which was greatly influenced by the Chicago School of Economics with its neoliberal ideology, was not in the first place a school of thought on international law.

However, the Chicago Law School's emphasis on economic cost-benefit analysis of social costs, together with neoliberalism, had a big impact on the domestic politics of the US in the 1980s under the Reagan administration and as a consequent a large significant influence on the evolution of international climate change governance during the international diplomatic negotiations of the Kyoto Protocol and its aftermath, especially in the introduction of market-based mechanisms by the US delegation into the provisions of the Kyoto Protocol.[353]

It was the first time in the history of MEAs that there was provision in an international environmental agreement for a market mechanism as the measure for bargaining among the developed and developing countries to find the optimal least-cost pathway to solving a global common problem.[354] The conventional approach as demonstrated by the governance of the ocean global commons has been to rely on the exclusion of the global commons with the 'state' using the provisions available in international law to 'privatize' part of the ocean global commons for themselves.[355]

1.3.2.3.1. Coase Theorem

The cornerstone of the study of law and economics at the Chicago Law School is the Coase Theorem, based on the article, entitled "The Problem of Social Cost", of Ronald

[352] United Nations (1992a) supra note 16, Article 2.

[353] Article 2 (1) (a) of the Kyoto Protocol recommends the use of market instruments. The rationale advanced by the proponents of the flexible mechanisms of international transfer was that as the geographical location of climate change abatement is largely irrelevant, it is perfectly acceptable from a cost-effectiveness perspective to carry out the mitigation project where it is the cheapest option regardless of location. If the location happened to be in a developing country there is also the additional benefit of fund transfer and possibly technology transfer as well.

[354] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) Principles of International Environmental Law, 4th Edition, Cambridge University Press, Cambridge, p. 310.

[355] See Section 3.1.2.

Coase, a Nobel laureate in the Economic Sciences, in the Journal of Law and Economics, edited and published by the Chicago Law School.[356]

Ronald Coase did not intend in his article to set forth any particular theorem. It was George Stigler who first called it a 'theorem', when he summarized the resolution of the externality problem in the absence of transaction costs in a 1966 economics textbook in terms of private and social cost.[357] What Coase did intend was to show that the modern economic analysis and policy considerations of the problem based on Pigou's "Economics of Welfare"[358] were incorrect, particularly the section of Part II, which deals with divergences between private and social costs that come about because "one person A, in the course of rendering some service, for which payment is made, to a second person B, incidentally also renders services or disservices to other persons (not producers of like services), of such a sort that payment cannot be exacted from the benefited parties or compensation enforced on behalf of the injured parties."[359] The Pigou tradition approach in such a situation is to ask how should one restrain person A? Coase pointed out that the real question to ask is: "should A be allowed to harm B or should B be allowed to harm A? The problem is to avoid the more serious harm."[360] In other words, the externalities involving more than a single party engaged in conflicting activities must be treated as a reciprocal problem.

The Coase Theorem then states that under conditions of perfect competition and no transaction costs, the private and social costs are the same. It can be applied to situations where the activities of one business damage the property of another business. Although "it is necessary to know whether the damaging business is liable or not for damage caused since without the establishment of this initial delimitation of rights there can be no market transactions to transfer and recombine them. But the ultimate result (which maximizes the value of production) is independent of the legal position if the pricing system is assumed to work without cost."[361]

In other words, it means that an efficient set of inputs and outputs to and from

[356] R. H. Coase (1960) The Problem of Social Cost, Journal of Law and Economics, Volume III (October 1960), pp. 1-44.

[357] Robin I. Mordfin and Marsha Ferziger Nagorsky (2011) Chicago and Law and Economics: A History, 11 October 2011, Chicago Law School, University of Chicago, Chicago, IL, USA. Accessed on 11 August 2019 at: https://www.law.uchicago.edu/news/chicago-and-law-and-economics-history

[358] A. C. Pigou (1932) The Economics of Welfare, 4th Edition, MacMillan & Co. Ltd., London, UK.

[359] R. H. Coase (1960) supra note 356, p. 2.

[360] A. C. Pigou (1932) supra note 358, p. 183.

[361] R. H. Coase (1960) supra note 356, p. 8.

production-optimal distribution will be selected by the two businesses regardless of how property rights are divided as long as property rights are delimited so that market transaction through negotiation can occur. In the negotiation process, funds may either be offered to compensate the damaged business for the damaging business's activities or for the business vulnerable to damage to pay the business whose activities will inflict the damages to forgo those activities. Hence, the Coase Theorem offers another way to resolve the commons problem. However, the application of the Coase Theorem to solve the commons problem requires the strict conditions of efficient, competitive markets, and, most importantly, zero transactions costs.

1.3.2.3.2. Necessary Conditions for the Coase Theorem

However, Coase himself admitted in his article that "[t]his is, of course, a very unrealistic assumption. In order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on. These operations are often extremely costly, sufficiently costly at any rate to prevent many transactions that would be carried out in a world in which the pricing system worked without cost."[362]

Coase suggested in his article that if the market transactions costs were too high for negotiation to occur, an alternative form of economic organization is to use the firm instead of the market.[363] The establishment of international organizations and other international institutional arrangements by the Parties of a MEA is reminiscence of the 'firm' in Coase's approach to law and economics jurisprudence.

Coase also acknowledged in the article that the firm is not the only alternative approach. He also suggested that especially if the administrative costs of the firm are high, the other alternative is direct State regulation, which, in a sense, is a "super-firm" because it is able to influence the use of factors of production by administrative decision" and it has "at its disposal the police and the other law enforcement agencies to make sure that its regulations are carried out."[364] Obviously, in the case of MEAs, the provisions for

[362] Id., p. 15.

[363] R. H. Coase (1937) The Nature of the Firm, Economica, Volume 4, Issue 16 (November 1937), pp. 386-405.

[364] R. H. Coase (1960) supra note 356, p. 17.

enforcement and sanctions are weak or non-existent.[365]

Coase is not against legislative or regulatory preemption of conflicts over property rights and privately negotiated settlements *per se*, he is advocating that "the opportunity cost concept" be used "to approach these problems by comparing the value of the product yielded by factors in alternative uses or by alternative arrangements"[366] and that "in devising and choosing between social arrangements we should have regard for the total effect."[367]

In summary, the Coase Theorem states that when dealing with an externality, the same efficient outcome can be reached without any government intervention as long as the following conditions must hold true, namely:

(1) The property rights among the Parties involved must be clearly defined.
(2) The externality or spillover effects must be bilateral.
(3) There must be little to no transactions costs in the market transaction.
(4) There must be only a few Parties involved or the transactions costs will be too high.
(5) There must be no wealth effects, which means the efficient solution will be the same, regardless of who gets the initial property rights.

In the cases investigated by Coase all these conditions hold true. In the case of the climate global commons, the property rights among the nation-States are not defined. The externality of GHG emissions is not bilateral. There are high transactions costs. The Parties involved include the whole international community of more than 193 sovereign nation-States. There are wealth effects. Thus the Coase Theorem in general does not apply to the governance of the climate change problem.

1.3.2.3.3. Application of the Coase Theorem

Some scholars of law and economics have understood the Coase Theorem to mean that markets would achieve efficient results when the transactions costs are brought close to zero. Coase's point was that, because transactions costs in reality cannot be brought to zero, one must not assume that an institutional arrangement will necessarily be efficient.

[365] David G. Victor (2000) Enforcing International Law: Implications for an Effective Global Warming Regime, Duke Environmental Law and Policy forum, Volume 10, p. 147.

[366] R. H. Coase (1960) supra note 356, p. 40.

[367] Id., p. 44.

It is important to always compare the alternative institutional arrangements to see which would come closest to the unattainable ideal of zero transaction costs.[368] Recognizing that the necessary conditions virtually do not apply to real world situations, some scholars have inverted the theorem: "Because transaction costs are positive, the initial allocation of entitlements can matter to efficiency."[369] Viewed in its inverted form, it has served as an explanation for why so many apparently inefficient outcomes to economic disputes are found in the real world. Meanwhile, other scholars have used the inverted theorem to argue that because transactions costs are never zero, it is therefore appropriate for a government to intervene and regulate.

The Chicago School of Law and Economics as an academic department itself has also been criticized. For instance, behavioral economics scholars have challenged the fundamental assumption of the school that humans are rational self-interest maximizers. Instead, they argue that certain decision heuristics and biases prevent people from being the ideal decision makers the Chicago school assumes them to be. For instance, Richard Thaler had conducted game-theoretical experiments to demonstrate that people were more likely to be concerned with ensuring fairness in negotiations when negotiating over their own tangible property rather than in an abstract sense. This suggests that in practice, people would not be willing to accept the efficient outcomes prescribed by the Coasean bargaining if they deem them to be unfair.[370] Others have argued that the Chicago school's goal of efficiency is achieved at the cost of justice and equality.[371]

1.3.2.3.4. From the Perspective of Climate Change Governance

First, of relevance to solving the climate change problem, is the insight that Pigouvian taxation is not the only way to internalize an externality. Market and contractual institutions should also be considered, as well as corrective subsidies. Another useful insight is that when transaction costs are minimized or nonexistent, the legal appropriation of liability diminishes in importance or disappears completely. In other words, parties involved in the conflict can arrive at an economically efficient solution

[368] Id., p. 15.

[369] Lee Anne Fennell and Richard H. McAdams (2017) Inverted Theories, Public Law and Legal Theory Working Papers, Chicago Unbound, 11 August 2017, Chicago Law School, Chicago, IL, USA, p. 1-2.

[370] Richard H. Thaler (2015) Misbehaving: the making of behavioral economics, W. W. Norton & Company, New York, NY, USA.

[371] George Monbiot (2016) Neoliberalism – the ideology at the root of all our problems, The Guardian, 15 April 2016. Accessed on 11 August 2019 at: https://www.theguardian.com/books/2016/apr/15/neoliberalism-ideology-problem-george-monbiot

that may ignore the legal framework in place.

Second, while it is often claimed that Coasean bargaining is an alternative to Pigouvian taxation, it has also been argued that in a hold-up situation Coasean bargaining may actually justify a Pigouvian tax.[372]

Mainly through the advocacy of the US delegation with its strong neoliberal logic to use the free competitive market to internalize an externality, provisions for the use of flexible market-based mechanisms were introduced into the 1997 Kyoto Protocol to enable Annex I countries to meet their commitments under the Protocol by purchasing or acquiring credits representing GHG emissions reduction that had or are taking place in other countries.[373] The rationale advanced by proponents of the flexible mechanisms of international transfer was that the geographical location of climate change abatement is largely irrelevant as it is perfectly acceptable from a cost-effectiveness perspective to carry out the mitigation project where it is the cheapest option regardless of location.[374] If the location happened to be in a developing country there is also the additional benefit of fund transfer and possibly technology transfer as well.

The three flexible market-based mechanisms provided for in the Kyoto Protocol were (1) Joint Implementation [JI], (2) Emissions Trading System [ETS], and (3) Clean Development Mechanism [CDM].[375] However, the provision of these market-based mechanisms was partly responsible for the failure of the Kyoto Protocol.

First, policymakers might make it easier to comply with the Kyoto Protocol emissions reduction targets by creating accounting systems to allow their respective countries to take credit for 'sinks' that remove carbon dioxide, the most important GHG, from the atmosphere. Hence, although the developed countries in Annex 1 accepted the GHG emissions reduction targets yet they were hoping to make the targets less onerous through clever 'sink' accounting systems. The more credits awarded for the carbon dioxide that plants and trees are already absorbing, the easier it is for nations then to comply with the Kyoto Protocol targets without actually changing behavior.[376]

[372] Stephanie Rosenkranz and Patrick W. Schmidt (2007) Can Coasean Bargaining Justify Pigouian Taxation, Economica, Volume 74, Issue 296, pp. 573-585.

[373] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth Mackenzie (2018) supra note 354, p. 310.

[374] Farhana Yamin and Joanna Depledge (2004) The International Climate Change Regime: A Guide to Rules, Institutions and Procedures, Cambridge University Press, Cambridge, p. 136.

[375] See Section 4.2.2.4.

[376] David G. Victor (2001) The Collapse of the Kyoto Protocol and the Struggle to Slow Global

Second, through both JI and CDM, the polluters in the developed countries of the global North were hoping to buy themselves out of GHG emissions reduction efforts in their own countries by investing in GHG emissions reduction projects in the developing countries of the global South. It, however, raised strong opposition from several quarters as it smacked of the buying of indulgences by the rich and powerful corporations from the global North for the privilege to continue polluting by supporting questionable projects in the global South, which are often carried out at the expense of the interests of the local communities.[377] Not only does it violate the critical success factor of fair burden sharing by all,[378] it also does not result in behavioural change for both the developed and developing countries. Besides, putting the CDM into international practice proved to be very slow and inefficient,[379] which significantly increased transaction costs and militate against the intent of the Coase theorem.

Third, through the ETS the developed countries had hoped to reduce the cost of full compliance. But creating an ETS requires creating emission permits worth hundreds of billions of dollars gave governments strong financial incentives to game the system. Meanwhile, the difficult-to-measure sinks undermine public confidence in the value of those emission permits.[380]

More importantly, the introduction of the three flexible market-based mechanisms with their neoliberal logic only serve to consolidate the status quo of the current economic system, which is highly dependent on fossil fuels, and to foster a business-as-usual attitude that had retarded the momentum in seeking a fundamental re-construction of the ways of life and the means of production that is needed in the long term to solve the climate change problem. For instance, the use of a market-based mechanism in the form of a carbon offsetting reduction scheme for international aviation (CORSIA) has been adopted for ICAO to achieve a collective medium term global aspirational goal of keeping the global net carbon emissions from international aviation at the same level from its 2020 baseline. This global market-based mechanism is intended to be the major contributor in the basket of measures to achieve carbon-neutral growth.[381]

Warming, Princeton University Press, Princeton, NJ, USA, p. 8.

[377] Geoffrey Heal (2007) Endangered Economies: How Neglect of Nature Threatens Our Prosperity, Columbia Univeristy Press, New York, NY, USA, p. 74.

[378] See Section 4.1.3.

[379] David G. Victor (2001) supra note 376, p. 10.

[380] Id., p. 10.

[381] ICAO (2016) Resolution A39-03, Resolutions Adopted by the Assembly, 39th Assembly, Montreal, 27 September – 6 October 2016, Provisional Edition, October 2016, ICAO, pp. 25-32.

The real failure of the Kyoto Protocol is not that it failed in even its minimal effort at reducing global GHG emissions; the real failure is that the Protocol "has subjected the world to an ineffective path-dependent model for solving the climate change problem." It had extracted a very high opportunity cost in terms of time wasted, and time is not in humankind's favor when it comes to preventing catastrophic climate disruptions.[382]

1.3.2.4. Critical Legal Studies (Critical Theory)

The Critical Legal Studies (CLS) movement started by Roberto Unger[383] and Duncan Kennedy[384] of Harvard Law School was antithetical to the problem solving Chicago school of law and economics. Although both the Chicago school and the CLS movement shared a critical view of modern liberalism, their diagnoses of what was defective in the state and the social order in which it was embedded were very different. Although the CLS movement is not a single, monolithic body of legal thought, several common critiques of defects of law are discernible in its adherents' works.

1.3.2.4.1. Common Themes in Critical Legal Studies

First, the CLS movement contends that legal materials do not completely determine the outcome of legal disputes. It takes a more extreme position as compared to the classical stance of 'relative indeterminacy' for some difficult but marginal legal cases there might not be one correct understanding, "rule-making authority must exercise a discretion".[385] Although law may impose many significant constraints on the adjudicators in the form of substantive rules, yet in the final outcome, it is often not enough to bind the adjudicators to a particular decision in a given particular case. This debate on the

[382] Amanda M. Rosen (2015) The Wrong Solution at the Right Time: The Failure of the Kyoto Protocol on Climate Change, Politics and Policy, Volume 43, Number 1, p. 32.

[383] Roberto Mangabeira Unger (born 1947) is a philosopher and politician, who is professor at Harvard Law School. Together with Morton Horwitz and Duncan Kennedy of Harvard Law School, and Mark Tushnet of the University of Wisconsin-Madision, they were the founding members of the Critical Legal Studies movement. Extracted from G. Edward White (1986) From Realism to Critical Legal Studies: A Truncated Intellectual History, Southwestern Law Journal, Volume 40, pp. 819-843.

[384] Duncan Kennedy (born 1942) is the Carter Professor of General Jurisprudence (Emeritus) at Harvard Law School. Together with Morton Horwitz and Roberto Unger of Harvard Law School, and Mark Tushnet of the University of Wisconsin-Madision, they were the founding members of the Critical Legal Studies movement. Extracted from G. Edward White (1986) From Realism to Critical Legal Studies: A Truncated Intellectual History, Southwestern Law Journal, Volume 40, pp. 819-843.

[385] H.L.A. Hart (1961) The Concept of Law, Clarendon Press, Oxford, UK, p. 128.

indeterminacy in law has continued to rage to this day.[386] The indeterminacy in international law is discussed in the following Section 1.3.3.4.2.

Second, there is the notion in the CLS tradition that law is politics by other means. This means that legal decisions are a form of political decision although it is possible to tell judicial and legislative acts apart.[387] "It is clear that there can never be a complete separation between law and politics."[388] An analogy of the relationship between law and politics is that between Christianity in particular and religion in general. Traditionally, CLS argues that while the form of Christianity may differ from the forms of other specific religions, they all occupy the same social space of religion in general. This argument essentially rejects the positivist notion that law and politics can be entirely separated into two different spheres of knowledge and practice.[389] However, the more recent trend is to reject the complete reductivism that law is all politics. Instead the CLS movement now asserts that the two disciplines are mutually intertwined. There is no 'pure' law or 'pure' politics. The two forms are complementary. They constantly shift from one to the other depending on the context or environment. The modern analogy of the relationship between law and politics is the modern concept of the complementary nature of the electron, which may manifest properties associated with its wave-like nature or particle-like nature depending on its interaction with the environment. Meanwhile, in this chapter, the insights on critical success factors and limitations in the evolution of the international climate change regime are mainly with reference to both international law and international politics.

Third, the CLS movement suspects that the law tends to serve the interests of the rich and powerful by protecting them against the demands for greater justice by the poor and the lowly. This claim is often coupled with the legal realist argument that what the law says it does and what it does are two different things. Many legal rules claim to have the objective of protecting the interests of the poor and the lowly. However, on closer examination, the rules often serve the interests of the power elites.[390] In the case of the international community, it would be the developed countries of the North, with its highly developed markets, advance technology, and participatory democracy. However, more importantly, since there is nothing intrinsic in the concept of law that makes it

[386] Jan M. Broekman and Larry Catà Backer (2013) Lawyers Making Meaning: The Semiotics of Law in Legal Education II, Springer, Dordrecht, Germany, p. 123.

[387] Id., p. 123.

[388] Malcolm N. Shaw (2008) supra note 288, p. 11.

[389] Martti Koskenniemi (2011a) The Politics of International Law, Hart Publishing Ltd, Oxford, UK, p. v.

[390] Jan M. Broekman and Larry Catà Backer (2013) supra note 386, p. 124.

specifically an instrument of social injustice, it can be changed into an instrument for justice and equality for both domestic law and international law.

Fourth, the CLS movement questions the Kantian notion of the autonomous individual, which is one of law's central assumptions. A human being is identified as belonging to a certain nation-State, community, class, gender, race, religion, and other social and political conditions of life. He perceives the world through these abstract categories, beliefs and assumptions associated with his identity. He, consciously or unconsciously, makes facts amenable to ideas, and ideas to facts, to support a convincing and coherent image of the world. Hence, the social and political conditions constraint his thoughts and actions, and he cannot rightly be considered an autonomous individual.[391] It fits in well with the concept of a more general nature of the archetypal man of the ISPO approach, which has been developed as the general analytical framework in this thesis.

Similar to the integrated socio-ecological system (SES) approach,[392] the process approach of global governance by the Commission on Global Governance,[393] and the New Haven School of social jurisprudence,[394] the critiques of the CLS movement are the critical issues confronting international law and international politics today, namely:

(1) International law and international politics are mutually intertwined
(2) Indeterminacy of international law due to flight from international politics
(3) Power relations in international law and international politics
(4) North-South economic divide

1.3.2.4.2. Indeterminacy in International Law

In the specific case of indeterminacy in international law, the Finnish jurist and former diplomat Martti Koskenniemi claims in "From Apology to Utopia"[395] that international lawyers in practice have difficulties to apply the provisions of international law to legal cases not because of indeterminacy with "how decisions are made", which is the stance of the CLS movement, owing to semantic ambiguities of legal rules or ambivalences of

[391] Allan C. Hutchinson and Patrick J. Monahan (1984) Law, Politics, and the Critical Legal Scholars: The Unfolding Drama of American Legal Thought, Stanford Law Review, Volume 36, Number 1/2, Critical Legal Studies Symposium (January 1984), pp. 213-215.

[392] Elinor Ostrom (2009) supra note 51.

[393] Commission on Global Governance (1995) supra note 79, pp. 2-7.

[394] W. Michael Reisman, Siegfried Wiessner and Andrew R. Willard (2007) supra note 80.

[395] Martti Koskenniemi (2005) supra note 295, pp. 598-599.

legal argument or even inconsistencies in legal interpretations; the difficulties arise from "how they are justified in argument".[396] According to Koskenniemi, it is the structure of the legal argument in the international system,[397] the descending and ascending patterns of justification in the interpretation and argumentative procedures accompanying it,[398] and the language or grammar used in the international legal argument that make the outcome of the international legal argument indeterminate.

In fact, the main reason for this difficulty with argumentation lies in the very identity of international law itself. In an international system in which the units are assumed to serve no higher purpose than their own interests and "which assumes the perfect equality of those interests," the Rule of Law seems the only principle of organization other than *bellium omnium contra omnes*.[399] However, "the fight for an international Rule of Law is a fight against politics," which is understood to stand for the furthering of subjective desires, passions and prejudices that would only lead to international anarchy.[400] Although politics is unavoidable in such an anarchical international system it should, however, be constrained by non-political rules: "... the health of the political realm is maintained by conscientious objection to the political."[401]

First, the identity of international law is kept distinct from the descriptions of international politics by "assuming that it tells people what to do and does not just describe what they do [normative]." Second, by "assuming it is less dependent on subjective beliefs about what the order among States should be like [concrete]". To prevent international law from losing its distinctiveness from international politics, the international lawyer has to ensure normativity by creating distance between it and State behavior/interest and to ensure concreteness by distancing it from a natural morality.[402]

These two distinctive characteristics of "objectivity" in the identity of international law, however, have not been and cannot be simultaneously maintained. It is "constantly lapsing either into what seems like factual description [non-normative] or political

[396] Id., p. 58.

[397] Id., pp. 59-60.

[398] Id., pp. 563-589.

[399] *Bellum omnium contra omnes* is a Latin phrase meaning "the war of all against all". Thomas Hobbes used this description to depict human existence in the state of nature in his thought experiment that he conducted in the Leviathan (1651).

[400] Martti Koskenniemi (2011a) supra note 389, pp. 35-38.

[401] Martin Wright (1966) Western Values in International Relations. In: Diplomatic Investigations: Essays in the Theory of International Politics [Herbert Butterfield (ed.)], Allen and Unwin, London, UK, p. 122.

[402] Martti Koskenniemi (2005) supra note 295, pp. 16-17.

prescription [non-concrete].”[403] First, a descending argument assumes that international law is “external to State behavior, will or interest”, and that its “objectivity lies in its normativity” and thus in “its capacity to constraint”. Second, an ascending argument supposes that international law reflects the “subjectivity of value” and that its impartiality lies in its “acceptance” by the State as a “sovereign choice” that cannot be overruled. This conundrum forces the international legal system to maintain itself “in constant movement from emphasizing concreteness to emphasizing normativity and vice-versa without being able to establish itself permanently in either position”[404]

International law is always vulnerable to critics of apology as it can readily be “invoked to justify any behaviour”. It is also always exposed to critics of utopia since it is somehow “incapable of providing a convincing argument of the legitimacy of any practices”[405] To escape being apologist, the only solution is to demonstrate that international law binds the State notwithstanding its own will, interests or the changing circumstances within which a State might find itself. To escape being utopian, the only solution is to lay down how international law corresponds to State actual practice, and why it is consequently binding for the State. In the final analysis, “[n]either concreteness nor normativity can be consistently preferred”[406]

1.3.2.4.3. From the Perspective of Climate Change Governance

From the perspective of climate change governance, the notion in the CLS tradition that law and politics are complementary is of the utmost importance. In assessing the successes and limitations in the evolution of climate change governance thus far, the view constantly shifts from one to the other depending on the context of the specific issue. Therefore, Chapter 4 discusses both successes and limitations of climate change governance from the standpoint of both international law and international politics.

1.3.3. International Politics Approach to Global Commons Governance

There are a diverse set of theoretical approaches that an international law research student can draw on to analyze the international politics of global commons governance. International Politics or Relations (IR) as a distinct academic discipline commenced

[403] Id., p. 16.
[404] Id., pp. 63-65.
[405] Id., p. 67.
[406] Id., p. 66.

soon after the First World War. It was the advent of the First World War, which brutally exposed the failure of classical international law to prevent open conflict among the Western nation-States that opened the way for the ascendancy of IR theories to explain the two World Wars, which happened in quick succession, in the first half, and the subsequent Cold War period in the second half of the 20th century. Hence, the main preoccupation of international relations, in general, was with the problems of war and peace, and the assurance of national security for the sovereign nation-States in the anarchical international system.[407]

The dominant IR theory during this period was Realism. The realists expect to find the perennial presence of conflict as the usual pattern of interaction in international politics due to the struggle for power over others that underlie human nature (and therefore all collective action) and advocate reliance on the balance of power to break out of the Hobbesian *bellum omnium contra omnes* or "the war of all against all".[408] Environmental issues, perceived as the international management of common pool resources or public goods, or the disputes of transboundary pollution, were of minor interest before the 1970s, as it was considered 'low' politics as compared to the 'high' politics of war, peace and statecraft.[409]

However, perception of the minor importance of environmental issues in international relations began to change around the time when the United Nations Conference on the Human Environment (UNCHE), was convened in Stockholm, Sweden, in 5-16 June 1972, which was initiated by the United Nations General Assembly (UNGA) via its Resolution 2398 (XXIII) dated 3 December 1968.[410]

Twenty years later, with the end of the Cold War, epitomized by the fall of the Berlin War and the collapse of the Soviet Union, and the continuing success of the strategic nuclear arms control agreements between the US and the Russian Federation (successor to the Soviet Union), there was a rethink in national security[411] and the focus turned to other public policy issues, including the environmental problem of climate change,

[407] John Vogler (2015) Mainstream theories: Realsim, rationalism and revolutionism. In: Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, UK, p. 30.

[408] See supra note 399.

[409] John Vogler (2015) supra note 407, p. 31.

[410] UNGA (1968) Problems with the human environment, Resolution A/RES/2398(XXIII), 1733rd Plenary Meeting, 3 December 1968. Accessed on 11 August 2019 at: file:///Users/checkwoomacair2/Downloads/A_RES_2398(XXIII)-EN.pdf

[411] David A. Baldwin (1996) Security Studies and the End of the Cold War, World Politics, Volume 48, Issue 1 (October 1995), pp. 117-141.

which by now has become inseparably linked to sustainable development. The climate change problem moved to central court in international affairs with the United Nations Conference on the Environment and Development (UNCED), which convened in Rio de Janeiro, Brazil, from 3-14 June 1992.[412] It proved to be a unique milestone in the evolution of international climate change governance.

The question humankind has been asking since then is "[c]an a fragmented and often highly conflictual political system made up of over [193] sovereign states and numerous other actors achieve the high (and historically unprecedented) levels of cooperation and policy coordination needed to manage environmental problems on a global scale?"[413]

The issue of governing the global commons collectively through international cooperation in an anarchical system of independent sovereign nation-States is at the heart of the academic study of liberal institutionalism, which is one of the mainstream theories under the broad category of Rationalism. While sharing many of the economic assumptions of classical liberalism, the institutionalists also understand that economic activity and international cooperation necessarily take place within a framework of principles, norms, rules and decision-making procedures that can be explicit and implicit, and that actor expectations and behaviors converge around such a framework in a given issue area, which is defined by the institutionalists as an international regime.[414] International rules and international organizations (generally referred to as institutions) are only constituent parts of the broader concept of international regime, which has been designed "by states to coordinate their expectations and organize aspects of international behavior in various issue-areas."[415]

Yet, after half a century of global collective action, inspired by liberal institutionalism, the international community has failed to convince the sovereign nation-States to reduce greenhouse gas emissions. The epistemic community of natural and social scientists is generally of the opinion that if global anthropogenic GHG emissions are not reduced drastically by about 45% from 2010 levels by 2030 and reaching net zero around 2050, there will be long-lasting or irreversible changes, such as the loss of some

[412] United Nations (1992a) supra note 16.

[413] Andrew Hurrell (1992) International Politics of the Environment, Clarendon Press, Oxford, UK.

[414] Stephen Krasner (1982) Structural Causes and Regime Consequences: Regimes as Intervening Variables, International Orgnaizations, Volume 36, Number 2, International Regimes (Spring 1982), pp. 185-205.

[415] F. Kratochwil and John G. Ruggie (1986) International organization: a state of the art on the state of the art, International Organizations, Volume 40, Number 4 (Autumn 1986), pp. 753-775.

ecosystems.[416] Hence, for the international law research student who is genuinely concern for the social-ecological consequences of systemic climate change, it is timely to look not only at the evolutionary but also at the revolutionary theoretical approaches to solve the climate change problem. These revolutionary theoretical approaches not only provide him with the foundations for critique of climate change governance by exposing their limitations and moral shortcomings,[417] they also provide him with valuable insights to understand better the complex social-ecological-economic-political-moral world system and to propose new normative approaches.

This points to Robert W. Cox's well-known dictum of difference between problem-solving theory and critical theory.[418] According to Cox, problem-solving theory "takes the world as it finds it, with the prevailing social and power relationships and the institutions into which they are organized, as the given framework for action. The general aim ... is to make these relationships and institutions work smoothly ... Critical theory ... does not take institutions and social and power relations for granted but calls them into question by concerning itself with their origins and how and whether they might be in the process of changing. It is directed towards an appraisal of the very framework for action ... which problem-solving theory accepts as its parameters."[419]

First, the thesis argues from a problem-solving perspective that a polycentric approach can provide a solution set, which can be implemented immediately across "many centres of decision-making that are formally independent of each other" to cut greenhouse emissions and reduce it by 45% in 2030 to keep the rise in global average temperature to below 1.5°C above the pre-industrial level by 2100.[420] Such a problem-solving approach is a viable and necessary immediate step to reduce the catastrophic risks associate with the emission of greenhouse gases because the systemic multi-factorial, multi-level climate change problem requires a multi-factorial, multi-level solution set, which includes the introduction of a carbon tax through domestic legislation to restrain indiscriminate greenhouse gas emissions at the local, corporate,

[416] IPCC (2018a) Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

[417] Stephen M. Gardiner (2004) supra note 349, pp. 555-600.

[418] Robert W. Cox (1981) supra note 28.

[419] Id., pp. 128-129.

[420] Vincent Ostrom, Charles M. Tiebout and Robert Warren (1961) supra note 49.

community, and regional levels as well as to incentivize their efforts to strive for greater energy use efficiency and to switch to low-carbon energy sources.

Second, the thesis critiques from a critical theory perspective the limitations of international law and politics as well as exposed their moral shortcomings. It then proposes a new normative approach of a world system of governance to address the global commons. The new normative approach will require diplomatic efforts at the international level to initiate political negotiations at establishing a world legal authority for the atmosphere global commons with supreme legislative powers as the long-term solution to achieve the ultimate objective of "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system"[421] and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations.[422]

In summary, there is a broad, expanding and eclectic collection of international relations theories. One method then to classify this broad collection of theories is to categorize the diverse theories into the three 'Rs': Realism, Rationalism and Revolutionism.[423]

1.3.3.1. Realism

The first category of theories under Realism, which includes classical realism, neorealism, and other variants, is the predominant theoretical approach of international relations or politics during the cold war period that emphasizes the balance of power among the nation-States in an anarchical and war-prone international community.[424] The role of classical international law was perceived to have little impact by then.

1.3.3.1.1. Classical Realism

Classical realism in the traditions of E.H. Carr, Reinhold Niebuhr and Hans Morgenthau asserts the primary of nation-States in pursuit of their national interests in the anarchical international community of sovereign nation-States. Morgenthau reduces the pursuit of national interests (collective action) to the pursuit of power because the political dimension of the multi-dimensional nature of the archetypal man is to pursue only his

[421] United Nations (1992a) supra note 16, Article 2.
[422] UNEP (1992a) supra note 75.
[423] John Vogler (2015) supra note 407.
[424] Id., p. 30.

own interest or desire for power over others, although for other realists national interests have been defined more broadly as the protection of its territorial integrity and the achievement of economic security and other central objectives of the nation-State.[425] Regardless, the usual pattern of interaction among the nation-States is one of conflict, especially when the legal and moral brakes are weak, because of the clash of differing national interests. Hence, the political realists advocate reliance on the balance of power to break out of *bellum omnium contra omnes* and place statecraft on the more optimistic footing of calculated self-interest to moderate and limit conflict not its abolition.[426]

Political realists consider cooperation to be less fundamental than conflict in the international arena, which has significant implications for the sustainable management of the global commons.[427] Therefore the struggle for power among the nation-States must be controlled. Without the internal control supplied by a universal moral code, the international community must fall back on external controls, which leads to the balance of power in the international arena. In general, realists do not insist that international cooperation is impossible but that efforts at international cooperation must take into consideration the realities of the power struggle among the nation-States and not ignore the perennial presence of conflict and understand the impact of relative influence that the distribution of power among the nation-States creates.[428]

In addition, the political realists, especially Hans Morgenthau, have been severely criticized for denying the need for moral principles in the practical responsibilities of statecraft. Yet Morgenthau did illuminate the possibilities for the statesman to combine respect for moral principles with dedication to the national interests, first, by arguing that in his own life time the two had diverged to a historically unprecedented degree and, second, by describing the means by which the two could still be brought together.

One of the most illuminating insights from Hans Morgenthau is his observation of "the deteriorating effect which the national interest, as created by the character of modern war, and the possibility of satisfying that interest, as presented by the modern technology of warfare, have had upon the moral limitations of international policies."[429] Morgenthau contended that the international arena confronting nation-States comprised

[425] Hans Morgenthau (1985) supra note 62, p. 5.

[426] Id., p. xviii.

[427] Id., p. xx.

[428] Id., p. xxi.

[429] Hans Morgenthau (1948) The Twilight of International Morality, Ethics, Volume 58, Number 2 (Jan 1948), p. 87.

of not only the geographical distribution of power among the nation-States but also the global climate of ideas that influences humankind. Hence, the expression of uncontrolled power by nation-States can be restrained by a set of ideas on morality, which includes moral principles, as expressed in world public opinion, mores practiced and imposed by local communities, and law legislated by the representatives of humankind, in ways parallel to "the domestic normative systems affect the struggle for power among the members of a domestic society." Thus moral principles, mores and law "reinforcing one another, give threefold protection to the life of society and the lives of individuals who compose it."[430]

Indeed, three of the six principles of political realism, as defined by Hans Morgenthau, in "Politics Among Nations" concern morality:
(1) Political realism is aware of the moral significance of political action.
(2) Political realism refuses to identify the moral aspirations of a particular nation with the moral laws that govern the universe.
(3) Political realism maintains that its intellectual and moral attitude to political matters is unique.

First, political realists maintain that the individual man has the right to sacrifice himself in defense of a moral principle, e.g. liberty, but the nation-State does not have the right to sacrifice its national survival for such a moral principle. The nation-State must exercise prudence and weigh the consequences of alternative political actions, which is the supreme virtue in politics.[431]

Second, realists also understand that few nation-States can resist the temptation for long to cloth their own particular moral aspirations as the moral purpose of the universe. There is a world of difference between the belief that all nation-States stand under the judgment of a Leviathan and the conviction that the Leviathan is always on one's side and that what one wills oneself cannot fail but be willed by the Leviathan also.[432]

Third, from the intellectual perspective, the political realist maintains that the autonomy of the political sphere. The political realist thinks in terms of interest defined as power as the economist thinks in terms of interest defined as wealth, the lawyer thinks in terms of the conformity of action with legal rules, and the moralist think in terms of

[430] Hans Morgenthau (1985) supra note 62, pp. 235-239.
[431] Id., p. 12.
[432] Id., p. 12.

conformity of action with moral principles. The political realist is not unaware of the existence and relevance of other standards of thoughts; however on political matters, he must subordinate those other standards to these of politics.[433]

The substance of Morgenthau's PhD thesis was intended to demonstrate that certain disputes between nation-States in the international community could not be settled by judicial methods (international law).[434] Such disputes are those that stand in relation to a tension and, therefore, the over-all distribution of power between the two nations in the dispute is at stake.[435] "The loss of the object of the dispute would be the symbolic equivalent of the loss of a decisive battle or of a war. It would signify defeat in the over-all struggle for power ... each nation will fight on [as] a matter of procedure or prestige with uncompromising tenacity, as though the national existence itself were at stake."[436]

1.3.3.1.2. Neorealism

A key realignment of political realism was initiated by Kenneth N. Waltz with his "Theory of International Politics", in which he focused his systemic theory based more on the 'structure' in the agent-structure interaction of international power politics as compared to Hans Morgenthau who focused more on the 'agent' or nation-States.[437]

One of the key findings of systems theory is that, in general, system structure affects the system components and the system components in turn affect the system structure. For instance, the complex climate system contains structures, e.g. the vertical temperature profile of the atmosphere or the thermocline of the ocean. Often the delay or the acceleration of effects is determined by the system structure rather than by the breakdown components of the system, e.g. the slow diffusion of gases from the troposphere into the stratosphere. Similarly, some explanations of behaviors and outcomes in the international political system are to be found in the system's structure itself.[438] A structure in international politics is similar to a force field in physics, which means interactions of agents within a structure (or field) will produce outcomes

[433] Id., p.13.

[434] Martti Koskenniemi (2011b) The Function of Law in the International Community: Introduction. In: Sir Hersch Lauterpacht (1933) The Function of Law in the International Community. Oxford Univeristy Press, Oxford, UK, p. xxxv.

[435] Hans Morgenthau (1985) supra note 62, pp. 450-451.

[436] Id., p. 451.

[437] Kenneth N. Waltz (1979) Theory of International Politics, Reissued by Waveland Press (2010), Waveland Press, Long Grove, IL, USA.

[438] Id., p. 73.

different from the interactions of the same agents occurred outside of the structure. The structure affects the agents and the agents in turn affect the structure.

The first insight from the "Theory of International Politics" is that the structure of the international political system is generated by the interactions of its principal units (components). In international politics, as in any self-help system, the nation-States with the greatest military and economic capabilities set the action situation for others as well as for themselves. Thus, the fates of all the nation-States in the international political system are affected much more by the acts and the interactions of the major powers than those of the minor ones.[439] The 193 nation-States in the world appear to form a system of fairly large numbers. However, given the inequality of nation-States, the number of significant nation-States is actually very small. Since the Treaty of Westphalia in 1648 to the present, eight major nation-States at most have sought to coexist peacefully or have contended for mastery in the international political system. Hence, "international politics can be studied in terms of the logic of small-number systems."[440]

The second insight is the significant difference in structural dynamics between economics and international politics. In the economic sphere, because market equilibrium is defined in terms of the price and quality of the products, their producing units (firms) are constantly in jeopardy. With free market competition, the inefficient firms are driven to bankruptcy. Meanwhile, the efficient firms survive and profit from the market, thereby attracting new firms into the market. Although each firm seeks to promote its own interest, the constructive results of free market competition transcend the self-interest of the separate firms. The elimination of the inefficient firms, forced by the 'invisible hand' of the free market system, is a necessary condition for the good performance of the free market economy. In the international political sphere, the term 'efficiency' has little system-wide meaning. It is the producing units and not the products that are of paramount concern. For instance, two nation-States competing for the favor of a third nation-State may be forced by competition to provide more and better goods and services (military and economic) to the third party. The competition, however, serves chiefly as incentive for each of the nation-States to promote its own national interests. That the competition benefits others is mainly in the by-products, which do not necessarily transcend the national interests of the nation-States. Economic systems are judged more by the price and quality of their products than by the fate of the producing units while the international political systems are judged more by the fate

[439] Id., pp. 93-97.
[440] Id., p. 131.

of the producing units than by the price and quality of their products.[441]

The third insight is that while the constructive purpose of economic competition is easily seen, it is hard to argue that nation-States are better off because of political competition. Hence, for a politician without moral principles, he sees disequilibrium in the international political system because humankind is obsessed with the fate of the nation-States that composed it. However, for a politician with moral principles, the performance standards applicable to the international political system are at the very least widely different from those of the economic system. As a parallel, in the natural ecosystem, the scientists who believe that the unhampered processes of natural selection only lead to progress do not "count the cost of the struggle".[442] However, in the international political system, for the politician with moral principles, it is the costs of the struggle that counts, and thus of paramount importance to the nation-States. The elimination rate among modern nation-States is remarkably low.[443]

1.3.3.1.3. From the Perspective of Climate Change Governance

From the perspective of climate change governance, there are also many useful insights from both classical realism and neorealism.

First, the classical realist accepts the multi-dimensional nature of the archetypal man. Real man is a composite of 'economic man', 'political man', 'moral man', 'religious man', etc. A man who is nothing but a 'political man' would be a beast for he would be completely lacking in moral restraint. A man who is nothing but a 'moral man' would be a fool for he would be completely lacking in prudence.[444] Such a multi-dimensional theory of the nature of the archetypal man is not in opposition to the more general theory of bounded rationality, according to the SES and New Haven School frameworks, although the strong desire for power over others may well suppress those moral sentiments needed for cooperation to solve the systemic climate change problem. Hence, unlike the more optimistic views of human nature proffered by the SES and New Haven School frameworks, Morgenthau freely conceded that his view of human nature is a pessimistic one.[445] However, no matter from which pole of the continuous spectrum one

[441] Id., p. 136.

[442] John Maynard Keynes (1926) The end of laissez-faire-II, New Republic, Volume 48 (1 September 1926), p. 37.

[443] Id., p. 137.

[444] Hans Morgenthau (1985) supra note 62, p. 15.

[445] Id., p. xviii.

assumes the theoretical nature of the archetypal man, there is still the need for community rules of use in the form of moral principles, mores and laws to restrain man from free-riding or uncontrolled power struggle.[446]

Second, another useful insight that highlights the importance of revisiting the IR theory of classical realism is that the entanglement of climate change to energy supply, economic growth and population growth (Section 2.3.1) gets very close to the heart of national interests, means that climate change governance, which had been considered as 'low politics' from the perspective of classical realism is now no longer tenable.[447]

Third, it is essential that the solution to the climate change problem must now take into serious consideration the conceptions of man, society and politics as expressed by classical realism, especially in the tradition of Hans Morgenthau. If the necessity to secure accessible and efficient supply of fossil fuels to power both economic and population growths of one's nation-State is seen as crucial to its national existence, then any loss of the object of dispute by any nation-State during the diplomatic negotiations to establish international agreements to solve the systemic climate change problem would be perceived as the symbolic equivalent of defeat in their over-all struggle for power. Hence, government representatives in international diplomatic efforts at UN climate change conferences will continue to dispute with uncompromising tenacity specific provisions in the draft international agreements as though the national existence of their nation-States were at stake.[448] In both cases of the ocean commons and climate change commons, the US was not prepared to have a supranational authority dictate terms in what it considered to be vital for its national existence.[449]

Fourth, one useful insight from neorealism is that an international political system composed of largely unequal nation-States is scarcely an interdependent system, when interdependence is defined here as mutual vulnerability and not as sensitivity of adjustment.[450] Such an international political system in which a few nation-States can take care of themselves quite well and most other nation-States cannot hope to do so is far from an interdependent system.[451] Hence, the international cooperation needed to solve the climate change problem will be very difficult to implement unless the major

[446] Id., pp. 235-239.
[447] John Vogler (2015) supra note 407, p. 31.
[448] Hans Morgenthau (1985) supra note 62, p. 451.
[449] See Section 3.1.6.1 and Section 3.3.4.1.
[450] Kenneth N. Waltz (1979) supra note 437, pp. 143-146.
[451] Id., p. 159.

nation-States of the United States, China, India and the European Union take concerted collective action to reduce GHG emissions. Similarly, in both cases of the ocean commons and the climate change commons, the non-cooperation of the US contributed significantly to the failure of the seabed regime and Kyoto Protocol respectively.[452]

Fifth, the implication of the significant difference in structural dynamics between economics and international politics is that the moral principles of justice and equity in international politics transcends the virtue of efficiency in economics, therefore the advocacy of international market-based mechanisms for optimal efficiency in the reduction of GHG emissions at the international level of nation-States is self-defeating not only from the economics perspective of the high transactional costs involved and its vulnerability to free riding but also from the international politics perspective of the North-South divide due to their wide differences in economic development. Similarly, in both cases of the ocean commons and the climate change commons, the quest for social justice and equity by the developing countries of the South had a significant impact on the provisions of UNCLOS III and UNFCCC respectively.[453]

1.3.3.2. Rationalism

The second category of theories under Rationalism, which includes classical liberalism, modern liberalism, neoliberalism, liberal institutionalism, and other variants, is the dominant theoretical IR approach after the Cold War.

In general, rationalists follow a liberal tradition informed by reason. At the core of the various rationalist traditions in IR are concepts that can be traced back at least to Hugo Grotius, the founding father of modern international law. Hence, the history of international law to a large extent and for a long time was imbued with the spirit of liberalism.[454] From the perspective of the international rationalists, the nation-States do not exist in a perpetual Hobbesian "war of all against all" because they are capable of developing internationally accepted norms and practices, even without the Leviathan of a supranational government,[455] that can ameliorate the lives of humankind beyond the "solitary, poore, nasty, brutish, and short".[456]

[452] See Section 3.1.6.1 and Section 3.3.4.1.
[453] See Section 3.1.6.2 and Section 3.3.3.1.
[454] Martti Koskenniemi (2011a) supra note 389, pp. 35-36.
[455] John Vogler (2015) supra note 407, p. 33.
[456] Thomas Hobbes (1651) supra note 191.

The classical rationalists, like the realists, were also mainly preoccupied with the problems of war and peace, and national security. However, there are now numerous current studies in the liberal tradition to improve the management of the global commons by the international community, and this subject matter has clearly moved to centre court in the IR theory of liberal institutionalism.[457]

1.3.3.2.1. Classical Liberalism

Both modern liberalism and neoliberalism have ideological roots in the classical liberalism of the 17th and 18th centuries, which championed the liberty of individuals and *laissez-faire* economics against the excessive power of government.

First, classical liberalism is associated with the physician and political philosopher John Locke (1632-1704) who argued in his "Second Treatise on Government" that men (mutatis mutandis to women) in the state of nature have rights. However, in order to avoid the state of war that often occurs in the state of nature and to protect their rights, men enter into the state of society. Furthermore, men can both form governments and dissolve them. Hence, the legitimacy of government is to protect the rights of men.[458]

Second, classical liberalism is associated with the economist and moral philosopher Adam Smith (1723-1790) who argued in "The Wealth of Nations" that markets are governed by an "invisible hand" and thus should be subjected to minimal government intervention.[459] As a moral philosopher, Adam Smith was also interested in the nature of the archetypal man and wrote "The Theory of Moral Sentiments".[460]

1.3.3.2.2. Modern Liberalism

Classical liberalism evolved rapidly in the 19th and 20th centuries and diverged into many strands with particular focuses. One of the major strands is modern liberalism tradition, which focuses on the protection and enhancement of individual liberty as the central doctrine of politics. Government is recognized as "a necessary evil." The legislative, adjudicative and executive functions of government are needed to secure

[457] John Vogler (2015) supra note 407, p. 35.

[458] John Locke (1690) Two Treatise on Government: In the former, the false principles, and foundation of Sir Robert Filmer, and his followers, are detected and overthrown; the latter is an essay concerning the true original, extent, and end of civil government, Awnsham Churchill, London, UK.

[459] See supra note 150.

[460] Adam Smith (1761) The Theory of Moral Sentiments, 2nd Edition, A. Millar, Strand, London, UK.

individual liberty but their coercive powers may also be turned against him. Hence, the crux of the political problem is to devise a governance system that gives those who govern the power necessary to protect individual liberty yet prevent them from abusing that power. In other words, liberals believe that government is necessary to protect individuals from being harmed by others, but they are also keenly aware that government itself can also pose a threat to individual liberty.[461]

In the international political arena, the modern liberal internationalist strand is reflected in the quest for the progressive reform of the international political system. From the interwar years of the 20th century, liberal internationalists have been advocating for national self-determination and encouraging the use of international law and organizations, e.g. United Nations and its specialized agencies, as the chief means to maintain and enhance international peace as well as to govern the global commons.[462] Liberal internationists are also suspicious of the State and therefore are receptive to the notion of a more pluralist, inclusive of non-governmental organizations, businesses, communities, etc., and transnational world system.[463] However, another strand of liberalism, known as neoliberalism, came to dominate the international political-economy system in the 1980s and 1990s.

1.3.3.2.3. Neoliberalism

During the stagflation (economic stagnation and inflation) period in the 1970s, some economists advocated a 'return' to classical liberalism, known as neoliberalism. Unlike modern liberalism, the focus of neoliberalism was on *laissez-faire* economics.

The Intellectual Foundations of Neoliberalism

The intellectual foundations of this 'revival' rested on two main planks. First, from the works of the Austrian-born British economist Friedrich von Hayek, co-winner of the Nobel Memorial Prize in Economic Sciences in 1974, who argued that the free market provides all the necessary protection against the one real political danger of totalitarianism, which was seen as happening in the Soviet Union at that time.[464] Hence,

[461] Extracted from Encyclopaedia Britannica (online). Accesssed on 11 August 2019 at: https://www.britannica.com/topic/liberalism

[462] See supra note 799.

[463] Christine Downie (2015) Nongovernmental organizations, civil society and individuals. In Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, UK, pp. 176-186.

[464] Friedrich A. Hayek (1944) The Road to Serfdom, Routledge Press, Abingdon, UK.

to prevent totalitarianism from happening, the State has to increase economic competition to be achieved through deregulation and opening up of domestic markets, including financial markets. It is a key modification of classical liberalism's beliefs in *laissez-faire* economics and a minimal state. In classical liberalism, the merchants simply asked the State to leave them alone to deal in a free market. In neoliberalism, the State is called upon to ensure a free market. This is the 'neo' in neoliberalism.

Second, from the works of the American economist Milton Friedman, winner of the Nobel Memorial Prize in Economic Sciences in 1976, who rejected the notion of government intervention in the form of fiscal policy aimed at influencing business cycle, as proposed by John Maynard Keynes and colleagues, which had prevailed since the interwar years. Friedman and colleagues, including several Nobel laureates in economic sciences, in the Chicago School of Economics insisted on a smaller role for the State to be achieved through privatization and limits of the ability of governments to run fiscal deficits and accumulate debt. Milton Friedman's highly successful book "Capitalism and Freedom" was a good example of how the economic arguments of neoliberalism can be translated into popular political ideology,[465] and Margaret Thatcher and Ronald Reagan were probably the best proponents of neoliberalism as political ideology.[466]

The primary assumption of the nature of the archetypal man in the Chicago school is the rational choice model of the completely rational actor who acts to maximize their self-interest and will, therefore, respond to price incentives. The presence of free competitive markets, which is populated by rational actors, will allocate the limited resources on the basis of their most valuable uses and produce the most efficient outcomes for society. Social good is maximized via the maximization of the reach and frequency of market transactions. The preferred contract is the one with the greater geographical range and the shorter time frame.[467] This preference parallels Lyotard's famous description of the postmodern condition as one where "the temporary contract is in practice supplanting permanent institutions in the professional, emotional, sexual, cultural, family and international domains, as well as in political affairs."[468]

[465] Milton Friedman (1962) Capitalism and Freedom, University of Chicago Press, Chicago, IL, USA.

[466] Peter Evans and William H. Sewell, Jr. (2013) Neoliberalism. In: Social Resilience in the Neo-Liberal Era [Peter A. Hall and Michele Lamont (eds.)], Cambridge University Press, Cambridge, UK, p. 37.

[467] David Harvey (2005) A Brief History of Neoliberalism, Oxford University Press, p. 3.

[468] Jean-Francois Lyotard (1979) The Post Modern Condition: A Report on Knowledge [Translation from the French by Geoff Bennington and Brian Massumi, Manchester University Press, Manchester, UK (1984), p.66].

The conditions necessary for a competitive free market to operate must be won politically so that the State can be re-designed to play a much smaller role. Every aspect of domestic politics, from the choices of the voters to the decisions of the politicians, has to be subjected to economic analysis. The lawmaker was not allowed to distort the natural responses of the market. The ideal State provides a fixed, neutral, universal legal framework within which market forces operate spontaneously. The teological purpose of the State is never preferred to the price system of the Market, which is not only efficient but maximises liberty or opportunity for men and women to make free choices about their own lives.[469]

The Chicago school's view of government intervention is best demonstrated by its approach to the use of antitrust law. The traditional approach to antitrust regulatory policy is to limit concentrations of market power by breaking up a firm that has become a monopoly. The Chicago school, however, argues that consumers are best protected by competition. If the competition is among only a few large firms in an industry, the government should not intervene because these large firms have gained their dominant market positions through efficient allocation of limited resources. Even when one such firm was to gain monopoly power in the process, the Chicago school still prefers to allow free market forces to correct the problem rather than to rely on government intervention, which may cause greater harm to efficiency.[470]

The Anglo-Saxon Epicenter

In the 1980s, the major conservative political parties in the US and UK enthusiastically embraced the ideology of neoliberalism.[471] The neoliberal ideology associated with the administrations of President Ronald Reagan (1981-1989) and Prime Minister Margaret Thatcher (1979-1990) became entrenched in both the US and UK as both held power in the US and UK for a long time respectively.[472]

Neoliberal ideology, which is more associated with conservatism than with liberalism, became increasingly influential as it continued to flourish in the 1990s under President Bill Clinton from the US Democratic Party and Prime Minister Tony Blair of the British

[469] David Hess (2016) Chicago School of Economics. Extracted from Encyclopaedia Britannica (online). Accessed on 11 August 2019 at: https://www.britannica.com/topic/Chicago-school-of-economics

[470] William H. Page (1989) The Chicago School and the Evolution of Antitrust: Characterization, Antitrust Injury, and Evidentiary Sufficiency, Virginia Law Review, Volume 75, Number 7 (October 1989), pp. 1221-1308.

[471] Peter Evans and William H. Sewell, Jr. (2013) supra note 466, p. 44.

[472] Id., pp. 44-46.

Labour Party.[473] In fact, it was Clinton and Blair from the centre-left of the political spectrum that did the most to consolidate neoliberalism domestically and internationally.[474] They probably did so against their own better instincts because the legacies of Reagan and Thatcher left them with little or no room for manoeuvre.[475]

In the US, the financial complex of Wall Street–International Monetary Fund (IMF)–US Treasury dominated economic policy during the Clinton administration. It was able to persuade, cajole, and on the back of structural adjustment programmes administered by the IMF, coerce many developing countries to take the neoliberal road. The US also used the carrot of preferential access to its huge consumer market to persuade these countries to reform their economies along neoliberal lines, sometimes through bilateral trade agreements. The Anglo-Saxon model of neoliberalism was touted as the panacea to all global problems. Considerable pressure was put first on Japan and Europe and later on the rest of the world to take the neoliberal road. The formation of the World Trade Organization (WTO) was the high point of the international neoliberal regime. The WTO set neoliberal standards and rules for interactions among its member-States in the global economy. Its primary objective, however, was to open up as much of the global economy as possible to unhindered capital flow (though always with the caveat clause of the protection of key 'national interests'), for this was the foundation of the capacity of the US financial power to exact tribute from the rest of the world.[476]

Uneven Geographical Spread

However, most nation-States that took the neoliberal turn generally did so partially, e.g. continental Europe combined neoliberal practices with social democratic institutions[477] while China has its market economy with Chinese characteristics.[478] Even in the wake of crises, e.g. the collapse of the Soviet Union, it has been followed by slow reversals as the unpalatable aspects of neoliberalism become more evident.[479]

Asian Financial Crisis

[473] Id., p. 47.
[474] David Harvey (2005) supra note 467, p. 93.
[475] Id., pp. 62-63.
[476] Id., pp. 92-93.
[477] Peter Evans and William H. Sewell, Jr. (2013) supra note 466, p. 52.
[478] David Harvey (2005) supra note 467, pp. 120-151.
[479] Id., p. 87.

The unpalatable aspects of neoliberalism were further exposed during the Asian financial crisis. The crisis began in Thailand in 1997 with the devaluation of the baht in the wake of the collapse of a speculative property market. The crisis first spread to the Asian countries of Indonesia, Malaysia, and the Philippines, and second to Hong Kong, Taiwan, Singapore, and South Korea. Estonia and Russia in Europe were then hit hard, followed shortly afterwards by the South American countries of Brazil and Argentina, which was badly affected with serious and long-lasting consequences. Even Australia, New Zealand, and Turkey were affected by the crisis. The social effects of the financial crisis were devastating. As the crisis progressed, GDP plummeted, unemployment soared, and banks closed. By 1998, the GDP in Indonesia had fallen by 13.1% and almost 15% of males working in 1997 had lost their jobs by August 1998. As GDP fell and unemployment soared, the IMF stepped in and mandated austerity by abolishing subsidies on food and kerosene in Indonesia in return for financial aid. The riots and violence that followed tore apart the country's social fabric.[480]

The standard IMF/US Treasury explanations for the financial crisis were that there was too much state intervention and, more importantly, corrupt relationships between state and business [crony capitalism],[481] which was clearly prevalent. However, the construction or restoration of dominant class power was actually exacerbated by the turn to neoliberalism in these developing countries.[482] IMF/US Treasury recommended further neoliberalization policies with disastrous consequences. The alternative view of the Asian financial crisis was that the push to liberalize the economy from the Anglo-Saxon neoliberal epicentre resulted in impetuous financial deregulation and the failure to construct adequate regulatory controls over unruly and speculative portfolio investments in these developing countries. The evidence for this latter view is substantial for those Asian countries that had not liberated their financial markets, including Singapore, Taiwan and China, were far less affected than those countries, such as Thailand, Indonesia, Malaysia, and the Philippines, that had liberated their financial markets.[483]

1.3.4.2.4. From the Perspective of Climate Change Governance

From the perspective of climate change governance, there are also useful insights from

[480] Id., p. 96.

[481] CED (2015) Crony Capitalism: Unhealthy Relations between Business and Government, Committee for Economic Development of the Conference Board, Arlington, VA, USA.

[482] David Harvey (2005) supra note 467, p. 156.

[483] Id., p. 97.

both modern liberal internationalism and neoliberalism.

One useful insight from modern liberal internationalism is that the promotion of national self-determination means increasing the number of nation-States in the international political system. The membership in the United Nations increased from 56 member-States during its inception to 193 member-States today. Most, if not all, of these member-States are minor nation-States in terms of military or economic capabilities. Such a significant development in the current international political system of a large number of nation-States with lower capabilities goes against the logic of small numbers with "two as the best of the small numbers", as advocated by the neorealists.[484] In the quest for national security after the Cold War, the smaller nation-States formed alliances in the economic sphere, e.g. G77. However, "alliance strategies are always the product of compromise since the interests of allies and their notions of how to secure them are never identical."[485] The formation of these flexible alliances had a significant impact during international diplomatic negotiations of the climate change agreements, i.e. North-South economic divide.[486]

The imposition of neoliberal short-term contractual logic on environmental resources will have disastrous consequences. The accelerating destruction of tropical forests since 1970 is a good example that has serious implications for both climate change and the loss of biodiversity. If humankind cross the critical thresholds of the nine planetary boundaries, particularly climate change, so as to make planet Earth unfit for human habitation, then further embrace of neoliberal practices will surely prove nothing short of deadly.[487]

Another useful insight is how neoliberalism ideology spread quickly in the 1990's from the Anglo-Saxon axis of the US and UK to the rest of the world, including the European Union, Latin America and East Asia.[488] As a result, the notion of using market-based mechanisms, at the insistence of the US delegation, to solve the climate change problem was introduced into the 1997 Kyoto Protocol. It was accepted by the international community to enable the Annex I countries to meet their commitments under the Protocol by purchasing or acquiring credits of GHG emissions reduction that had or are

[484] Kenneth N. Waltz (1979) supra note 437, p. 161.
[485] Id., p. 166.
[486] See Section 3.3.3.1.2.
[487] David Harvey (2005) supra note 467, pp. 172-173.
[488] Peter Evans and William H. Sewell, Jr. (2013) supra note 466, p. 44.

taking place in other countries.[489] The rationale advanced by proponents of the market-based mechanisms of international transfer was that the geographical location of climate change mitigation is largely irrelevant as it is perfectly acceptable from a cost-effectiveness perspective to carry out the mitigation project where it is the cheapest option regardless of the location.[490] If the location happened to be in a developing country there was also the additional benefit of fund transfer and possibly technology transfer as well. However, the provision of these market-based mechanisms was partly responsible for the failure of the Kyoto Protocol.[491]

1.3.3.3. Liberal Institutionalism and International Regime

The institutionalism part of liberal institutionalism tradition can be traced back to the works of the German political philosopher Immanuel Kant who prescribed three definitive and interconnected articles for peace in his 1795 essay on "Perpetual Peace: A Philosophical Sketch."[492]

1.3.3.3.1. Liberal Institutionalism

The first definitive article, from a domestic perspective, is "[t]he civil constitution of very nation should be republican",[493] i.e. each state should embrace a republican form of government in which legislative power and executive power are separated. Such a separation in the domestic institutions will make waging war more difficult because the citizens, who have to bear much of the cost, would need to approve it. The second article, from an international perspective, is that these republican states should band together to form a pacific "federation of free states",[494] in which member-states renounces the right to wage war with one another. The federation would eventually include all the nation-States. Such an international institution will facilitate trade and other linkages so that waging war would be even more damaging for its perpetrators. The third article, from a universal perspective, is that the "[c]osmopolitan right should

[489] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth Mackenzie (2018) supra note 354, p. 310.

[490] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 136.

[491] Amanda M. Rosen (2015) supra note 382, p. 32.

[492] Immanuel Kant (1795) Zum ewigen Frieden: ein philosophischer Entwurf [Perpetual Peace: A Philosophical Sketch], Friedrich Nicolovius, Konisberg, Germany [Perpetual Peace and Other Essays, translated by Ted Humphrey, Hackett Classics, 1st Edition, 1983, Hackett Publishing Company, Indianapolis, IN, USA].

[493] Id., p. 112.

[494] Id., p. 115.

be limited to conditions of universal hospitality",[495] so that citizens of the world should conduct themselves peacefully and be permitted to travel freely to interact and do business in states other than their own.

Once the States are restrained at the domestic and international levels, their citizens are more likely to respect the rights of other States' citizens, further reducing the impetus for inter-state conflict. In theory, as the Kantian political system widens over time with more States becoming republican, joining the pacific federation, and practice the virtue of reciprocity among its citizens, more States will subscribe to the set of universal values, which guide how the growing number of member-States in the in-group must be treated. In essence, the international institutions lie at the core of the expanding Kantian system that is built to discourage the waging of war.[496]

In the 1990s, with the expansion in the activities of the United Nations system, the end of the Cold War, the decline in Marxist ideology, and the ascendancy of the modern liberal internationalist strand, the Kantian system inspired the liberal institutionalists to grapple with issues of governing the global commons collectively through international cooperation in an anarchical international political system. It became the dominant IR theory to deal with the global commons, including climate change.

1.3.3.3.2. From the Perspective of Climate Change Governance

The liberal institutionalists accept the economic assumptions of the classical liberalists and appreciate that the economic activities and international cooperation must necessarily take place with the framework of international institutions. However, the classical liberalists were also much inspired by the collaborative approach of the epistemic community of climate experts since the 1970s.

It was John Gerald Ruggie who introduced the concept of 'regime' in international relations, which is intimately associated with liberal institutionalism. In his 1975 classic paper focusing on the need to restructure international organizations to deal with the increasing scope of scientific and technological developments, defined "international regime [as] a set of mutual expectations, rules and regulations, plans, organizational energies, and financial commitments, which have been accepted by a group of states."

[495] Id., p. 118.

[496] Tana Johnson and Andrew Heiss (2018) Liberal Institutionalism. In: International Orgnaiztion and Global Governance, 2nd Edition [Thomas g. Weiss and Rorden Wilkinson (eds.)], Routledge, London, UK, p. 124.

Ruggie even cited the international system of national weather bureaus under the World Meteorological Organization (WMO) exercising their capabilities "in accordance with a collectively defined and agreed-to plan and implementation program" as a good example of such an international regime".[497] More importantly, it marked the successful transfer of authority for coordination and standard setting from national organizations to an international organization, which is an important indicator of regime effectiveness.[498]

Hence, an international institutional framework of principles, norms, rules and decision-making procedures that can be explicit and implicit, and that actor' expectations and behaviors converge around such a framework in a given issue area is defined by the liberal institutionalists as an international regime. Both international law and international organizations (generally referred to as international institutions) are only constituent parts in the broader concept of international regime, which has been designed to analyze human interactions upon which international cooperation is built.[499]

In ordinary English usage the term 'regime' denotes a system of government or a particular governing administration. However, in International Relations, the term 'regime' is used to describe the "sets of implicit or explicit principles, norms, rules and decision-making procedures around which actors' expectations converge in a given area of international relations. Principles are beliefs of fact causation and rectitude. Norms are standards of behavior defined in terms of rights and obligations. Rules are specific prescriptions or proscriptions for actions. Decision-making procedures are prevailing practices for making and implementing collective choice."[500]

The central concern of an international regime is with the form of governance, including international law, for international cooperation to solve a global commons issue in the absence of government. It comprises the whole range of principles, norms, rules, and decision-making procedures that exist in relation to that specific global commons issue. Hence, international regime governance goes beyond international law. However, the specific MEAs and the international institutions set up by the MEAs constitute the core of international regime governance. The governance of the atmosphere global commons, including climate change, is a good example of international regime governance.

[497] John Gerard Ruggie (1975) International Responses to Technology: Concepts and Trends, International Organization, Volume 29, pp. 557-83.

[498] Paul N. Edwards (2010) A Vast Machine: Computer Models, Climate Data and the Politics of Global Warming, MIT Press, Cambridge, USA, p. 242.

[499] F. Kratochwil and John G. Ruggie (1986) supra note 415.

[500] Stephen Krasner (1982) supra note 414.

The types of international regime governance could range from one extreme of the functional equivalent of a government providing an international public good to reduce associated transactional costs to the other extreme of merely registering a minimal rule that a common resource or common sink is open access. Although, international regimes have been analyzed based on as many as four different dimensions: (1) specific vs. diffused, (2) formal vs. informal, (3) evolutionary vs. revolutionary, and (4) distributive bias,[501] it is helpful to think in terms of a continuum of international regimes based on the criterion of the degree of fragmentation. At one extreme of this continuum is an integrated regime with fully integrated international institutions that impose regulation through comprehensive, hierarchical rules, e.g. GATT. At the other extreme is a fragmented regime a collection of international institutions around the same issue-area but without clear hierarchy or an identifiable core. The international institutions of a fragmented regime generally have no or weak links among them. The climate change issue-area could be considered as being governed by a regime complex, which is in-between an integrated regime and a fragmented regime.[502]

The meaning of 'governance' in policy science and 'regime' in international relations are very close, except that 'governance' may be a slightly broader term as it "includes formal institutions and regimes empowered to enforce compliance, as well as informal arrangements that people and institutions either have agreed to or perceive to be in their interests."[503] As the focus of Chapter 3 is on the role of formal institutions and regimes and less on informal arrangements, it would seem that the term, 'international climate change regime' should be used instead of the term, 'international climate change governance'. The preference, however, is to use the broader term 'governance' to 'regime' as 'governance' is also used in subsequent chapters of the thesis to describe other forms of formal and informal governance of climate change including 'polycentric governance' and 'national governance'. The terms, 'international climate change regime' and 'international climate change governance' are, therefore, used interchangeably, as well as the terms, 'regime governance', 'regime' and 'governance', in this thesis. Besides, Keohane and Victor in analyzing the international climate regime complex had

[501] Donald J. Puchala and Raymond F. Hopkins (1983) International regimes: lessons from inductive analysis. In: International Regimes [Stephen d. Krasner (ed.)], Cornell University Press, Ithaca, NY, USA, pp. 61-91.

[502] Robert O. Keohane and David G. Victor (2010) The Regime Complex for Climate Change, Discussion Paper 10-33 (January 2010), The Harvard Project on International Climate Agreements, Harvard Kennedy School, Harvard University, Cambridge, MA, USA.

[503] Commission on Global Governance (1995) supra note 79, p. 2.

already aligned it with the social-ecological (SES) approach of CPRs governance.[504]

1.3.3.4. Revolutionism

Besides realism and rationalism, Martin Wright of the English School of International Relations also identified a mainstream revolutionist tradition in international relations. This third category under Revolutionism is a diverse collection of IR theories, which includes Marxism, including the neo-Gramiscian framework, constructivism, and other critical theories from the Frankfurt School to Jurgen Habermas to Michel Foucault to feminism.[505] While it is true that some Marxist and socialist writers did have an explicit revolutionary intent, some others had more moderate aspirations for the transformation of the anarchical international political system into a more congenial and pacific world system in which both individuals and communities live in a greater degree of liberty and cooperation. The unifying leitmotiv of these IR theories and frameworks is a rejection of the status quo and with it the kind of international political system that realists accept as inevitable while rationalists sought to reform and ameliorate. Typically, the independent sovereign nation-States are viewed as part of the problem rather than part of the solution of a more cosmopolitan and ecologically sustainable world system. To use Cox's incisive dictum, problem-solving theory is the domain of realism and rationalism while critical theory is the domain of the revolutionism.[506]

The political philosopher Immanuel Kant had earlier proposed a viable solution for perpetual peace as discussed in Section 1.3.4.3. Although the proposed Kantian system is that of a world federated system, it is still considered evolutionary as the means to its attainment is based on the rational reform of the existing sovereign nation-States and international institutions. This optimistic perspective of Immanuel Kant is not only at odds with the problem-solving Realism tradition it is even more at odds with the critical Marxism tradition. Far from seeing the capitalist institutions and their economic relations as the underpinnings of peace, the Marxists see them as the sites for conflict between social classes as well as vehicles for the exploitation at both domestic and international levels. The Marxism perspective clashes with the Kantian perspective that these political institutions can bind people together and promote peace.[507]

[504] Robert O. Keohane and David G. Victor (2010) supra note 502, pp. 9-14.

[505] Hayley Stevenson (2015) Alternative theories: Constructivism, Marxism and other critical approaches. In: Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, UK, pp. 42-55.

[506] John Vogler (2015) supra note 407, p. 38.

[507] Tana Johnson and Andrew Heiss (2018) supra note 496, p. 125.

In fact, this significant difference between the Kantian system and the Realist and Marxist systems foreshadows one of thorniest issues for the liberal institutionalists who were inspired by the Kantian system: for until all States accept such an identical set of universal values there will still exist an in-group and an out-group. Incentives for one are threats to the other. Hence until the Kantian system is universal, the peace obtained will be fragile, partial, and intermittent. Hence, it is difficult to interpret the outbreaks of war in the short-term? Are they to be viewed as the temporary obstacles on the road to perpetual peace, or are to be accepted as evidences that the Kantian system is not a viable approach to international politics?[508]

1.3.3.4.1. Marx's Approach to Climate Change Governance

The first strand of capitalist-centered critique is based on the German political theorists Karl Marx and Friedrich Engel's historical materialism, which states that it is the material conditions of the means of production in a society, and not the ideas of its members, that determines its social institutions.

Peter Newell has recently observed that although capitalism is "the elephant in the room" as it is deeply implicated in climate change governance, research students and scholars thus far have generally maintain a polite silence about the capitalist system, which suggests that there is a pervasive reluctance on the part of these students and scholars, first, to align themselves in opposition to a well-established locked-in capitalist system and, second, to be associated with the failed communist system of the 20th century.[509] However, one should not judge Marxism or any other system theories solely by the actions of those who profess belief in these theories because their practices are often the antithesis of the theories.[510]

Besides, the philosophy of Marx and Engels "emerged a century before the ecological crisis matured, and we would expect its received form to be both incomplete and flawed when grappling with a society, such as ours, in advanced ecosystemic decay."[511] The

[508] Id., p. 125.

[509] Peter J. Newell (2011) The elephant in the room: capitalism and global environmental change, Global Environmental Change, Volume 21 (February 2011), pp. 4-6.

[510] David Pepper (1993) Eco-Socialism: From Deep Ecology to Social Justice, Routledge, London, UK.

[511] Joel Kovell (2007) The Enemy of Nature: The End of Capitalism or the End of the World? 2nd Edition, Zed Books, New York, NY, USA, pp. 9-10.

international law research student needs to delve deeper into Marxist philosophy to appreciate how it could prove useful as one of the theoretical foundations to highlight the limitations of the current international political system, which is capitalist-based, and to suggest possibilities of an alternative world system.

For instance, despite the reductionism of historical materialism, Marx and Engels understood ecology as complex interacting processes and objects that could not be understood in isolation from one another.[512] Engels did warn humankind that "let us not ... flatter ourselves overmuch on account of our human conquests over nature ... for each such conquest takes its revenge on us".[513] The most insightful account of the capitalist system's impacts on environmental degradation was that on the soil crisis, which was the environmental issue during Marx's time. Central to this critique was Marx's concept of "social metabolism", which conveys the notion of "the complex, dynamic interchange [of matter and energy] between human beings and nature".[514] Marx then observed that capitalism generated an unavoidable "metabolic rift" in the soil nutrients by rupturing the "metabolic interaction" between human beings and the earth. In other words, when food production and consumption take place locally, the resultant wastes returned to the land as fertilizers, completing a natural nutrient cycle working in close proximity with delay. The accumulative imperative of capitalism, however, drives concentration of land ownership, depopulates the rural areas, increases the density of urban areas, and creates an urban-rural divide that results in nutrients accumulating as waste in the urban areas, which is now far away for natural recycling into the rural soil and has to be disposed of, causing a rift in the natural nutrient cycle.[515]

Contemporary Marxist scholars have extended Marx's theory of the "metabolic rift" to analyze the modern global economy, which is far more damaging ecologically than anything witnessed during Marx's time. For instance, one such "metabolic rift" has spread throughout the global agricultural and food production systems due to the technological fix of intensive application of industrial nitrogen fertilizers to compensate for the loss of organic nitrogen, resulting in the release of airborne nitrogen compounds contributing to global warming and nutrient run-offs in water courses resulting in eutrophication and marine "dead zones".[516] In fact, one of the nine tipping points of the

[512] Carolyn Merchant (2008) Ecology, 2nd Edition, Promotheus Books, Amherst, NY, USA, p. 44.

[513] Id., p. 56.

[514] John Bellamy Foster (2000) Marx's Ecology: Materialism and Nature, Monthly Review Press, New York, NY, USA, p. 158.

[515] John Bellamy Foster, C. Clarke and R. York (2010) The Ecological Rift: Capitalism's War on the Earth, Monthly review Press, New York, NY, USA, p. 77.

[516] Id., pp. 81-82.

Earth's system is eutrophication due to excessive application of industrial fertilizers.[517]

These negative impacts on the environment are generated by the logic of capitalism, which prescribes ever-greater efficiency from accumulation of capital. However, this logic will lead eventually to disequilibrium of the Earth's system by the system's own externalized costs of soil degradation, water supplies depletion, biodiversity loss and climate change, as well as an "intractable dependence" on fossil fuels.[518]

Hence, one useful insight from the Marxist structural analysis of society is that capital accumulation, which is seen as the primary function of the nation-State, determines the upward spiral of economic activity that is responsible for the excessive use of the Earth's resources, loss of habitats, and rising levels of pollution. Hence, it directly challenges the liberal market-based theories, especially neoliberalism, on how to solve the climate change problem. Even the international regime for climate change governance of the liberal institutionalists, which is rational reform within the prevailing system of the international community of sovereign nation-States and international institutions and the capitalist economic growth model, cannot provide a long-term solution. Only from a Marxist perspective can the international law research student adequately grasp the adverse ecological impact of the capitalistic means of production and the anarchical political character of the system of sovereign nation-States to offer a coherent understanding of the true nature of the climate change crisis and the necessary political means to provide the right incentives for humankind to de-carbonize the global economy and solve the climate change problem.

1.3.3.4.2. Neo-Gramscian Framework Approach to Climate Change Governance

The second strand of capitalist-centered critique is inspired more by the Italian political theorist Antonio Gramsci's historical materialism. While Gramsci shared many of the same findings from Marx and Engel's structural analysis about capitalist processes and relations, he, however, did emphasize a stronger notion of individual agency such that social transformation could be brought about by "historically situated social agents whose actions are enabled by their social self-understanding." [519]

[517] See supra note 8.

[518] Tony Weis (2010) The accelerating biophysical contraditions of industrial capitalist agriculture, Journal of Agrarian Change, Volume 10, Number 3, pp. 316-317.

[519] Mark Rupert (2007) Marxism. In: International Relations Theory for the Twenty-First Century: An Introduction [Martin Griffiths (ed.)], Routledge, London, UK, p. 40.

The main concept of Grasmci's work is based on the notion of "hegemony", which refers to "the persistence of specific social and economic structures that systematically advantage certain groups."[520] The social and economic structures conspire to privilege such a social group based on the ideological power of the privileged group over civil society and such a situation is taken for granted as "common sense". However, it also creates the opportunity for the civil society of historically situated individuals with social self-understanding to act strategically by engaging the capitalists in a "war of position" in order to expose the tensions and contradictions of these hegemonic projects, thereby de-reifying them and proposing an alternative social order.[521]

1.3.3.4.3. International Politics Explanation of Climate Change Governance

It has been argued that the international politics of climate change governance were best explained using a historical materialist framework comprising of three elements. The first element is the recognition of the structural power of capital, which emerges from the Marxist perspective that the primary function of the nation-State is to ensure capital accumulation. This structural power empowers the capitalists because they have the capacity to withhold of shift investment, and to construct "hegemonic ideas concerning the conditions for economic growth" The second element is the key Gramscian concept of hegemony, which is about "the ideological struggles which occur over the projects of the dominant class designed to secure the basic conditions for accumulation." In securing these conditions, the dominant class engages in continual ideological struggles to keep the capitalist system intact. The third element is the dominant class will exploit the inequalities generated by this process of accumulation.[522]

In fact, the three issues that were responsible for the non-implementation of the deep seabed regime in UNCLOS III as well as the obstacles encountered in the evolutionary path of climate change governance, namely: (1) the reversal in US political history from classical liberalism to neoliberalism, (2) the conflicts of the North-South economic divide, and (3) the refusal of the US to concede sovereignty and power to a supranational authority[523] could be explained by the above-mentioned historical materialist framework of the three elements from the Marxist and Gramscian theories.

[520] David L. Levy and Peter J. Newell (2002) Business strategy and international environmental governance: towards a neo-Gramscian synthesis, Global Envionmental Politics, Volume 2, Issue 4, p. 86.

[521] Mark Rupert (2007) supra note 519, p. 40.

[522] Matthew Paterson (1996) Global Warming and Global Politics, Routledge, London, UK, p. 158.

[523] See Section 3.1.6.2.

CHAPTER 2: SYSTEMIC CLIMATE CHANGE

"We need this sense of the continuing interconnectedness of the system as part of the common knowledge, so that politicians feel it and believe it, and so that voters feel it and believe it, and so that kids feel it and believe it, so that they'll grow up with an ethic."

Wallace White[524]

"It ... may help to provoke a movement among the educational systems of the world for both research and teaching about the world as a total system ..."

Kenneth E. Boulding[525]

The pioneering efforts of Greta Thunberg[526] the student activist from Sweden who, at the age of 15, began protesting outside the Swedish Parliament in August 2018 about the need for immediate action to combat climate change, is what we need to witness in the years ahead. The generation most affected by the likely catastrophic disruptions to the biophysical climate system and the human socio-economic system should know about Earth as a holistic system and the systemic impacts of climate change.

2.1. INTERCONNECTIONS TO SOCIO-ECONOMIC SYSTEM

The special characteristic of the Earth's climate system is that not only Earth's carbon life is dependent on the climate system; the growth and development of our vaunted human civilization is also dependent on the climate system. Hence changes in the fragile climate system are deeply connected to the growth of human population, the

[524] Wallace White (1989) Her Deepness, The New Yorker, July 3, 1989, pp. 41-65. Profile of Dr. Sylvia A. Earle, a marine botanist & biologist who is perhaps the world's best-known woman marine scientist, who was one of the first people in marine science to use scuba equipment.

[525] Kenneth E. Boulding (1985) The World as a Total System, Sage Publications, Newbury Park, CA, USA, p. 8.

[526] David Crouch (2018) The Swedish 15-year-old who's cutting class to fight the climate crisis, The Guardian, 1 September 2018. Acesssed on 28 August 2019 at: https://www.theguardian.com/science/2018/sep/01/swedish-15-year-old-cutting-class-to-fight-the-climate-crisis

increase in economic wealth, and the improvement in the quality of life associated with the socio-economic system. Global warming and climate change are intertwined with our dependence on access to energy and progress in technology.

The Royal Swedish Academy of Sciences decided to award the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2018 to William D. Nordhaus "for integrating climate change into long-run macroeconomic analysis" and to Paul M. Romer "for integrating technological innovations into long-run macroeconomic analysis".[527] William Nordhaus began work on the connection between nature and society in the 1970s as scientists had become increasingly worried about the combustion of fossil fuel resulting in a warmer climate. In the mid-1990s, he created the first integrated quantitative assessment model that describes the global interplay between the economy and the climate. His model integrates theories and empirical results from climate science and economics. It is now widely used to simulate how the economy and the climate co-evolve, e.g. to examine the consequences of climate policy interventions in the form of carbon taxes. Romer demonstrated how knowledge functioned as a driver of long-term economic growth. Previous macroeconomic research had already emphasized technological innovation as the primary driver of economic growth, but had not explained how economic decisions and market conditions determine the creation of new technologies. Paul Romer solved this problem by demonstrating how economic forces govern the willingness of firms to produce new ideas and innovations. His endogenous growth theory explains how ideas are different to other goods and require specific market conditions to thrive.[528]

Technological innovations require increased amount of fossil fuel energy and/or the more efficient use of that energy. The next large-scale transition in sustainable economic growth will require technological innovation to move humankind to rely on non-fossil fuel sources of energy as well as the more efficient use of that energy. The quantitative data for world economic, population and energy usage growth rates before and after Industrial Revolution provides the framework to understand the deep interconnections between energy, economic and population growth to climate change.

[527] The Nobel Prize (2018) The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2018, The Nobel Foundation. Accessed on 29 August 2019 at: https://www.nobelprize.org/prizes/economic-sciences/2018/press-release/

[528] Larry Elliott (2018) US economists win Nobel prize for work on climate and growth, The Guardian, 8 October 2018. Accessed on 29 August 2019 at: https://www.theguardian.com/world/2018/oct/08/two-us-economists-win-nobel-prize-for-work-on-climate-and-growth-william-nordhaus-paul-romer

2.1.1. Energy, Economic and Population Growth

The world economic growth in terms of the total Gross Domestic Product (GDP) estimates doubled in 1500 years from 1 AD to 1500. It doubled again in 200 years from 1500 to 1700 and by 1820, just before the Industrial Revolution, it was about 6 times the total GDP estimates at 1AD. The world population growth rate was fairly similar to the economic growth rate before the Industrial Revolution. It doubled in 1600 years from 1 AD to 1600. It doubled again in 220 years from 1600 to 1820, just before the Industrial Revolution took off, or about 4 times the population at 1 AD.[529] After the Industrial Revolution, the growth in total GDP quadrupled in 100 years from 1820 to 1920, which was followed by a quintupling in 50 years from 1920 to 1970. Today, the total GDP is at about US$90 trillion, which is over 100 times that of 1820.[530] The population growth had moved at a significantly slower rate. It had doubled in 100 years from 1820 to 1920, which was followed by another doubling in 50 years from 1920 to 1970. The world population stands today at 7.6 billion, which is about 8 times the population at 1 AD.[531] There are no comparable data available for energy usage prior to the Industrial Revolution. We can assume that the growth rate of energy usage would be similar to the growth rates of economic and population growths at about 4-6 times at 1820 as compared to 1 AD. After the Industrial Revolution, the energy usage tripled in 100 years from 1820 to 1920, which was followed by a quadrupling in 50 years from 1920 to 1970.[532] The world primary energy usage in 2018 is estimated at about 600 EJ, which is about 30 times that of 1820.[533] The three growth rates before Industrial Revolution were similar. After the Industrial Revolution, the three growth rates began to diverge with the slope of the energy growth rate nesting between those of economic growth and population growth respectively. Both economic and population growth relies on energy to grow but economic growth is more dependent on energy usage.

Economic growth fueled population growth, which called for greater technological innovation, further improvements in human productivity, and bigger accumulation of capital. A virtuous cycle was initiated, which extended and accelerated the use of fossil

[529] Angus Maddison (2003) The World Economy: Historical Statistics, Development Centre Studies, OECD, Paris, pp. 256-259.

[530] IMF (2008) GDP Nominal Data, World Economic Outlook Database, April 2018. Accessed on 6 July 2018 at: http://www.imf.org/external/pubs/ft/weo/2018/01/weodata/index.aspx

[531] Worldometer (2018) Current World Population, Population, Worldometers.info. Accessed on 6 July 2018 at: http://www.worldometers.info/world-population/?

[532] Vaclav Smil (2010) supra note 128, p. 155.

[533] Id., p. 155. The estimated primary energy usage in 2008 was 456 EJ. Assuming an average rate of 2.7% per annum over the last decade, the energy usage in 2018 would be about 600 EJ.

fuels. As a result, the anthropogenic carbon dioxide emissions into the atmosphere grew exponentially.[534] Its atmospheric concentration has already surpassed 400ppm after a short 265 years since the pre-industrial (before 1750) level of 280ppm, which had remained stable throughout the inter-glacial period of 12,000 years.[535] Humanity has modified the atmospheric composition[536] and the IPCC in its latest report has concluded that "warming of the climate system is unequivocal" with widespread impacts on natural and human ecosystems, the loss of ice and snow, the warming of the atmosphere and ocean, and the rising of sea levels are unprecedented over decades to millennia.[537]

2.1.2. Large-Scale Transition to Fossil Fuel Energy

Human beings had already modified the climate, especially since the first agricultural revolution[538], which commenced some 12,000 years ago. In fact, William F. Ruddiman suggested that early agriculturalists had caused a reversal in the natural declines of atmospheric carbon dioxide about 8,000 years ago with the start of widespread deforestation, and the emission of methane into the atmosphere about 5,000 years ago with the beginning of rice cultivation, resulting in a concomitant increase in the global mean temperature of ~0.8°C.[539] Still, it is generally accepted that human beings did not significantly influenced the global climate parameters till the Industrial Revolution because pre-industrial societies relied solely on wood and other biomass, manual or animal power as the energy source for work, which is carbon-neutral in the long term.

The patent of the vacuum steam engine by James Watt in 1769[540] was the turning point in the transition to the use of coal as the efficient and "untiring" energy source. The

[534] Dennis L. Hartmann (2016) Global Physical Climatology, 2nd Edition, Elsevier, Amsterdam, The Netherlands, p. 398.

[535] EPA (2016) Climate Change Indicators in the United States: Atmospheric Concentrations of Greenhouse Gases, United States Environmental Protection Agency, updated April 2016, p. 2. Accessed on 7 July 2016 at: https://www3.epa.gov/climatechange/science/indicators/ghg/ghg-concentrations.html

[536] Maria-Antoinette Melieres and Chloe Marechal (2015) Climate Change: Past, Present and Future, translated by Eric Gressler, Wiley-Blackwell, Chichester, UK, p. 91.

[537] IPCC (2014b) Climate Change 2014: Synthesis Report. In: Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp, p. 2.

[538] A detailed description of the Neolithic Revolution or the First Agricultural Revolution is available at: https://genographic.nationalgeographic.com/development-of-agriculture/

[539] William F. Ruddiman (2003) The Anthropogenic Greenhouse Era Began Thousands of Years Ago, Climate Change, Volume 61, pp. 261-293.

[540] Henry Winram Dickinson (1939) A Short History of the Steam Engine, Cambridge University Press, Cambridge, republished on 17 February 2011, pp. 86-87.

steam engine was an external combustion engine. Soon after, inventors worked on developing an internal combustion engine. By 1885, Karl Benz had produced the first automobile, which was a chassis powered by an internal combustion engine with petroleum as fuel.[541] Since then, the use of fossil fuels has grown exponentially.[542] The fossil fuels[543], in the form of coal, petroleum and natural gas, comprise of hydrocarbon molecules. The chemical energy stored in these hydrocarbons is released by combustion. The energy released is then used, after appropriate conversion into other forms, to drive turbine for electricity, as process heat in factories, for heating in buildings, and to power motor vehicles, trains, ships and aircrafts. Fossil fuels are abundant and easy to extract with today's technology. They are also stable (vs. nuclear power), reliable, (vs. wind and solar power), have high energy densities (vs. biomass), and portable (vs. renewable energy). With economy of scale, these fossil fuels can be mined, stored, transported and distributed to customers at comparatively low costs.

2.1.3. Carbon Lock-In

About 50 countries export crude oil and about 150 nations import it. Nearly all countries trade in refined oil products. About 20 countries sell natural gas either by cross-border pipelines or by using tankers to carry liquefied gas. About a dozen countries are major coal importers and a similar number have substantial coal imports.[544] These fossil fuels have become the predominant energy sources for almost all human activities, and their utilization has transformed human society and will continue to impact lives of many generations of humanity to come.[545] All large-scale energy transitions, including the transition to fossil fuel, are inherently long-term affairs. Because of the technical and infrastructure requirements, and because of numerous linkages to social, economic and political considerations, global energy transitions usually take decades to accomplish. The greater the reliance on a particular energy source and the greater the extent of its

[541] New World Encyclopedia Contributors (2014) Internal Combustion Engine, New World Encyclopedia. Accessed on 16 August 2017 at: http://www.newworldencyclopedia.org/entry/Internal_combustion_engine

[542] Gail Tverberg (2012) World Energy Consumption Since 1820 in Charts, Our Finite World, 12 March 2012. Accessed on 7 July 2016 at: https://ourfiniteworld.com/2012/03/12/world-energy-consumption-since-1820-in-charts/

[543] A detailed description of fossil fuels, its uses, and our dependence on fossil fuels is available at: http://www.eesi.org/topics/fossil-fuels/description

[544] Vaclav Smil (2010) supra note 128, p. 13.

[545] John S. Dryzek, Richard B. Norgaard and David Schlosberg (2013) Climate Change and Society: Approaches and Responses. In: The Oxford Handbook on Climate Change and Society [John S. Dryzek, Richard B. Norgaard and David Schlosberg (eds.)], Oxford University Press, Oxford, pp. 3-17.

uses and conversions, the longer the transition period will be. The highly capital-intensive infrastructure associated with its extraction, storage, transportation, distribution, and utilization are institutionalized and global in scale, resulting in carbon lock-in[546], making future growth dependent on the continued use of fossil fuels.

With more than 250 years of widespread experimentation and cumulative experience, the technological processes and business models required to harness fossil fuel energy efficiently are now very well entrenched. As recent as 25 May 2016, the shareholders of Exxon Mobil Corp and Chevron Corp, two of the world's largest petroleum producers, voted not to accept proposals designed to push the companies towards responding more proactively to climate change risks and regulations in their business operations despite strong public sentiments and intense scrutiny of environmentalists and investors.[547]

2.1.4. Next Large-Scale Transition to Non-Fossil Fuel Energy

What humankind needs today is another major transition in energy use from fossil fuel sources to non-fossil fuel sources (nuclear energy or renewable energy sources) for a low carbon world. Because the chief pollutant in global warming is carbon dioxide, tinkering at the periphery of our fossil fuel-based energy systems will not bring about deep cuts in carbon dioxide emissions. The technical solution to our climate change problem would require a massive re-engineering of our current energy systems, especially on how power utilities generate electricity and what fuel to use for transportation. A low carbon world is sorely needed, and we hope to hasten its arrival with our collective commitment to technological innovation. However, the inherently gradual nature of large-scale energy transitions means that to accelerate the energy transition from fossil fuels to renewable energy sources will not be soon realized. Getting there will "exact not only a high financial and organizational cost" but will also require "persistent dedication and considerable patience." "Barring some extraordinary and entirely unprecedented financial commitments and determined actions," the

[546] G. C. Unruh (2000) Understanding carbon lock-in, Energy Policy, Volume 28, Issue 12, October 2000, pp. 817-830. The term carbon lock-in was used by G. C. Unruh to describe how the industrial nations have been locked into fossil fuel-based energy systems through a process of technological and institutional co-evolution driven by path-dependent increasing returns to scale. It can inhibit the diffusion of alternative carbon-saving technologies despite their apparent environmental and economic advantages.

[547] Reuters (2016) FACTBOX-Climate change proposals for Exxon, Chevron shareholders, Reuters Commodities, 26 May 2016. Accessed on 26 May 2016 at: http://in.reuters.com/article/oil-climatechange-factbox-idINL2N18M1DZ

expected energy transition will unfold over decades and not years.[548]

For instance, although global development agencies and western banks have been shunning coal projects on environmental grounds, there was an increase in global coal consumption in 2017 after four years of decline. India, which is the world's second-biggest burner of coal after China, consumed an additional 27m tons, which was an increase of 4.8% in 2017 as compared to the previous year, making it the major contributor to the increase in global coal consumption although demand also picked up slightly in China and there were large increases in the use of thermal coal for electrification in other parts of Asia as well, including Bangladesh, Pakistan, the Philippines and South Korea.[549] President Barack Obama in his State of the Union Address of January 2014 clearly understood and acknowledged that "the shift to a cleaner energy economy won't happen overnight, and it will require tough choices along the way." He then went on to emphasize the dire need to transit now to non-fossil fuel energy with these words, "and when our children's children look us in the eye and ask if we did all we could to leave them a safer, more stable world, with new sources of energy, I want us to be able to say yes, we did."[550]

2.1.5. Continued Dependence on Fossil Fuel Energy

It is a *sine qua non* that economic growth is fueled by increased energy consumption. In the last decade, available statistics have shown that a nominal annual increase of 3.4% in gross world product[551] or total GDP has been accompanied by an annual increase of about 2.7% in global energy consumption. In 2003, the global energy consumption was about 422 quadrillion British thermal units (Btu).[552] By 2014, we were consuming

[548] Vaclav Smil (2010) supra note 128, p. viii.

[549] The Economist (2018) India shows how hard it is to move beyond fossil fuels, The Economist, Briefing on the black hole of coal, 2 August 2018. Accessed on 3 August 2018 at: https://www.economist.com/briefing/2018/08/02/india-shows-how-hard-it-is-to-move-beyond-fossil-fuels

[550] Barack Obama (2014) State of the Union Address, 28 January 2014. Accessed on 11 July 2018 at: https://obamawhitehouse.archives.gov/the-press-office/2014/01/28/president-barack-obamas-state-union-address

[551] IMF (2015) IMF World Economic Outlook Database 2015, International Monetary Fund. Accessed on 26 April 2016 at: http://www.imf.org/external/pubs/ft/weo/2015/01/weodata/weorept.aspx?pr.x=21&pr.y=15&sy=2006&ey=2016&ssd=1&sort=country&ds=.&br=1&c=001%2C110%2C163%2C200&s=NGDP_RPCH&grp=1&a=1#download

[552] McKinsey Global Institute (2007) Curbing global energy demand growth: the energy productivity opportunity, McKinsey&Company, p.10.

approximately 550 quadrillion Btu of energy[553] at an average rate of 2.7% per annum over the last decade. Despite the breath and depth of today's energy market, there are still about 1.2 billion people without electricity and more than 2.7 billion people who still burn solid fuels, such as wood, crop residue and dung, to cook their food. Providing an affordable and reliable source of energy to this deprived population is essential for its wellbeing and for global economic development.[554] John S. Watson, Chairman of the Board and CEO of Chevron Corp, in a recent interview, remarked, "This will require more energy in the years ahead than we can possibly produce by renewable sources given today's technology … It's clear that to meet those needs we'll need all forms of energy – renewable, oil, natural gas, coal and nuclear."[555]

Fossil fuel energy will continue to be the life-blood of our economic growth. The latest estimates provided by the International Energy Agency (IEA) show that about 81% of the world's total primary energy supply (TPES) is provided by fossil fuels and only 14% is provided by renewable energy and 5% by nuclear energy.[556] The bottom line is that the fossil fuels are sustaining the global economy. The global consumption of energy is projected to reach some 820 quadrillion Btu by 2040 and it is estimated that more than 75% of which would still be provided by fossil fuels.[557]

2.1.6. Hidden Costs of Fossil Fuels Energy Usage

Humankind has already started paying back in lieu for the unrelenting use of fossil fuels with increasing damage to the environment by air pollution and associated public health problems. In monetary terms, the International Monetary Fund (IMF) has estimated in a recent survey that energy subsidies are projected at US$5.3 trillion in 2015, or 6.5

[553] BP (2015) BP Statistical Review of World Energy 2015, British Petroleum. Accessed on 26 April 2016 at: http://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2015/bp-statistical-review-of-world-energy-2015-full-report.pdf

[554] Population figures from the International Energy Agency available at: https://www.iea.org/topics/energypoverty/

[555] John S. Watson (2016) Why I think oil and natural gas are indispensable for the foreseeable future. Interview with LinkedIn Executive Editor Dan Roth, 30 August 2016. Accessed on 2 September 2016 and available at: https://www.linkedin.com/pulse/why-i-think-oil-natural-gas-indispensable-foreseeable-john-s-watson

[556] IEA (2015) IEA Key World Energy Statistics 2015, International Energy Agency. Accessed on 26 April 2016 at: http://www.iea.org/publications/freepublications/publication/key-world-energy-statistics-2015.html

[557] EIA (2013) EIA Energy International Outlook 2013 with Projections to 2040, United States Energy Information Administration, p. 1. Accessed on 26 April 2016 at: http://www.eia.gov/forecasts/archive/ieo13/pdf/0484(2013).pdf

percent of global GDP. Most of this subsidy arises from countries setting energy taxes below levels that fully reflect the environmental damage, including air pollution and global warming, and its concomitant public health problems, associated with fossil fuel energy consumption.[558] Unless humankind is able in the near future to cut down on its dependency on fossil fuels as sources of energy for economic development, our future generations will have to bear the enormous hidden costs of not only air pollution but climate change as well.[559] Although the immediate negative impact in the use of fossil fuels is air pollution, the main by-products discharged into the atmosphere by the combustion of fossil fuels are not air pollutants but carbon dioxide and water vapor,[560] which absorb terrestrial infrared radiation, contributing to global warming.[561]

2.2. IMPACTS OF SYSTEMIC CLIMATE CHANGE

Because of the systemic nature of the complex biophysical climate system, the rapid increase in the average Earth's surface temperature will induce significant changes in all the physical and biological components of the climate system. More importantly, the natural climate system interacts with the human socio-economic system. Hence, global warming will also directly affect the sub-systems of the socio-economic system. The impacts on the climate and human systems are summarized below.

2.2.1. Impacts in the Cryosphere

The components of the cryosphere, which include snow, river and lake ice, sea ice, ice shelf, ice sheet, glacier, ice cap and frozen ground, have very different lifespan. River and lake ice often do not survive beyond summer. Sea ice generally advances and retreats with the seasons although Arctic sea ice can stay frozen for several years. The East Antarctic Ice Sheet is considered to have been relatively stable for the past 14

[558] David Coady, Ian Parry, Louis Sears, and Baoping Shang (2015) How Large Are Global Energy Subsidies? International Monetary Fund, Fiscal Affairs Department, WP/15/105, May 2015. Accessed on 22 May 2016 at: https://www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf

[559] Union of Concerned Scientists (2016) The Hidden Cost of Fossil Fuels. Accessed on 13 June 2016 at: http://www.ucsusa.org/clean_energy/our-energy-choices/coal-and-other-fossil-fuels/the-hidden-cost-of-fossil.html#.V14IzuZ96nS

[560] C_xH_{2y} [hydrocarbon] + $(y+2x)O_2$ [oxygen] → yH_2O [water] + xCO_2 [carbon dioxide]

[561] EPA (2014a) Overview of Greenhouse Gas Emissions. In: Climate Change, United States Environmental Protection Agency. Accessed on 14 June 2016 at: https://www3.epa.gov/climatechange/ghgemissions/gases.html

million years. Because its components are "inherently sensitive to temperature change over a wide range of time scales, the cryosphere is a natural integrator of climate variability and provides some of the most visible signatures of climate change."[562]

The cryosphere exerts significant control on the physical, biological and social systems over a large part of the Earth's surface because of its major impact on the Earth's energy balance, water cycle, primary productivity, ocean surface gas exchange, and sea level. Ice sheets and glaciers determine the global sea level. The loss of glaciers near populated areas may impact the winter tourist industry while wild gyrations in the seasonal snow cover affect the availability of potable water. The reduction in sea ice extent will continue to alter ocean circulation, marine ecosystem productivity, and regional climates. It will also impact directly on sea transport and resource exploration industries, and indirectly on trade and economic development.

2.2.1.1. Loss of Arctic Sea Ice: Leading Indicator of Climate Change

Currently, attention is on Arctic sea ice extent because its rapid loss greatly exceeds the predictions of climate models. It is changing the seascape of the Arctic Ocean and this change has significant impacts on global and regional climate processes.[563,564] Decrease in snow cover will damage vulnerable Arctic infrastructure as well as increase the total anthropogenic RF via the release of methane underneath the Arctic permafrost.[565] The main driver of the loss in Arctic sea ice extent, over multi-decadal timescales, is enhanced advection of warm Atlantic water into the Arctic.[566] The explanation of the

[562] Vaughan, D.G., J.C. Comiso, I. Allison, J. Carrasco, G. Kaser, R. Kwok, P. Mote, T. Murray, F. Paul, J. Ren, E. Rignot, O. Solomina, K. Steffen and T. Zhang (2013) Observations: Cryosphere. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 319.

[563] James A. Scree and Ian Simmonds (2010) The central role of diminishing sea ice in recent Arctic temperature amplification, Nature, Volume 46, 29 April 2010, pp. 1334-1337.

[564] Meiji Honda, Jun Inoue and Shozo Yamane (2009) Influence of low Arctic sea-ice minima on anomalously cold Eurasian winters, Geophysical Research Letters, Volume 36, Issue 8, 28 April 2009, L08707.

[565] Vaughan, D.G., J.C. Comiso, I. Allison, J. Carrasco, G. Kaser, R. Kwok, P. Mote, T. Murray, F. Paul, J. Ren, E. Rignot, O. Solomina, K. Steffen and T. Zhang (2013) supra note 562, pp. 321-323.

[566] Robert F. Spielhagen, Kirstin Werner, Steffen Aagaard Sørensen, Katarzyna Zamelczyk, Evguenia Kandiano, Gereon Budeus, Katrine Husum, Thomas M. Marchitto, Morten Hald (2011) Enhanced Modern Heat Transfer to the Arctic by Warm Atlantic Water, Science, Volume 331, 28 January 2011, pp. 450-453.

current trend is consistent with global warming.[567] Climate model simulation based on the CCSM4 model output reveals that 50% of the observed trend can be explained by internal variability and the other 50% by anthropogenic forcing.[568]

The Arctic sea ice extent shrank during all seasons between 1979 and 2013. The annual mean Arctic sea ice extent decreased with a rate that was very likely in the range 3.5–4.1% per decade (range of 0.45–0.51 million km^2 per decade), and very likely in the range 9.4–13.6% per decade (range of 0.73–1.07 million km^2 per decade) for the summer sea ice minimum (perennial sea ice).[569] However, 35 years is short with respect to climate change. To answer the question as to whether the current trend is anomalous, it was necessary to expand sea ice extent data into the past for comparison. It meant relying on proxy data from paleoclimate studies for reconstruction of a longer period. The sea ice extent for the summer month had the most available data. When the reconstructed data was smoothened, the trend showed that the Arctic sea ice extent has never been lower in the last 1450 years than in the last decade, and that the decrease in the last 35 years is unprecedented in both duration and magnitude.[570]

According to IPCC, there is medium confidence in projecting that year-round reductions in Arctic sea ice extent will take place by 2100, ranging from 43% for RCP2.6 to 94% for RCP8.5 in September and from 8% for RCP2.6 to 34% for RCP8.5 in February.[571] By using a subset of the climate models that most accurately reproduce the Arctic climate mean state and the 1979–2012 trend of the Arctic sea ice extent, there is medium confidence that a nearly ice-free Arctic Ocean in September is likely to take place by 2050 under emission scenario RCP8.5.[572]

---

[567] Dirk Notz and Jochem Marotzke (2012) Observations reveal external driver for Arctic sea-ice retreat, Geophysical Research Letters, Volume 39, Issue 8, 20 April 2012, L051094.

[568] Jennifer E. Kay, Marika M. Holland and Alexandra Jahn (2011) Inter-annual to multi-decadal Arctic sea ice extent trends in a warming world, Geophysical Research Letters, Volume 38, Issue 15, 11 August 2011, L15708.

[569] IPCC (2013a) Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 9.

[570] Christophe Kinnard, Christian M. Zdanowicz, David A. Fisher, Elisabeth Isaksson, Anne de Vernal and Lonnie G. Thompson (2011) Reconstructed changes in Arctic sea ice over the past 1,450 years, Nature, Volume 479, 24 November 2011, pp. 509-512.

[571] IPCC (2013a) supra note 569, p. 25.

[572] Conditions in the Arctic Ocean are referred to as nearly ice-free when the sea ice extent is less than 10^6 km^2 for at least five consecutive years.

Arctic sea ice is the leading indicator of climate change due to its sensitivity to global warming and its amplification via positive feedback mechanisms.[573] The most important positive feedback is the loss of sea ice-albedo due to the much lower albedo of the open sea. Hence, a decrease of sea ice leads to additional heating of the ocean, which results in further decrease of sea ice, triggering self-acceleration of the sea ice melt.[574,575] Climate model simulation, however, has demonstrated that at least a strong sea ice recovery can take place in four years.[576] Knowing that the Arctic sea ice could quickly recover under a colder climate has increased our confidence that the current observed progressive decline in the Arctic sea ice is a highly sensitive indicator of climate change.

2.2.1.2. Changes in Antarctic Sea Ice

The behavior of sea ice in the Southern Ocean defies the predictions of most climate models. These simulations generally show a decrease in sea ice extent. Observations, however, show that the sea ice extent is advancing, albeit slowly.[577] It is very likely that the Antarctic sea ice extent increased at a rate of between 1.2–1.8% per decade (0.13–0.20 million km^2 per decade) from 1979–2012.[578] Since peaking in 2015, there has been a decline with very rapid loss from early September 2016. Since November 2016, the daily Antarctic sea ice extent has been at its lowest levels in the satellite record. The loss only slowed down in February 2017 with the onset of winter.[579]

---

[573] Wieslaw Maslowski, Jaclyn Clement Kinney, Matthew Higgins and Andrew Roberts (2012) The Future of Arctic Sea Ice, Annual Review of Earth and Planetary Sciences, Volume 40, May 2012, pp. 625-654.

[574] Donald K. Perovich and Christopher Polashenski (2012) Albedo evolution of seasonal Arctic sea ice, Geophysical Research Letters, Volume 39, Issue 8, 20 April 2012, L051432.

[575] James A. Scree and Ian Simmonds (2010) supra note 563, pp. 1334-1337.

[576] D. Schroder and W. M. Connolley (2007) Impact of instantaneous sea ice removal in a coupled general circulation model, Geophysical Research Letters, Volume 34, Issue 14, 19 July 2007, L030253.

[577] Peter Wadhams (2016) Antarctic Sea Ice Changes and Their Implications. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, pp. 49-62.

[578] Stocker, T.F., D. Qin, G.-K. Plattner, L.V. Alexander, S.K. Allen, N.L. Bindoff, F.-M. Bréon, J.A. Church, U. Cubasch, S. Emori, P. Forster, P. Friedlingstein, N. Gillett, J.M. Gregory, D.L. Hartmann, E. Jansen, B. Kirtman, R. Knutti, K. Krishna Kumar, P. Lemke, J. Marotzke, V. Masson-Delmotte, G.A. Meehl, I.I. Mokhov, S. Piao, V. Ramaswamy, D. Randall, M. Rhein, M. Rojas, C. Sabine, D. Shindell, L.D. Talley, D.G. Vaughan and S.-P. Xie (2013) Technical Summary. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 40.

[579] NASA (2017b) Sea Ice Extent Sinks to Record Lows at Both Poles, United States National Aeronautical and Space Administration, 23 March 2017. Accessed on 2 April 2017 at:

In a set of idealized simulations in which the pre-industrial sea ice extent is maintained, the study found the surface temperature response to be 37% less than in the presence of sea ice loss, independent of carbon dioxide concentration. It implies that the sea ice-albedo feedback is similar in magnitude to the GHG forcing in terms of their influence on the Earth's energy balance.[580] The Antarctic sea ice extent is about 20% larger than the Arctic. If current reversal to a loss trend were to persist, there would be significant changes to the planetary sea ice-albedo feedback. Because the Southern Ocean absorbs about one-sixth of the anthropogenic GHG emissions and is responsible for a disproportionate amount of the global ocean heat uptake,[581] any sea ice loss, through their effects on the temperature and salinity of surface waters, could further influence the climate system by regulating the heat and carbon dioxide exports from the atmosphere to the ocean.[582] The same effects are also important factors in determining the stability of the massive land ice sheets and glaciers on Antarctica, which is crucial for anticipating sea levels in the coming decades.[583,584] Sea ice extent is also a key determinant of the structure and function of Antarctica's biological ecosystems, including the temperature and salinity gradients, light availability and nutrient dynamics.[585] The productivity in the Southern Ocean takes place not in open water but within sea ice where the algal communities flourish, providing the critical food source for krill all year round. These algal communities also contribute to the massive phytoplankton blooms during the spring and summer melt in the Southern Ocean. Any change to the sea ice–dependent communities at the bottom of the food chain would

https://www.nasa.gov/feature/goddard/2017/sea-ice-extent-sinks-to-record-lows-at-both-poles

[580] Ivana Cvijanovic and Ken Caldeira (2015) Atmospheric impacts of sea ice decline in CO_2-induced global warming, Climate Dynamics, Volume 44, Issue 5, pp. 1173-1186.

[581] Thomas L. Frolicher, Jorge L. Sarmiento, David J. Paynter, John P. Dunne, John P. Krasting and Michael Winton (2014) Dominance of the southern ocean in anthropogenic carbon and heat uptake in CMIP5 models, Journal of Climate, Volume 28, 15 January 2015, pp. 862–886.

[582] Cecilia M. Bitz, P. R. Gent, R. A. Woodgate, M. M. Holland, and R. Lindsay (2006) The influence of sea ice on ocean heat uptake in response to increasing of Climate, Journal of Climate, Volume 19, 1 June 2006, pp. 2437-2450.

[583] Robert A. Massom, A. Barry Giles, Helen A. Fricker, Roland C. Warner, Benoit Legrésy, Glenn Hyland, Neal Young and Alexander D. Fraser (2010) Examining the interaction between multi-year landfast sea ice and the Mertz Glacier Tongue, East Antarctica: Another factor in ice sheet stability? Journal of Geophysical Research, Volume 115, C12027.

[584] Bertie W. J. Miles, Chris R. Stokes and Stewart S. R. Jamieson (2016) Pan–ice-sheet glacier terminus change in East Antarctica reveals sensitivity of Wilkes Land to sea-ice changes, Science Advances, Volume 2, May 2016, e1501350.

[585] Robert A. Massom and Sharon E. Stammerjoh (2010) Antarctic sea ice change and variability—physical and ecological implications, Polar Science, Volume 4, Issue 2, August 2010, pp. 149-186.

affect fish and other animals higher on the trophic ladder.[586]

There is high confidence that there is distinctive regional variability in Antarctic sea ice extent with some regions increasing and some regions decreasing. Most of the increase in the total sea ice extent has occurred in the western Ross Sea while the sea ice extent and duration are decreasing in the Bellingshausen Sea. Many local, regional and global processes influencing sea ice extent have been proposed. It is still not clear which mechanisms best explain the observed regional variability and the slight increase in Antarctic sea ice extent. There is currently low confidence in projecting whether the Antarctic sea ice extent and volume would increase or decrease to 2100 as the global mean surface temperature continues to rise.[587]

The Arctic and Southern Oceans are significantly different dynamic systems. Unlike the Arctic Ocean, which is affected by the enhanced advection of warm Atlantic water to the Arctic due to anthropogenic forcing, the Southern Ocean surface is relatively insensitive to such anthropogenic forcing. Hence, its surface waters have experienced less warming than has been observed in other areas.[588] Moreover, temperature and salinity changes in the deep ocean can have an outsized effect on the Southern Ocean because of significant upwelling. If the deep waters in the Southern Ocean were to continue warming, the trapped heat will eventually be brought to the surface by upwelling. This heat will melt the Antarctic ice for many decades to come, even if GHG emission levels were markedly reduced in the future.[589]

2.2.1.3. Melting of Land Ice: Icons of Climate Change

Video of a collapsing ice front crashing into the ocean and time-lapse photographs of a melting glacier are often portrayed as iconic examples of climate change. Snowfall over many years on land compresses into large, thickened ice masses. The compressed land ice requires persistent temperatures below 0ºC to be sustained, which is found at either

[586] Kevin R. Arrigo, Thomas Mock and Michael P. Lizotte (2010) Primary Producers and Sea Ice. In Sea Ice, 2nd Edition [David N. Thomas and Gerhad S. Dieckmann (eds.)], Wiley-Blackwell, Chichester, UK, pp. 283-326.

[587] IPCC (2013a) supra note 569, p. 25.

[588] NSIDC (2017c) All About Sea Ice: Arctic vs. Antarctic, United States National Snow and Ice Data Center (NSIDC), University of Colorado, Boulder, USA. Accessed on 4 April 2017 at: https://nsidc.org/cryosphere/seaice/characteristics/difference.html

[589] Jeff Tollefson (2016) The Hostile Ocean that Slowed Climate Change, Nature, Volume 539 (17 November 2016), pp. 346-348. Accessed on 4 April 2017 at: http://www.nature.com/polopoly_fs/1.20978!/menu/main/topColumns/topLeftColumn/pdf/539346a1.pdf

high altitudes or latitudes. The land ice is grouped into 19 distinctive regions, with each region influenced by similar glaciological characteristics and climate conditions.[590]

The compressed land ice known as glaciers or ice caps range in size from a few kilometers in length to about 1.0 X 10^4 km^2 in area, e.g. large ice caps in the Canadian Arctic. About 56% by area of glaciers lie in the Arctic, which is experiencing greater warming than the global average.[591] The largest concentration of glaciers outside the poles lies in Central and South Asia, which includes the Himalaya, Karakorum and Tibetan Plateau, sometimes referred to as the third Pole. Around the margins of Greenland and parts of the Antarctica there are glaciers that are disconnected from the adjacent ice sheets. These glaciers respond more rapidly to warming as compared to their much larger neighboring ice sheets. The ice sheets (continental glaciers) on Greenland and Antarctica are 100–1,000 times larger in area at 1.8 X 10^6 and 13.9 X 10^6 km^2 respectively. In fact, these two ice sheets make up about 99.5% of the total volume of land ice on the planet.[592] The Greenland Ice Sheet (GrIS) has the largest ice volume in the north. In the south, the Antarctica Ice Sheet (AIS) is usually split into three regions with different glaciological characteristics and climate conditions: West Antarctic Ice Sheet (WAIS), East Antarctic Ice Sheet (EAIS) and Antarctic Peninsula. The WAIS is similar in volume to the GrIS but has a large fraction of its ice resting on bedrock that is substantially below the sea level.[593] Contribution of the ice sheets if completely melted to sea level rise would add 66 meters to the current sea level.[594]

There is very high confidence that land ice shrinkage has taken place in all 19 regions

[590] Arendt, A., A. Bliss, T. Bolch, J.G. Cogley, A.S. Gardner, J.-O. Hagen, R. Hock, M. Huss, G. Kaser, C. Kienholz, W.T. Pfeffer, G. Moholdt, F. Paul, V. Radić, L. Andreassen, S. Bajracharya, N.E. Barrand, M. Beedle, E. Berthier, R. Bhambri, I. Brown, E. Burgess, D. Burgess, F. Cawkwell, T. Chinn, L. Copland, B. Davies, H. De Angelis, E. Dolgova, L. Earl, K. Filbert, R. Forester, A.G. Fountain, H. Frey, B. Giffen, N. Glasser, W.Q. Guo, S. Gurney, W. Hagg, D. Hall, U.K. Haritashya, G. Hartmann, C. Helm, S. Herreid, I. Howat, G. Kapustin, T. Khromova, M. König, J. Kohler, D. Kriegel, S. Kutuzov, I. Lavrentiev, R. LeBris, S.Y. Liu, J. Lund, W. Manley, R. Marti, C. Mayer, E.S. Miles, X. Li, B. Menounos, A. Mercer, N. Mölg, P. Mool, G. Nosenko, A. Negrete, T. Nuimura, C. Nuth, R. Pettersson, A. Racoviteanu, R. Ranzi, P. Rastner, F. Rau, B. Raup, J. Rich, H. Rott, A. Sakai, C. Schneider, Y. Seliverstov, M. Sharp, O. Sigurðsson, C. Stokes, R.G. Way, R. Wheate, S. Winsvold, G. Wolken, F. Wyatt, N. Zheltyhina (2015) Randolph Glacier Inventory – A Dataset of Global Glacier Outlines: Version 5.0. Global Land Ice Measurements from Space, Digital Media, Boulder, Colorado, USA.

[591] Jonathan Bamber (2016) Land Ice: Indicator and Integrator of Climate Change. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, p. 64.

[592] Id., p. 64.

[593] Id., pp. 64-65.

[594] A substantial portion of the Antarctic ice sheet is submerged in the sea and this volume of submerged ice has only a small effect on sea level rise on melting.

over the past five decades. Ice mass loss has also likely increased in many regions in the last two decades. However, since around 2005 there have been slightly smaller losses in some regions. In the Central Europe region, the increase in loss rates was earliest and strongest. In the Russian Arctic, the Antarctic and the Sub-Antarctic, the signals are highly uncertain and the trends unclear.[595] There is very high confidence that the Greenland ice sheet has lost ice and contributed to sea level rise over the last two decades and there is high confidence that the average rate of ice loss has increased from 34 gigatons per year over the period 1992–2001 to 215 gigatons per year over the period 2002–2011.[596] There is high confidence that the Antarctic ice sheet and its peripheral glaciers are currently also losing ice and this ice mass loss has increased since 2005. The average rate of ice loss has likely increased from 30 gigatons per year over the period 1992–2001 to 147 gigatons over the period 2002–2011.[597]

There is medium confidence that the global glacier volume, excluding glaciers on the periphery of Antarctica, will decrease by 15 to 55% for RCP2.6, and by 35 to 85% for RCP8.5 by 2100. There is medium confidence that the area of near-surface permafrost will decrease by 37% for RCP2.6 and 81% for RCP8.5 by 2100.[598] Several recent studies of velocity change and sizes of accumulation areas indicate that the world's glaciers are far from equilibrium with present-day climate conditions and will therefore continue to lose considerable mass in the future even without further global warming.[599]

2.2.1.4. Impact of Land Ice Melting on Global Mean Sea Levels (GMSL)

Observations from satellite and airborne surveys in the last two decades coupled with calculations using mass budget, repeat altimetry and gravimetric methods indicated that the Greenland contribution to the Global Mean Sea Levels (GMSL) has very likely (90–100%) increased from 0.09mm per year for the earlier period 1992–2001 to 0.59mm per year for the latter period 2002–2011 while the Antarctica contribution has likely (66–100%) increased from 0.08mm per year for 1992–2001 to 0.40mm per year for 2002–

[595] Vaughan, D.G., J.C. Comiso, I. Allison, J. Carrasco, G. Kaser, R. Kwok, P. Mote, T. Murray, F. Paul, J. Ren, E. Rignot, O. Solomina, K. Steffen and T. Zhang (2013) supra note 562, p. 342.

[596] Stocker, T.F., D. Qin, G.-K. Plattner, L.V. Alexander, S.K. Allen, N.L. Bindoff, F.-M. Bréon, J.A. Church, U. Cubasch, S. Emori, P. Forster, P. Friedlingstein, N. Gillett, J.M. Gregory, D.L. Hartmann, E. Jansen, B. Kirtman, R. Knutti, K. Krishna Kumar, P. Lemke, J. Marotzke, V. Masson-Delmotte, G.A. Meehl, I.I. Mokhov, S. Piao, V. Ramaswamy, D. Randall, M. Rhein, M. Rojas, C. Sabine, D. Shindell, L.D. Talley, D.G. Vaughan and S.-P. Xie (2013) supra note 578, p. 41.

[597] Id., p. 46.

[598] IPCC (2013a) supra note 569, p. 25

[599] Vaughan, D.G., J.C. Comiso, I. Allison, J. Carrasco, G. Kaser, R. Kwok, P. Mote, T. Murray, F. Paul, J. Ren, E. Rignot, O. Solomina, K. Steffen and T. Zhang (2013) supra note 562, p. 342.

2011.[600] The combined contribution of both ice sheets for 1993–2010 was 0.60 mm per year while that from other glaciers was 0.76 mm per year for the same period. The observed average rise in GMSL for this same period was 3.2 mm per year. Hence, the contribution of land ice melting to the GMSL was estimated to be about 43%.[601]

2.2.2. Impacts in the Hydrosphere

The movement of water in the climate system is primarily driven by heat energy. Water evaporates into vapor in the atmosphere. It cools into liquid to form clouds. It solidifies into snow and ice in the cryosphere, and it melts into liquid on land and flows back into the ocean. The water cycle is essential for growth and maintenance of life.[602] It is connected to all components of the Earth. Hence, warming impacts on all components via the water cycle. The amount of water vapor stored in the atmosphere is only a tiny fraction (about 0.001%) of the total water content in the climate system. About 0.8% is fresh-water in the form of surface water or ground water, 1.7% is stored in the form of ice sheets, glaciers and ice caps while 96.5% is contained in the ocean. The ocean is the ultimate reservoir that initiates the water cycle.[603] 75% of water exchange between the atmosphere and the Earth's surface is evaporation and precipitation over the oceans.[604]

Because of its large mass, the high specific heat capacity of seawater, and its ability to connect its surface water to its deep interior, the ocean has a large capacity to store heat energy. For instance, 93% of the excess heat energy stored by the Earth over the last 50

[600] Church, J.A., P.U. Clark, A. Cazenave, J.M. Gregory, S. Jevrejeva, A. Levermann, M.A. Merrifield, G.A. Milne, R.S. Nerem, P.D. Nunn, A.J. Payne, W.T. Pfeffer, D. Stammer and A.S. Unnikrishnan (2013) Sea Level Change. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 1153.

[601] Id., p. 1151.

[602] Stocker, T.F., D. Qin, G.-K. Plattner, L.V. Alexander, S.K. Allen, N.L. Bindoff, F.-M. Bréon, J.A. Church, U. Cubasch, S. Emori, P. Forster, P. Friedlingstein, N. Gillett, J.M. Gregory, D.L. Hartmann, E. Jansen, B. Kirtman, R. Knutti, K. Krishna Kumar, P. Lemke, J. Marotzke, V. Masson-Delmotte, G.A. Meehl, I.I. Mokhov, S. Piao, V. Ramaswamy, D. Randall, M. Rhein, M. Rojas, C. Sabine, D. Shindell, L.D. Talley, D.G. Vaughan and S.-P. Xie (2013) supra note 578, p. 42.

[603] USGS (2016) The Water Science School: the World's Water, United States Geological Survey, US Department of the Interior, 2 December 2016. Accessed on 11 April 2017 at: https://water.usgs.gov/edu/earthwherewater.html

[604] Raymond w. Schmitt (2008) Salinity and the Global Water Cycle, Oceanography, Volume 21, Number 1, March 2008, pp. 12-19.

years is in the ocean.[605] Working as a coupled atmosphere-ocean circulation system, the ocean moves heat from the equator to the poles to cool the tropics and warm the poles.[606] At the same water-air interface, the ocean exchanges gases and particles with the atmosphere. It removes carbon dioxide and releases oxygen, and participates in biogeochemical cycles that regulate the biosphere. The ocean currently contains 50 times more carbon than the atmosphere.[607] It slows down the global warming rate by absorbing about 25% of the anthropogenic carbon dioxide emissions.[608] Covering 71% of the Earth's surface to an average depth of 3730m and containing 97% of surface water, the ocean has an enormous capacity to store and release heat energy and chemical species on timescales of seasons to centuries.[609]

2.2.2.1. Ocean as Long-Term Integrator of Climate Change

The ocean is a long-term integrator of climate change. Its enormous capacity to hold heat and carbon dioxide means that the ocean integrates short-term climate variability and provides a better signal of long-term impact. Hence, both climate variability and climate change on time scales from seasons to millennia is linked to the ocean and its interactions with the cryosphere and atmosphere. Observation of long-term changes in the ocean is a useful tool to track the evolution of climate change. It also serves as a relevant benchmark for determining the validity of climate model simulations.[610]

It is virtually certain (99–100%) that the upper ocean above 700m has warmed from

[605] S. Levitus, J. I. Antonov, T. P. Boyer, O. K. Baranova, H. E. Garcia, R. A. Locarnini, A. V. Mishonov, J. R. Reagan, D. Seidov, E. S. Yarosh, and M. M. Zweng (2012) World ocean heat content and thermosteric sea level change (0–2000 m), 1955–2010, Geophysical Research Letters, Volume 39, 17 May 2012, L10603.

[606] Maria-Antoinette Melieres and Chloe Marechal (2015) supra note 536, p. 33.

[607] Christopher L. Sabine, Richard A. Feely, Nicolas Gruber, Robert M. Key, Kitack Lee, John L. Bullister, Rik Wanninkhof, C. S. Wong, Douglas W. R. Wallace, Bronte Tilbrook, Frank J. Millero, Tsung-Hung Peng, Alexander Kozyr, Tsueno Ono, and Aida F. Rios (2004) The Oceanic Sink for Anthropogenic CO_2, Science, Volume 305, 16 July 2004, pp. 367-371.

[608] Corinne Le Quéré, Taro Takahashi, Erik T. Buitenhuis, Christian Rödenbeck, and Stewart C. Sutherland (2010) Impact of climate change and variability on the global oceanic sink of CO_2, Global Biogeochemical Cycles, Volume 24, GB4007.

[609] Dennis L. Hartmann (2016) supra note 534, p. 17.

[610] Rhein, M., S.R. Rintoul, S. Aoki, E. Campos, D. Chambers, R.A. Feely, S. Gulev, G.C. Johnson, S.A. Josey, A. Kostianoy, C. Mauritzen, D. Roemmich, L.D. Talley and F. Wang (2013) Observations: Ocean. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 255-315.

1971 to 2010. There is high confidence in this assessment because of the increased data coverage after 1971 and a high level of agreement among independent observations of sub-surface temperature, sea surface temperature, and sea level rise, which includes a substantive component due to thermal expansion. The strongest warming is 0.11[0.09–0.13]°C per decade found in the upper 75m, decreasing to about 0.015°C per decade at 700m. Hence, it is virtually certain that the heat content has increased for the ocean above 700m during this period. There is also high confidence that ocean warming dominates the global energy change inventory, accounting for about 93% of the increase in the Earth's energy budget between 1971 and 2010, and warming of the upper ocean above 700m accounts for about 64% of the ocean warming.[611]

The export of GHG emissions into the deep ocean by carbon sequestration is known as the 'biological pump'.[612] The phytoplanktons in the euphotic zone synthesize organic carbon compounds in the form of soft tissues via photosynthesis while the planktons and mollusks recycle inorganic calcium carbonate in the form of hard shells. These species form the base of the marine food web. Through respiration, some of the fixed carbon stay in the euphotic zone to be recycled as part of the regenerative nutrient cycle. The remaining fixed carbon sink to the ocean floor. The sinking particles form aggregates, enhancing the sinking rate. This aggregation gives the sinking particles a better chance of escaping predation and decomposition by bacteria. The fixed carbon decomposed by bacteria is re-mineralized for use again in primary production. The particles that escape all these processes are sequestered in the ocean sediments and may remain there for millions of years. This 'biological pump' is responsible for lowering the atmospheric carbon dioxide content. There is high agreement among the multiple independent studies on the increases in the ocean inventory of anthropogenic carbon to conclude that it is virtually certain (99–100%) that the ocean is increasingly absorbing anthropogenic carbon dioxide. It is very likely that the oceanic anthropogenic carbon inventory increased from 1994–2010 at 1.0–3.2 PgC per year.[613]

2.2.2.2. Ocean Acidification: Good Indicator of Climate Change

[611] Id., p. 257.

[612] S. Honjo, T.I. Eglinton, C.D. Taylor, K.M. Ulmer, S.M. Sievert, A. Bracher, C.R. German, V. Edgcomb, R. Francois, M.D. Iglesias-Rodriguez, B. van Mooy, and D.J. Repeta (2014) Understanding the role of the biological pump in the global carbon cycle: An imperative for ocean science, Oceanography, Volume 27, Number 3, pp. 10-16.

[613] Rhein, M., S.R. Rintoul, S. Aoki, E. Campos, D. Chambers, R.A. Feely, S. Gulev, G.C. Johnson, S.A. Josey, A. Kostianoy, C. Mauritzen, D. Roemmich, L.D. Talley and F. Wang (2013) supra note 610, p. 293.

Increase in atmospheric carbon dioxide content also affects ocean acidification, which is the reduction in ocean pH over an extended period, typically decades or longer. The observed decrease is another good indicator of climate change. Although it can be caused by natural additions or subtractions, e.g. increased volcanic activity, methane hydrate releases, changes in net respiration, the primary cause is increased absorption of atmospheric carbon dioxide.[614] There is high confidence that the ocean pH has decreased by 0.1 since the preindustrial era.[615] Because pH is a logarithmic scale, the observed decrease of 0.1 corresponds to a 26% increase in the hydrogen ion concentration of seawater.[616] Carbon dioxide (CO_2) reacts with water (H_2O) to form the bicarbonate ion (HCO^{3-}) and hydrogen ion (H^+), decreasing the pH. In the ocean, this change can be buffered by the dissolution of bases, such as carbonate ion (CO_3^{2-}). The current rate of atmospheric carbon dioxide absorption is too rapid to be buffered sufficiently by dissolved bases to prevent a reduction in pH.[617] Although the average pH of ocean surface waters has decreased from 8.2 to 8.1 since the advent of the Industrial Revolution, the ocean pH is not expected to become acidic (pH < 7).[618]

To date, the oceans have absorbed approximately 155±30 PgC, which corresponds to roughly one-fourth of the total amount of carbon dioxide emitted (555±85 PgC) by human activities since preindustrial times. Based on paleoclimatic studies, this current rate of ocean acidification is unprecedented in the last 300 million years.[619] More importantly, it has been projected that it would take tens of thousands of years for the ocean pH to return naturally to a near pre-industrial state.[620] It is virtually certain that

[614] Id., p. 295.

[615] Id., p. 294.

[616] James C. Orr, Victoria J. Fabry, Olivier Aumont, Laurent Bopp, Scott C. Doney, Richard M. Feely, Anand Gnanadesikan, Nicolas Gruber, Akio Ishida, Fortunat Joos, Robert M. Key, Keith Lindsay, Ernst Maier-Reimer, Richard Matear, Patrick Monfray, Anne Mouchet, Raymond G. Najjar, Gian-Kasper Plattner, Keith B. Rodgers, Christopher L. Sabine, Jorge L. Sarmiento, Reiner Schlitzer, Richard D. Slater, Ian J. Totterdell, Marie-France Weirig, Yasuhiro Yamanaka, and Andrew Yool (2005) Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms, Nature, Volume 437, pp. 681–686.

[617] Carol Turley and Helen S. Findlay (2016) Ocean Acidification. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, p. 271.

[618] Rhein, M., S.R. Rintoul, S. Aoki, E. Campos, D. Chambers, R.A. Feely, S. Gulev, G.C. Johnson, S.A. Josey, A. Kostianoy, C. Mauritzen, D. Roemmich, L.D. Talley and F. Wang (2013) supra note 610, p. 297.

[619] Bärbel Hönisch, Andy Ridgwell, Daniela N. Schmidt, Ellen Thomas, Samantha J. Gibbs, Appy Sluijs, Richard Zeebe, Lee Kump, Rowan C. Martindale, Sarah E. Greene, Wolfgang Kiessling, Justin Ries, James C. Zachos, Dana L. Royer, Stephen Barker, Thomas M. Marchitto Jr., Ryan Moyer, Carles Pelejero, Patrizia Ziveri, Gavin L. Foster, Branwen Williams (2012) The Geological Record of Ocean Acidification, Science, Volume 335, 2 March 2012, pp. 1058-1063.

[620] David Archer (2005) Fate of fossil fuel CO_2 in geologic time, Geophysical Research Letters,

ocean acidification will increase in the future. Studies based on the CMIP5 Earth System models projected decrease in global mean surface pH of 0.06–0.07 for RCP2.6, 0.14–0.15 for RCP4.5, 0.20–0.21 for RCP6.0, and 0.30–0.32 for RCP8.5.[621]

2.2.2.3. Impact of Ocean Acidification on Marine Biological Ecosystems

To date, there are few empirical data of trends in marine biology that can be attributed directly to ocean acidification. Although there is a paucity of current observational records, the past geological records are imprinted with numerous examples of marine biotic responses to natural ocean acidification.[622] Palaeoclimatic studies indicate that ocean acidification is a threat to the survival of many marine organisms, particularly organisms that use calcium carbonate to produce shells and skeletons.[623] One of the best-studied palaeoclimatic events took place during the Palaeocene-Eocene thermal maximum (PETM) period 55.5 million years ago, which was characterized by a transient climatic warming with clear evidence of ocean acidification.[624] A major extinction of deep-sea benthic foraminiferal fauna took place during the PETM. Although the operating mechanism is still not well understood, it is most probably associated with global warming.[625] Results from simulating and comparing PETM and current climate conditions demonstrated that the current ocean acidification exceeds that during the PETM, which could endanger calcifying marine organisms. The results also showed that the higher rates of current environmental change at the ocean surface could potentially even affect the ability of phytoplankton to adapt.[626]

Volume 110, 21 September 2005, C09S05.

[621] Ciais, P., C. Sabine, G. Bala, L. Bopp, V. Brovkin, J. Canadell, A. Chhabra, R. DeFries, J. Galloway, M. Heimann, C. Jones, C. Le Quéré, R.B. Myneni, S. Piao and P. Thornton (2013) Carbon and Other Biogeochemical Cycles. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 531.

[622] Bärbel Hönisch, Andy Ridgwell, Daniela N. Schmidt, Ellen Thomas, Samantha J. Gibbs, Appy Sluijs, Richard Zeebe, Lee Kump, Rowan C. Martindale, Sarah E. Greene, Wolfgang Kiessling, Justin Ries, James C. Zachos, Dana L. Royer, Stephen Barker, Thomas M. Marchitto Jr., Ryan Moyer, Carles Pelejero, Patrizia Ziveri, Gavin L. Foster, Branwen Williams (2012) supra note 619, p. 1058.

[623] Carol Turley and Helen S. Findlay (2016) supra note 617, p. 287.

[624] Andy Ridgwell and Daniela N. Schmidt (2010) Past constraints on the vulnerability of marine calcifiers to massive carbon release, Nature Geoscience, Volume 3, Number 3, March 2010, pp. 196-200.

[625] Ellen Thomas (2007) Cenozoic mass extinctions in the deep sea: What perturbs the largest habitat on Earth? In: Large Ecosystem Perturbations: Causes and Consequences [Monechi, S., Coccioni, R., and Rampino, M.R., (eds.)], Geological Society of America Special Paper 424, pp. 1–23.

[626] Andy Ridgwell and Daniela N. Schmidt (2010) supra note 624, p. 196.

2.2.2.4. Impact on Coral Reefs: Visual Indicator of Climate Change

One of the most captivating sights on Earth is the multicolour coral reefs just beneath the ocean surface. The bleaching of these colourful 'rainforests' of the ocean is a visual indicator of climate change. Corals are actually jelly-like creatures that reside in their self-made calcium carbonate home. These corals also housed different types of colourful algae, which provide the corals with food, making the coral reefs the colourful 'rainforests' of the ocean. Healthy coral reefs support an amazing diversity of marine life and provide many benefits, including coastal protection, food, medicine, employment and recreational activities.[627] However, when the corals are stressed, the tenants are evicted, and the corals turned white. This is known as coral bleaching, which occurred in 1998, the joint warmest year in the entire historical records. That fateful year, bleaching began in French Polynesia, skipped the western South Pacific islands, but wrought havoc on the Great Barrier Reef of Australia. It proceeded westward into the Indian Ocean and destroyed 90% of the coral reefs in the Maldives, moved to Africa and ended with the bleaching of corals in the West Indies. The whole scene was visible from space. The sheer global scale of the coral bleaching took scientists by surprise.[628]

Corals can survive and retrieve their algae when temperature cools. However, if the warming were too high or too long, the corals die. This could be the fate of the Australian Great Barrier Reef. Aerial surveys showed that two consecutive mass bleaching episodes in 2016 and 2017 have affected two-thirds of the reef over a 1,500km stretch, leaving only the southern one-third unscathed. These consecutive episodes gave the reef corals little chance to recover. The mass bleaching in 2017, second in severity only to 2016, has occurred in the absence of an El Niño event.[629]

2.2.2.5. Impact on Planktonic and Pelagic Communities

The marine pelagic zone is the largest natural ecosystem on the planet, occupying 71%

[627] NOAA (2018) Can a coral reef recover from bleaching and other stressful events? National Oceanic and Atmospheric Administration, United States Department of Commerce. Accessed on 15 July 2018 at: https://oceanservice.noaa.gov/facts/reef-resilience.html

[628] Gabrielle Walker and Sir David King (2008) The Hot Topic: How to Tackle Global Warming and Still Keep the Lights On, Bloomsbury, London, pp. 43-44.

[629] Christopher Knaus and Nick Evershed (2017) Great Barrier Reef at terminal stage: scientists despair at latest coral bleaching data, The Guardian, 9 April 2017. Accessed on 21 August 2017 at: https://www.theguardian.com/environment/2017/apr/10/great-barrier-reef-terminal-stage-australia-scientists-despair-latest-coral-bleaching-data

of the Earth's surface, forming the major part of its biosphere. The marine planktonic and pelagic communities in the zone contribute the overwhelming majority of the marine biological production that fuels the marine food web and nutrient cycling as well as about half of the world's oxygen production and carbon sequestration. Because more than 99% of the planktonic and pelagic organisms are ectothermal or cold-blooded, they are highly sensitive to fluctuations in the ocean surface temperature.[630] Meanwhile, because of the short life cycle of the planktonic organisms and their passive response to advective changes, the planktonic communities response very rapidly to changes in their environment. These communities are very sensitive to climate change and provide significant feedbacks to the Earth's climate system.[631] The longer-lived and larger pelagic organisms, e.g. whales, are able to buffer against short-term climate variability because of their longer lifespan and ability to undergo large geographical migration. The impact of acidification is opposite that of warming by affecting polar waters most. Their combinatory effect may result in further range contraction for the boreal and polar species and restriction of the northward migration of tropical and temperate species.[632]

2.2.2.6. Ecological Responses of Marine Species to Climate Change

Changes in temperature also modulates directly and indirectly species interactions, e.g. competition, prey-predator relationships, and food web structures. Global warming will open up new habitats for non-indigenous species, e.g. sub-tropical species in the North Sea. Meanwhile, invasive species can establish viable populations in regions that were once unsuitable.[633] Large numbers of a Pacific Ocean diatom *Neodenticula seminae* was found in the Labrador Sea of the North Atlantic Ocean in 1988. According to paleoclimatic evidences and modern surface sampling studies in the North Atlantic Ocean since 1948, it was the first record of this diatomic species in the North Atlantic Ocean for 800,000 years. It subsequent spread southward and eastward to other areas of the North Atlantic Ocean. The scale and rapidity of its spread after such a long lapse is a good indicator of the impact of climate change on the marine ecosystems.[634]

---

[630] D. Atkinson and R. M. Sibly (1997) Why are organisms usually bigger in colder environments? Making sense of a life history puzzle, Trends in Ecological Evolution, Volume 12, Issue 6, pp. 235-239.

[631] Martin Edwards (2016) Sea Life (Pelagic Ecosystems). In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, pp. 167-182.

[632] Carol Turley and Helen S. Findlay (2016) supra note 617, p. 280.

[633] Martin Edwards (2016) supra note 631, p. 177.

[634] Reid, P. C., D. G. Jones, M. Edwards, M. Starr, M. Poulins and P. Snoeijs (2007) A biological consequence of reducing Arctic ice cover: arrival of the Pacific diatom Neodenticula seminae in the North Atlantic for the first time in 800,000 years, Global Change Biology, Volume 13, Issue 9, pp. 1910-1921.

2.2.2.7. Rising Sea Levels: Most Important Risk for Socio-economic System

In the latest update by WG II on the impacts, vulnerability, and adaptation of coastal systems and low-lying areas to climate change, sea level rise was *"*perceived as the most important risk for human systems*"*, which includes not only the built-up environment (e.g. settlements, transportation infrastructure and networks, water storage, drainage) but human activities (e.g. tourism, fisheries, aquaculture) as well as formal and informal institutions (e.g. policies, laws, customs and culture).[635] Of the current and anticipated impacts of climate change, the rise in sea levels will likely be the most immediate and the most certain to bring about a human catastrophe on a global scale.[636]

Coastal regions have always been attractive regions for human settlements because of their ample subsistence resources, access to marine transportation and trade, suitability for recreational and cultural activities, or simply because of their special sense of place at the interface between land and sea.[637] Utilization of the coastal regions dramatically increased during the 20th century, and this trend seems certain to continue through the 21st century.[638] This development is partially linked to the global trends of growth and urbanization, leading to widespread conversion of natural coastal landscapes for agriculture, aquaculture as well as for industrial, residential, recreation and cultural uses. It is estimated that 23% of the world's population now lives both within 100km distance of the coast and less than 100m above sea level.[639] The population densities of coastal regions are three times higher than the global average. Migration to the coastal regions

[635] Wong, P.P., I.J. Losada, J.-P. Gattuso, J. Hinkel, A. Khattabi, K.L. McInnes, Y. Saito, and A. Sallenger (2014) Coastal Systems and Low-Lying Areas. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 361-409.

[636] Orring H. Pilkey and Rob Young (2009) The Rising Sea, Island Press, Washington, DC, 203 pp, p. 4.

[637] Barbara Neumann, Athanasios T. Vafeidis, Juliane Zimmermann and Robert J. Nicholls (2015) Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding - A Global Assessment, PLoS ONE, Volume 10, Number 3, 11 Mach 2015, e0118571, p. 2.

[638] Nicholls, R.J., P.P. Wong, V.R. Burkett, J.O. Codignotto, J.E. Hay, R.F. McLean, S. Ragoonaden and C.D. Woodroffe (2007) Coastal systems and low-lying areas. In Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.)]. Cambridge University Press, Cambridge, UK, pp. 315-356.

[639] Christopher Small and Robert J. Nicholls (2003) A global analysis of human settlement in coastal zones, Journal of Coastal Research, Volume 19, Issue 3, pp. 584–599.

is common in both developed and developing countries with 60% of the world's 39 metropolises with a population of over 5 million being located within 100km of the coast, including 12 of the world's 16 cities with populations greater than 10 million.[640] About 360 million of these urban residents living in coastal regions that are on grounds lower than 10m above the sea level are particularly exposed.[641] Assuming a GMSL rise of about 0.5–2 m, it has been estimated that without coastal protection 72–187 million people would be displaced due to land loss from submergence and erosion by 2100.[642] There is very high confidence that the coastal systems and low-lying areas will increasingly experience adverse impacts such as submergence, coastal flooding, and coastal erosion.[643] According to James Hansen, "… the world in which civilisation developed, the world with climate patterns that we know and stable shorelines, is in imminent peril."[644] Many small island nations are only a few meters above current sea level. They face the most serious threat of partial or total inundation from future sea-level rise. Among the most vulnerable are the Marshall Islands, Kiribati, Tuvalu, Tonga, the Federated States of Micronesia, and the Cook Islands located in the Pacific Ocean; Antigua and Nevis in the Caribbean Sea; and the Maldives in the Indian Ocean.[645]

Despite these warnings, governments, local communities, and developers have chosen to ignore the inevitability and dire consequences of continuous sea level rise. For instance, the United Arab Emirates (UAE) government has constructed spectacular palm-shaped artificial islands along the Persian Gulf off Dubai, providing spaces for the

[640] Nicholls, R.J., P.P. Wong, V.R. Burkett, J.O. Codignotto, J.E. Hay, R.F. McLean, S. Ragoonaden and C.D. Woodroffe (2007) supra note 638, p. 319.

[641] World Bank (2013) Resilient Coastal Cities June 2013 The Economic, Social and Environmental Dimensions of Risk, World Bank, Caribbean Knowledge Series (June 2013), p. 4.

[642] Wong, P.P., I.J. Losada, J.-P. Gattuso, J. Hinkel, A. Khattabi, K.L. McInnes, Y. Saito, and A. Sallenger (2014) supra note 636, pp. 381-382.

[643] Stocker, T.F., D. Qin, G.-K. Plattner, L.V. Alexander, S.K. Allen, N.L. Bindoff, F.-M. Bréon, J.A. Church, U. Cubasch, S. Emori, P. Forster, P. Friedlingstein, N. Gillett, J.M. Gregory, D.L. Hartmann, E. Jansen, B. Kirtman, R. Knutti, K. Krishna Kumar, P. Lemke, J. Marotzke, V. Masson-Delmotte, G.A. Meehl, I.I. Mokhov, S. Piao, V. Ramaswamy, D. Randall, M. Rhein, M. Rojas, C. Sabine, D. Shindell, L.D. Talley, D.G. Vaughan and S.-P. Xie (2013) supra note 578, p. 68.

[644] James Hansen (2009) Storms of My Grandchildren: The Truth about the Coming Climate Catastrophe and Our Last Chance to Save Humanity, Bloomsbury, New York, USA, 303pp, p. ix.

[645] Smith J.B., H-J Schellnhuber, M. M. Q. Mirza, S. Fankhauser (Switzerland), R. Leemans, Lin Erda, L. Ogallo, B. Pittock, R. Richels, C. Rosenzweig, U. Safriel, R.S.J. Tol, J. Weyant, G. Yohe, W. Bond, T. Bruckner, A. Iglesias, A.J. McMichael, C. Parmesan, J. Price, S. Rahmstorf, T. Root, T. Wigley, K. Zickfeld (2001) Vulnerability to Climate Change and Reasons for Concern: A Synthesis. In Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change [C. Hope and S.K. Sinha (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 915-967.

construction of hundreds of luxurious homes. The Dubai urban area has almost tripled in less than two decades via these Palm Islands and the World Archipelago projects. The built-up environment is located at low elevation, exposed to inundation by even a modest sea-level rise.[646]

Meanwhile, South Florida, USA, is already home to 6 million people and is projected to grow by 3 million over the next three decades. Current sea-level rise has not stopped developers from building more luxurious condominiums. The government is contented to spend billions to hold the shoreline in place with artificial beaches, breakwaters and sea-walls, and the local communities are flocking there to own a piece of tropical luxury. Its very existence depends on the continued allure of the beaches, waterways and natural environment.[647] Because of the porous limestone on which the major cities in South Florida are built, even modest sea level rise comes at great economic cost. It has been estimated that between US$15 billion and US$23 billion of existing property will likely be below sea level by 2050, and between US$53 billion and US$208 billion by 2100.[648] According to the same report, if the whole nation were to continue with business as usual, between US$66 billion and US$106 billion worth of existing coastal property will likely be below sea level by 2050, and from US$238 billion to US$507 billion by 2100. There is a 1-in-20 chance that more than US$701 billion worth of existing coastal property will be below sea level nationwide and more than US$730 billion additional property at risk during high tide by 2100.[649]

2.2.2.8. Projection in Sea Level Rise

Over decades and centuries, the GMSL will rise because of the increase in the amount of liquid water in the ocean and expansion of its volume.[650] The main increase is melt-feed from the cryosphere as a result of rising air temperature, estimated at 1.46mm per

[646] Naser Al Wasmi (2017) UAE's coastal cities at high risk from rising sea levels, The National, Friday, 21 April 2017. Accessed on 21 April 2017 at: http://www.thenational.ae/uaes-coastal-cities-at-high-risk-from-rising-sea-levels

[647] Erika Bolstad (2016) Seas Rising but Florida Keeps Building on the Coast: Sea level rise as a result of global warming is not stopping developers of Florida's coast, Scientific American, 20 June 2016. Accessed on 27 April 2017 at: https://www.scientificamerican.com/article/seas-rising-but-florida-keeps-building-on-the-coast/

[648] Michael R. Bloomberg, Henry M. Paulson, Jr., Thomas F. Steyer, Henry Cisneros, Gregory Page, Robert E. Rubin, George P. Shultz, Donna E. Shalala, Olympia Snowe and Alfred Sommer (2014) Risky Business: The Economic Risks of Climate Change in the United States, Risky Business Project, Risky Business, June 2014, p. 24.

[649] Id., p. 4.

[650] Maria-Antoinette Melieres and Chloe Marechal (2015) supra note 536, p. 274.

year. Volume expansion due to temperature increase was estimated at 1.10mm per year for the period 1993–2010.[651] Another significant contributor to the sea level budget is terrestrial water. Although filling of reservoirs affects the sea level rise negatively, other human interferences with the water cycle, e.g. wetland drainage, sedimentation in reservoirs, groundwater mining, surface water consumption and deforestation, affects sea level rise positively.[652] It was estimated at 0.38mm per year for 1993–2010.[653] Hence, there is a discrepancy in the sea level budget when the observed sea level rise of 3.2mm per year is compared to the total estimate of 2.84mm per year from the 3 contributors, which has been attributed to the underestimation of the ice melt[654] and the uncertainty of the terrestrial water sources.[655]

Direct observations of sea level change have been made with tide gauges over 150 years, and with satellite radar altimeters over 20 years. Although there is regional and local variability, the evidence indicates that the GMSL is rising.[656] The historical tide gauge record shows that the GMSL in the 20th century was 1.7mm per year.[657] This rate increased to 3.2mm per year in 1993–2010.[658] There is medium confidence in projecting that the GMSL rise for 2081–2100 relative to 1986–2005 will likely be in the ranges of 0.26–0.55 m for RCP2.6, 0.32–0.63 m for RCP4.5, 0.33–0.63 m for RCP6.0, and 0.45–0.82 m for RCP8.5. There is medium confidence that the rise for RCP8.5 will be in the range 0.52–0.98 m for year 2100.[659] Although it will not be uniform in the world's

[651] Church, J.A., P.U. Clark, A. Cazenave, J.M. Gregory, S. Jevrejeva, A. Levermann, M.A. Merrifield, G.A. Milne, R.S. Nerem, P.D. Nunn, A.J. Payne, W.T. Pfeffer, D. Stammer and A.S. Unnikrishnan (2013) supra note 600, p. 1151.

[652] Roland Gehrels (2016) Rising Sea Levels. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, p. 244.

[653] Church, J.A., P.U. Clark, A. Cazenave, J.M. Gregory, S. Jevrejeva, A. Levermann, M.A. Merrifield, G.A. Milne, R.S. Nerem, P.D. Nunn, A.J. Payne, W.T. Pfeffer, D. Stammer and A.S. Unnikrishnan (2013) supra note 600, p. 1151.

[654] Laury Miller and Bruce C. Douglas (2004) Mass and volume contributions to twentieth-century global sea level rise, Nature, Volume 428, 25 March 2004, pp. 406-409.

[655] T. G. Huntingdon (2008) Can we dismiss the effect of changes in land-based water storage on sea-level rise? Hydrological Processes, Volume 22, Issue 5, 29 February 2008, pp. 717-723.

[656] Cubasch, U., D. Wuebbles, D. Chen, M.C. Facchini, D. Frame, N. Mahowald, and J.-G. Winther (2013) Introduction. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 136.

[657] John A. Church and Neil J. White (2011) Sea-Level Rise from the Late 19th to the Early 21st Century, Surveys in Geophysics, Volume 32, Issue 4, September 2011, pp. 585-602.

[658] Id., p. 585

[659] IPCC (2013a) supra note 569, p. 25.

oceans, it is very likely that the sea level will rise in over 95% of the oceans.[660] The collapse of marine-based sectors of the Antarctic ice sheet could cause a substantial GMSL rise above this range. A recent study simulating the evolution of the whole West Antarctic Ice Sheet showed that if the Amundsen Sea were to be destabilized the entire marine ice sheet would discharge into the ocean causing a sea level rise of about 3m.[661]

2.2.2.9. Impacts in Other Parts of the Hydrosphere

The amount of water vapor in the lower troposphere increases with global warming. Measurements indicate that the lower tropospheric water vapor has increased at large spatial scales since the 1970s. An increase of 3.5% in the observed global tropospheric water vapor over the past 40 years is consistent with the observed temperature increase of about 0.5°C with relative humidity staying approximately constant. This change can be attributed to human-induced global warming with medium confidence.[662]

Changes in precipitation are harder to ascertain because of the difficulty in precipitation sampling. The projected rate of increase for precipitation at 2% per degree rise in temperature is much lower than the projected 7% per degree rise in temperature for the lower tropospheric water vapour. Still, precipitation is projected to increase gradually in the 21st century.[663] The changes in precipitation will not be uniform. Some regions, e.g. the high latitude landmasses in Eurasia and America, will likely experience a higher increase in precipitation, especially during the winter season. The mid-latitude and subtropical arid and semi-arid regional belts will likely experience a decrease in precipitation. The remaining regions will not experience much change at all.[664]

Improving the reliability of future projections in precipitation is crucial for the Sahel region in Africa (12°N–20°N), which is a semi-arid region on the southern margin of the Sahara desert. For instance, the Sahel region experienced an unprecedented severe drought lasting from the late 1960s to the late 1980s, with only partial recovery through

[660] Id., p. 26.

[661] Johannes Feldmann and Anders Livermann (2015) Collapse of the West Antarctic Ice Sheet after local destabilization of the Amundsen Basin, Proceedings of the National Academy of Sciences for the United States of America, Volume 112, Number 46, 17 November 2015, pp. 14191-14196.

[662] Stocker, T.F., D. Qin, G.-K. Plattner, L.V. Alexander, S.K. Allen, N.L. Bindoff, F.-M. Bréon, J.A. Church, U. Cubasch, S. Emori, P. Forster, P. Friedlingstein, N. Gillett, J.M. Gregory, D.L. Hartmann, E. Jansen, B. Kirtman, R. Knutti, K. Krishna Kumar, P. Lemke, J. Marotzke, V. Masson-Delmotte, G.A. Meehl, I.I. Mokhov, S. Piao, V. Ramaswamy, D. Randall, M. Rhein, M. Rojas, C. Sabine, D. Shindell, L.D. Talley, D.G. Vaughan and S.-P. Xie (2013) supra note 578, p. 42.

[663] Id., p. 44.

[664] Id., p. 44.

2003.[665] There is great concern because the region is dependent on agriculture. Negative trends in annual precipitation may significantly alter the availability of water resources in the Sahel region.[666] The region appears to be tending to drier conditions, largely driven by a weakening of the West African Monsoon, which is one of the three main processes responsible for inter-seasonal precipitation, namely a flow of moist air from the south associated with the west African monsoon onset, the seasonal movement of the ITCZ, and a dry and aerosol-rich advection from the Sahara.[667] However, there are conflicting evidences from different studies related to the Sahel region.[668]

2.2.3. Impacts in Atmospheric Circulation

The trend in pole-ward displacement of major pressure systems and wind belts are likely to have significant impact on regional climates.[669] There has been a pole-ward expansion in atmospheric circulation since the 1970s based on evidences from multiple independent studies.[670] It essentially involves the meridional widening of the tropical belt, a pole-ward shift of storm tracks and eddy-driven jet in the extra-tropical belt, and a contraction of the northern polar vortex. Evidences for such a pole-ward expansion are more robust in the Northern Hemisphere as compared to the Southern Hemisphere.[671]

---

[665] Carlo Buontempo, Ben Booth, Dave Rowell and Wilfran Moufouna-Oki (2010) Sahelian climate: past, current; projections, Met Office, Exeter, UK, p. 5.

[666] IPCC (2007) Summary for Policymakers: Human and Natural Drivers of Climate Change. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 256.

[667] Carlo Buontempo, Ben Booth, Dave Rowell and Wilfran Moufouna-Oki (2010) supra note 665, p. 4.

[668] Kjeld Rasmussen, Sarah D'haen, Rasmus Fensholt, Bjarne Fog, Stephanie Horion, Jonas Ostergaard Nielsen, Laura Vang Rasmussen, and Anette Reenberg. (2016) Environmental Change in the Sahel: Reconciling Contrasting Evidence and Interpretations, Regional Environmental Change, Volume 16, Number 3, pp. 673–80.

[669] Thomas Reichler (2016) Poleward Expansion of the Atmospheric Circulation. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, The Netherlands, p. 79.

[670] Id., pp. 82-84.

[671] Stocker, T.F., D. Qin, G.-K. Plattner, L.V. Alexander, S.K. Allen, N.L. Bindoff, F.-M. Bréon, J.A. Church, U. Cubasch, S. Emori, P. Forster, P. Friedlingstein, N. Gillett, J.M. Gregory, D.L. Hartmann, E. Jansen, B. Kirtman, R. Knutti, K. Krishna Kumar, P. Lemke, J. Marotzke, V. Masson-Delmotte, G.A. Meehl, I.I. Mokhov, S. Piao, V. Ramaswamy, D. Randall, M. Rhein, M. Rojas, C. Sabine, D. Shindell, L.D. Talley, D.G. Vaughan and S.-P. Xie (2013) supra note 578, p. 39.

2.2.3.1. Pole-ward Expansion of Tropical Belt

The meridional widening of the tropical belt is concomitant with the pole-ward shift of the Hadley Cell edge. Following the first climate model study in 2001[672] to gauge the response of atmospheric circulation to GHG emissions, many subsequent studies, based on observation, specific climate models, or climate models from CMIP3 and CMIP5 archives respectively, concluded that GHG-related global warming does lead to an expansion of the meridional tropical circulation over both hemispheres.[673] Magnitude of the pole-ward shift of the Hadley Cell edge over the past few decades have been estimated by recent studies to be about 0.35ºlatitude per decade in the Northern Hemisphere and 0.17ºlatitude per decade in the Southern Hemisphere.[674,675] These findings are significant because the edges of the Hadley Cell represent the boundaries of the tropical and sub-tropical regions, which have sharp meridional gradients in precipitation.[676] Although there is no direct observational evidence, the intensity of this tropical circulation might have decreased as a result of the imbalance brought about by increasing moisture-holding capacity of warmer air not being followed by an equivalent intensification of the water cycle.[677] To date, changes in intensity and position of the global atmospheric circulation systems have been modest in magnitude. However, even small shifts in the location and intensity of the Hadley Cell, storm tracks and eddy-driven jets can have important implications by modifying patterns of storminess, temperature, and precipitation, particularly in the subtropical dry zone regions.[678]

2.2.3.2. Pole-ward Shift of Extra-Tropical Circulation

Concomitant with the pole-ward expansion of the tropical belt is the pole-ward shift in the extra-tropical circulation, namely storm tracks and eddy-driven jets, as there is

[672] Paul J. Kushner, Isaac M. Held and Thomas L. Delworth (2001) Southern hemisphere atmospheric circulation response to global warming, Journal of Climate, Volume 14, Number 10, 15 May 2001, pp. 2238-2249.

[673] Thomas Reichler (2016) supra note 669, pp. 90-91.

[674] Robert J Allen, Joel r Norris, Mahesh Kovilakam (2014) Influence of anthropogenic aerosols and the Pacific Decadal Oscillation on tropical belt width, Nature Geoscience, Volume 7, 16 March 2014, pp. 270-274.

[675] Qiang Fu and Pu Lin (2011) Poleward shift of subtropical jets inferred from satellite-observed lower-stratospheric temperatures, Journal of Climate, Volume 24, Number 21, November 2011, pp. 5597-5603.

[676] Thomas Reichler (2016) supra note 669, p. 83.

[677] Id., p. 85.

[678] R. Seager, M. Ting, I. Held, Y. Kushnir, J. Lu, G. Veechi, H. P. Huang, N. Harnik, A. Leetmaa, N. C. Lau, C. Li, J. Velex, N. Naik (2007) Model projections of an imminent transition to a more arid climate in southwestern North America, Science, Volume 316, Issue 5828, 5 April 2007, pp. 1181-1184.

evidence that the tropical and extra-tropical circulation trends are connected by the similar causes and mechanisms.[679] For instance, during a positive southern Annular Mode (SAM) event, the Westerly wind belt contracts towards Antarctica. As a result, high-pressure belts develop over southern Australia, and the Westerly winds become weaker than normal. The penetration of the wet cold fronts inland becomes restricted, resulting in less precipitation over southern Australia.[680] A study in 2002[681] was the first to connect the SAM trend to the stratospheric ozone layer depletion occurring over the Antarctica. It led to a number of climate modeling studies, which confirmed that localized cooling in the lower polar stratosphere, due to stratospheric ozone depletion, is an important driver for the SAM shift during late spring. Models that do not incorporate this effect did not reproduce the observed trend of the SAM.[682]

2.2.3.3. Drivers of Atmospheric Circulation Changes

Both external forcings and internal processes drive these atmospheric circulation changes. The forcings from changing levels of greenhouse gases, ozone and aerosols impact on the atmosphere's temperature structure and alter its circulation. This imbalance in the Earth's energy budget will also impact sea surface temperatures (SST), and the SSTs in turn will feedback onto the atmosphere's temperature and circulation. Studies investigating the relative roles played by these direct and indirect effects had been inconclusive. Finding conclusive evidences for the anthropogenic external forcings responsible for these atmospheric circulation changes has proven difficult because the shifts in the general atmospheric circulation are complex, including the superposition of various factors, with partly opposing effects, nonlinearities of the circulation system, effects of unknown factors, and unrealistic climate model responses to these factors.[683] Hence, it is still an open question whether external forcings or internal processes are more important in the observed atmospheric circulation changes.[684]

Climate model simulations of future expansion rates are smaller as they do not include

[679] Paul W. Staten and Thomas Reichler (2014) On the ratio between shifts in the eddy-driven jet and the Hadley cell edge, Climate Dynamics, Volume 42, Issue 5-6, March 2014, pp. 1229-1242.

[680] Bureau of Meteorology (2017) The Southern Annular Mode (SAM), Australian Government Bureau of Meteorology. Accessed on 5 August 2017 at: http://www.bom.gov.au/climate/enso/history/ln-2010-12/SAM-what.shtml

[681] David W J Thompson and Susan Solomon (2002) Interpretation of Recent Southern Hemisphere Climate Change, Science, Volume 296, 3 May 2002, pp. 895-899.

[682] Thomas Reichler (2016) supra note 669, p. 91.

[683] Id., p. 87.

[684] Id., p. 88.

the effects from natural climate variations. The width of the tropical belt is expected to expand by 200–300 km by 2100. These simulations indicate that long-term circulation trends can be attributed to anthropogenic activities, e.g. changes in greenhouse gases, stratospheric ozone, and aerosols while the natural climate variation associated with ocean variability is important on shorter, decade-long timescales.[685]

2.2.4. Impacts on Extreme Weather Events

Although climate changes are profound, they appear distant to most of humankind because the natural rhythm of daily and seasonal variability in the weather masks these changes in the Earth's climate. However, people are affected directly by deaths and injuries due to heat waves, droughts, floods and intense storms. They are also affected indirectly via illnesses due to air pollution, spread of disease vectors, water and food insecurity, under-nutrition, and displacement from crucial infrastructure disruptions.[686] In the 2017 publication of *Lancet* on planetary health, it was estimated that weather-related disasters could affect two-third of the European population annually during the period 2071–2100 as compared to one-twentieth in 1981–2010. The number of weather-related fatalities per year is expected to increase by 50 times from its current level in Europe. The study estimated that climate change could account for more than 90% of the rise in risk due to a rise in the frequency of heat waves.[687] Thus, when people experience extreme weather events at higher frequency and greater intensity, many will be concerned about the connection between extreme weather events and climate change.

Not every extreme weather event is a pure meteorological event. Droughts, floods and wild fires depend significantly on the state of human artifacts and activities, e.g. land management, controlled burning, dams and levees, which influence their magnitude and

[685] Id., p. 97-98.

[686] Nick Watts, W Neil Adger, Paolo Agnolucci, Jason Blackstock, Peter Byass, Wenjia Cai, Sarah Chaytor, Tim Colbourn, Mat Collins, Adam Cooper, Peter M Cox, Joanna Depledge, Paul Drummond, Paul Ekins, Victor Galaz, Delia Grace, Hilary Graham, Michael Grubb, Andy Haines, Ian Hamilton, Alasdair Hunter, Xujia Jiang, Moxuan Li, Ilan Kelman, Lu Liang, Melissa Lott, Robert Lowe, Yong Luo, Georgina Mace, Mark Maslin, Maria Nilsson, Tadj Oreszczyn, Steve Pye, Tara Quinn, My Svensdotter, Sergey Venevsky, Koko Warner, Bing Xu, Jun Yang, Yongyuan Yin, Chaoqing Yu, Qiang Zhang, Peng Gong, Hugh Montgomery, Anthony Costello (2015) Health and climate change: policy responses to protect public health, Lancet, Volume 386, Number 10006, 7 November 2015, pp. 1861-1914.

[687] Forzieri G, Cescatti A, Silva FB, Feyen L (2017) Increasing risk over time of weather-related hazards to the European population: a data-driven prognostic study, Lancet Planet Health, Volume 1, pp. e200–208.

frequency.[688] The definition of 'extreme indices' of weather events can either be based on probability of occurrence of given quantities or based on impact of threshold being exceeded. Typically they refer to events occurring as often as 5 or 10% of the time. Even if a weather event were not extreme in a statistical sense, it could produce an extreme impact by crossing a critical threshold in a social ecosystem. A typical tropical cyclone can have an extreme impact depending on where and when it approaches landfall even if it is not extreme in its intensity. Some types of extreme weather depend on the cumulative effects of individual events that are themselves not extreme, e.g. floods and droughts.[689] Changes in extreme weather events can also be due to changes in the mean climate. A substantial body of evidence shows that climate change has led to quantifiable changes in the intensity and/or frequency of some types of extreme weather events.[690,691] Defining extreme weather events is a complex process.

2.2.4.1. Attribution of Extreme Weather Events to Climate Change

The attribution of extreme weather events provides valuable information about the risks involved, requirements of an early warning system, how to plan forward, and what to regulate to alleviate future disasters. It also increases the confidence level of many risk calculations that underpin much of society's activities, e.g. management of land, shelter, water, food, transport and health.[692] There are also compelling reasons to study the extreme weather attribution from a scientific perspective. The knowledge would deepen

[688] National Academies of Sciences, Engineering, and Medicine (2016) Attribution of Extreme Weather Events in the Context of Climate Change, Committee on Extreme Weather Events and Climate Change Attribution, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies, United States National Academies of Sciences, Engineering, and Medicine, The National Academies Press, Washington, DC, p. x.

[689] Id., p. 115.

[690] Donat, M. G., L. V. Alexander, H. Yang, I. Durre, R. Vose, R. J. H. Dunn, K. M. Willett, E. Aguilar, M. Brunet, J. Caesar, B. Hewitson, C. Jack, A. M. G. K. Tank, A. C. Kruger, J. Marengo, T. C. Peterson, M. Renom, C. O. Rojas, M. Rusticucci, J. Salinger, A. S. Elrayah, S. S. Sekele, A. K. Srivastava, B. Trewin, C. Villarroel, L. A. Vincent, P. Zhai, X. Zhang and S. Kitching (2013) Updated analyses of temperature and precipitation extreme indices since the beginning of the twentieth century: The HadEX2 dataset, Journal of Geophysical Research-Atmospheres, Volume 118, Issue 5, pp. 2098-2118.

[691] Seneviratne, S. I., N. Nicholls, D. Easterling, C. M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang (2012) Changes in climate extremes and their impacts on the natural physical environment. In Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor and P. M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 109-230.

[692] National Academies of Sciences, Engineering, and Medicine (2016) supra note 688, p. ix.

our understanding of the climate system, enhancing scientists' ability to forecast future weather and climate states with greater accuracy for both mitigation and adaptation.[693]

One must not underestimate the difficulty of such a task. Our climate system is highly complex with many fluxes of energy and mass transfers among the different physical components operating over a wide range of spatial-temporal scales, often driven by non-linear interactions. Natural climate variability invariably plays a role in it too.[694,695] The attribution of specific extreme weather events to climate change is often confounded by low-frequency natural variability of internal processes, which influences the frequencies of extreme events on decadal to multi-decadal timescales. The observation of such longer-term trends is too few for their uncertainties to be assessed reliably. Besides, its low-frequency variability does not allow for accurate climate model simulations.[696] Therefore, it is important to note that statements about attribution are sensitive to the way questions are posed and the contexts of these questions. The interpretation of an attribution study is only valid when the assumptions and choices that were made in conducting the study are clearly stated and uncertainties are carefully estimated. Hence, the results of an attribution study should not be used to draw general conclusions about the impact of climate change on even the same type of extreme weather events.[697]

2.2.4.2. Extreme Heat and Cold Weather Events

It is very likely (90-100%) that the number of cold days/nights has decreased and the number of warm days/nights has increased between 1951 and 2010.[698] For instance, the average night temperature in Singapore for 1960–1969 was 23.53°C. It had increased to 25.41°C in 2008–2017.[699] It is likely that heat wave frequency has increased in large

[693] Id., pp. ix-x.

[694] Id., p. 10.

[695] Seneviratne, S. I., N. Nicholls, D. Easterling, C. M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang (2012), supra note 691, p. 115.

[696] National Academies of Sciences, Engineering, and Medicine (2016) supra note 688, p. 9.

[697] Id., p. 10.

[698] IPCC (2012) Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, p. 6.

[699] Department of Statistics (2018) Environment: Air Quality and Climate: M890191 - Air Temperature And Sunshine, Relative Humidity And Rainfall, Annual, Government of Singapore. Accessed on 14 July 2018 at: http://www.tablebuilder.singstat.gov.sg/publicfacing/createDataTable.action?refId=15309

parts of Europe, Asia and Australia. Due to the lack of data from Africa and South America, there is only medium confidence that the length and frequency of warm spells have increased on a global scale.[700] It is very likely (90-100%) that human influence has contributed to these changes in the frequency and intensity of daily temperature extremes since 1950.[701] It is also virtually certain (99-100%) that increases in the frequency and magnitude of warm extremes and decreases in cold extremes in daily temperatures will occur on a global scale throughout the 21st century.[702]

2.2.4.3. Heavy Rainfall, Floods and Droughts

Water moves through the global water cycle but it is essentially a local resource. Hence, water-related events such as heavy rainfall, floods and droughts differ between regions. It is likely (66-100%) the number of heavy rainfall events has increased in more regions since 1950. Many regions, however, have statistically non-significant or negative trends. There is only medium confidence that human influence has contributed to a global scale intensification of heavier rainfall since 1950 in land regions where observational coverage is sufficient for assessment.[703] Studies have projected that it is likely (66-100%) the frequency of heavier rainfall or proportion of total rainfall from heavy rainfalls will increase in the 21st century over many regions, especially in the higher latitudes and the tropics as well as the northern mid-latitudes in winter.[704]

Evidence to assess observed changes in the magnitude and frequency of floods due to climate change is limited because data are sparse. There is also low agreement among the sparse data. Hence, there is low confidence at the global scale regarding such

[700] IPCC (2012) supra note 698, p. 6.

[701] Bindoff, N.L., P.A. Stott, K.M. AchutaRao, M.R. Allen, N. Gillett, D. Gutzler, K. Hansingo, G. Hegerl, Y. Hu, S. Jain, I.I. Mokhov, J. Overland, J. Perlwitz, R. Sebbari and X. Zhang (2013) Detection and Attribution of Climate Change: from Global to Regional. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 912.

[702] Seneviratne, S. I., N. Nicholls, D. Easterling, C. M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang (2012), supra note 691, p. 112.

[703] Bindoff, N.L., P.A. Stott, K.M. AchutaRao, M.R. Allen, N. Gillett, D. Gutzler, K. Hansingo, G. Hegerl, Y. Hu, S. Jain, I.I. Mokhov, J. Overland, J. Perlwitz, R. Sebbari and X. Zhang (2013) supra note 701, p. 912.

[704] Seneviratne, S. I., N. Nicholls, D. Easterling, C. M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang (2012), supra note 691, p. 149.

changes. However, in the specific case of extreme coastal high water, it is likely (66-100%) that there has been an increase, which is directly related to increases in the GMSL.[705] The attribution of changes in floods to climate change is even more difficult. Besides the meteorological effects of rainfall, snow cover and sea level, and the hydrological effects of soil moisture content and land surface, there are also the confounding effects of changes in land use and infrastructure development, e.g. dikes and reservoirs. There is low confidence that climate change has affected the magnitude or frequency of floods.[706] Although projected increases in rainfall and temperature imply changes in floods, there is only medium confidence that projected increases in rainfall could contribute to an increase in rain-generated local flooding in some regions. Similarly, projected increases in temperature are likely (66-100%) to result in earlier spring peak flows in snowmelt- and glacier-fed rivers but there is low confidence in their projected magnitudes. Hence, there is low confidence in the global projections of changes in floods due to limited evidence and complexity of causes.[707]

There is medium confidence that some regions, southern Europe and West Africa, have experienced more intense and longer droughts, but in some regions, central North America and north-western Australia, droughts have become less frequent, less intense, or shorter.[708] Although drought is predominantly affected by rainfall, it is also affected by other meteorological conditions such as temperature, wind speed, and solar radiation, and hydrological conditions such as soil moisture content and land surface. Drought is also a complex phenomenon. There are large uncertainties in the observed changes in drought to anthropogenic forcing. There is also difficulty of differentiating between decadal-scale natural variability and climate change. Hence, the IPCC concluded that there is low confidence in detection and attribution of changes in drought due to anthropogenic forcing since 1950.[709] There is also low confidence in projecting changes in droughts due to insufficient agreement among studies. Some recent studies have indicated with medium confidence a projected increase in duration and intensity of droughts in southern Europe, the Mediterranean region, central Europe, central North

[705] IPCC (2012) supra note 698, pp. 6-7.

[706] Seneviratne, S. I., N. Nicholls, D. Easterling, C. M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang (2012), supra note 691, pp. 175-178.

[707] Id., p. 178.

[708] IPCC (2012) supra note 698, p. 6.

[709] Bindoff, N.L., P.A. Stott, K.M. AchutaRao, M.R. Allen, N. Gillett, D. Gutzler, K. Hansingo, G. Hegerl, Y. Hu, S. Jain, I.I. Mokhov, J. Overland, J. Perlwitz, R. Sebbari and X. Zhang (2013) supra note 701, p. 913.

America, Central America and Mexico, northeast Brazil, and southern Africa.[710]

2.2.4.4. Tropical and Extra-tropical Cyclones

Tropical cyclones are among the most destructive natural weather events. According to the United States Census Bureau, Hurricane Katrina was "the costliest U.S. hurricane on record, and the deadliest to strike our nation since 1928."[711] It made landfall 3 times and travelled as a hurricane 130 miles from the coast. A day before 29 August 2005, the city mayor ordered mandatory evacuation of all New Orleans residents, displacing about 400,000 people.[712] The city's levees broke and soon 80% of the city was underwater. It was responsible for 1,833 deaths and damage estimated at $151 billion, including $75 billion in New Orleans and along the Mississippi coast.[713] Although tropical cyclones are commonly associated with extreme wind, it is the surging storm and flooding from extreme rainfall, which generally causes the greatest damage and loss of life. The global frequency of tropical cyclones has remained roughly steady at 90 cyclones per year. However, there is substantial variability within the respective ocean basins over annual to decadal timescales, which when coupled with substantial variability in tropical cyclone tracks, pose significant challenges for mitigation and disaster planning.[714] IPCC has assessed that there is low confidence in attributing changes in cyclone activity to a particular forcing as there is substantial disagreement on the relative importance of internal variability, GHG and aerosols. It is likely (66-100%) that frequency of tropical cyclones will decrease or remain unchanged. It is also likely that the mean maximum wind speed will increase although increases may not occur in all regions. It is more likely than not (>50-100%) that frequency of the most intense storms will increase in some ocean basins. However, there is low confidence in projections of changes in

[710] Seneviratne, S. I., N. Nicholls, D. Easterling, C. M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang (2012), supra note 691, pp. 172-175.

[711] US Census Bureau (2015) FFF: Hurricane Katrina 10th Anniversary: 29 August 2015, United States Department of Commerce, United States Census Bureau, Release Number: CB15-FF.1629, July 2015. Accessed on 31 March 2017 at: https://www.census.gov/newsroom/facts-for-features/2015/cb15-ff16.html

[712] Gordon Russell (2005) Nagin orders first-ever mandatory evacuation of New Orleans, the Times-Picayune, 28 August 2005. Accessed on 31 March 2017 at: http://www.nola.com/katrina/index.ssf/2005/08/nagin_orders_first-ever_mandatory_evacuation_of_new_orleans.html

[713] US Census Bureau (2015) supra note 711.

[714] Seneviratne, S. I., N. Nicholls, D. Easterling, C. M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang (2012), supra note 691, p. 158.

tropical cyclone genesis, location, tracks, duration, or areas of impact.[715]

As extra-tropical cyclones are accompanied by windstorms, wave buildup, storm surges or heavy rainfall, changes in intensity of extra-tropical cyclones or a systematic shift in the location of extra-tropical cyclone activity can have a great impact on a wide range of regional weather events.[716] It is likely (66-100%) that there has been a pole-ward shift in the extra-tropical storm tracks the last 50 years. There is medium confidence that this observed shift is influenced by anthropogenic forcing although it has not been formally attributed. There is also medium confidence that an increased anthropogenic forcing will lead to a reduction in the number of mid-latitude cyclones averaged over each hemisphere.[717] Different studies have resulted in different projections of future regional changes leading to low confidence in region-specific projections.[718]

2.2.4.6. Extreme Snow and Ice Storms

There is no universal criterion for defining extreme snow or ice storm events. The situation is compounded by the presence of people in the area impacted by the storm. Hence, region-specific impact indices have been developed combining both the severity of the storm and population of the affected area.[719] Snowfall measurements are known to suffer from heterogeneities and snow depth data are of limited value as compaction and drifting are common with winter snow events.[720] Snow and ice storms are often accompanied by strong winds. Therefore, attribution of extreme snow and ice storm events suffers from similar challenges as other extreme events that are strongly governed by atmospheric circulation.[721] In view of the ambiguities in event definition, data limitation and uncertainty of forced changes for atmospheric circulation, there have been few attribution studies in observation of extreme snow and ice events.

2.2.4.7. Severe Convective Storms

The term ‘convection’ used in meteorology refers to strong vertical motion (updraft and downdraft) driven by buoyancy in the atmosphere, and the term “severe” is applied when some of the storm variables exceed specified thresholds, e.g., wind speeds greater

[715] Id., p. 163.
[716] Id., p. 163.
[717] Id., pp. 165-166.
[718] Id., p. 166.
[719] National Academies of Sciences, Engineering, and Medicine (2016) supra note 688, pp. 89-90.
[720] Id., p. 90.
[721] Id., p. 92.

than 25ms^{-1} or hailstones larger than 2cm. These storms usually produce strong winds, hail, tornadoes, extensive lightning, or heavy rainfall over land. They are small in both spatial extent and temporal duration as compared to other extreme weather events. The most extreme events, such as tornadoes and large hail, are localized and not well resolved by conventional meteorological observations.[722] The detection of trends in severe convective storms is also difficult due to data heterogeneities. To date, no attribution study of severe convective storms has been carried out.[723]

2.2.4.8. Wild Fires

Wildfires are not meteorological events. However, their initiation and extent are influenced by climate factors, e.g. thunderstorms, drought and winds. Attribution studies of extreme wildfires are limited by the availability of consistent data records. Globally, there has been a significant lengthening of the fire season during the period 1979–2013 across more than 25.3% of the Earth's vegetated surface, resulting in an 18.7% increase in the global mean fire weather season length, which would be consistent with global warming.[724] One of the earliest attribution studies demonstrated that human-induced climate change has a detectable influence on the increase of wildfire burn areas in Canada during 1959–1999 period.[725]

2.2.5. Impacts on Freshwater Resources

Only a small portion of about 2.5% of the planet's water is actually available in the form of freshwater to meet our basic needs of drinking, sanitation and irrigation while 97.5% is unavailable in the form of salt water. Of that 2.5% of freshwater, about 69.4% is locked up in the form of snow and ice in the cryosphere, about 30.1% is in the form of ground water, with less than 0.5% on the surface (lakes, ponds, bogs, rivers and streams), and less than 0.05% retained in the atmosphere as water vapor.[726] Changes in

[722] Gary M. Barnes (2017) Meteorological Hazards in the Tropics: Severe Convective Storms and Flash Floods. In Tropical Meteorology, Encyclopedia of Life Support Systems, UNESCO-EOLSS. Accessed on 16 August 2017 at: https://www.eolss.net/Sample-Chapters/C01/E6-158-20-00.pdf

[723] National Academies of Sciences, Engineering, and Medicine (2016) supra note 688, p. 98.

[724] W. Matt Jolly, Mark A. Cochrane, Patrick H. Freeborn, Zachary A. Holden, Timothy J. Brown, Grant J. Williamson & David M.J.S. Bowman (2015) Climate-induced variations in global wildfire danger from 1979 to 2013, Nature Communications, Volume 6, 7537.

[725] N. P. Gillett, A. J. Weaver, F. W. Zwiers and M. D. Flannigan (2004) Detecting the effect of climate change on Canadian forest fires, Geophysical Research Letters, Volume 31, Issue 18, L18211, 4 pp.

[726] USGS (2016) The World's Water, United States Geological Survey (USGS), U.S. Department of

the water cycle due to climate change can lead to diverse impacts and risks. However, the water cycle also interact with and are conditioned by the equally important, if not more important, non-climatic drivers of population increase, economic development, urbanization, and land use or natural geomorphic changes as well as water management responses, which also challenge the sustainability of freshwater resources by decreasing water supply or increasing demand.

Climate models project decrease of freshwater resources in some region and increase in other regions due to changes in rainfall, albeit with large uncertainties in many places. It is likely to decrease in some dry subtropical and mid-latitude regions and increase in some humid mid-latitude and high latitude regions.[727] Even where increases in rainfall are projected, there can still be short-term shortages due to greater variability in rainfall or seasonal reductions of water supply from the decrease in snow and ice storage in the glaciers over time.[728] Global warming will melt snow and ice, and there will be a "melt-water dividend" for many rivers fed by glaciers during part of the 21st century. However, the continued shrinkage of the glaciers means that the total amount of melt-water will decrease after several decades. More importantly, unless infrastructure investments are made to exploit the "melt-water dividend", the extra freshwater will ultimately flow into the sea without increasing the available freshwater supply.[729] Availability of potable water can also be reduced by the negative impact of climate change on the water quality. For instance, the quality of the water in lakes, for use as potable water, could be affected by the blooming of toxin-producing algae as a result of rising surface temperatures.[730]

It is more helpful to compare the different water cycle changes that are projected for the different emission scenarios. These projections provide quantitative estimates to what may happen under current water resources management practice and what actions may be needed to avoid undesirable results. The projections for 2100 are as follows:

(1) GMST ~2.7°C above the preindustrial period will increase the number of people

the Interior. Accessed on 1 August 2018 at: https://water.usgs.gov/edu/earthwherewater.html

[727] Jiménez Cisneros, B.E., T. Oki, N.W. Arnell, G. Benito, J.G. Cogley, P. Döll, T. Jiang, and S.S. Mwakalila (2014) Freshwater resources. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 251.

[728] Id., p. 257.

[729] Id., p. 257.

[730] Id., p. 251.

living under severe decrease in water resources by 15% and number of people living under absolute water scarcity by 40% as compared with the effects of population growth alone.[731]

(3) The projected population suffering from a 10% reduction of groundwater resources by the 2080s as compared to the 1971–2000 period decreases from 38% for RCP8.5 to 24% for RCP2.6. The projected population that will be spared any significant groundwater resources change would increase from 29% to 47% for RCP2.6.[732]

(3) The projected additional population (with >50% confidence level) exposed to new or aggravated water scarcity are 8%, 11% and 13% of the total population in 2100 with the GMST rise of 2°C, 3.5°C and 5°C respectively. Currently, approximately 1.3 billion people already live in water-scarce regions.[733]

2.2.6. Impacts on Fisheries and Aquaculture

The fisheries and aquaculture processes are more vulnerable to the impacts of climate change than agriculture and livestock. Fisheries are strongly influenced by the seawater and freshwater ecosystem structures and processes. Hence, the rise in water surface temperature, the changes in the intensity, frequency, and seasonality of climate patterns, the changes in intensity and frequency of extreme weather events, the sea level rise, the loss of Arctic and Antarctic sea ice, the melting of glaciers, ocean acidification, the northward shift of atmospheric circulation, the changes in precipitation with associated changes in groundwater and river flows are expected to result in significant changes across a wide range of marine and freshwater ecosystems with consequences for fisheries and aquaculture in many places.[734]

[731] Schewe, J., J. Heinke, D. Gerten, I. Haddeland, N.W. Arnell, D.B. Clark, R. Dankers, S. Eisner, B. Fekete, F.J. Colón-González, S.N. Gosling, H. Kim, X. Liu, Y. Masaki, F.T. Portmann, Y. Satoh, T. Stacke, Q. Tang, Y. Wada, D. Wisser, T. Albrecht, K. Frieler, F. Piontek, L.Warszawski and P. Kabat (2014) Multi-model assessment of water scarcity under climate change, Proceedings of the National Academy of Sciences of the United States of America, Volume 111, Issue 9, p. 3245.

[732] Felix T Portmann, Petra Doll, Stephanie Eisner and Martina Florke (2013) Impact of climate change on renewable groundwater resources: assessing the benefits of avoided greenhouse gas emissions using selected CMIP5 climate projections, Environmental Research Letters, Volume 8, 024023, p. 1.

[733] Dieter Gerten, Wolfgang Lucht, Sebastian Ostberg, Jens Heinke, Martin Kowarsch, Holger Kreft, Zbigniew W Kundzewicz, Johann Rastgooy, Rachel Warren and Hans Joachim Schellnhuber (2013) Asynchronous exposure to global warming: freshwater resources and terrestrial ecosystems, Environmental Research Letters, Volume 8, 034032, p. 1.

[734] Porter, J.R., L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso (2014) Food security and food production systems. In: Climate Change 2014: Impacts,

There is high confidence that climate change will impact negatively on fisheries and aquaculture production of developing countries in the tropical region. The poorest fishers and others dependent on fisheries and subsistence aquaculture will be the most vulnerable to these changes in climate, including those in Small Island Developing States, central and western African countries, Peru and Colombia in South America, and some tropical Asian countries. The developed countries in the temperate region, however, may experience benefits.[735]

An estimated 500 million people depend on coral reef ecosystems for food and other resources in their daily existence. Negative climate change impact therefore has important consequences for coral reef-related industries such as tourism and fisheries, as well as serious economic, social and political implications for the narrow-based economies of the many small island states.[736] Currently, more than 60% of the world coral reefs are considered to be under immediate risk of damage from a range of local threats, of which over-harvesting is the most serious. The risk of damage rises to about 75% when the climate change effects of rising ocean surface temperatures are added to these threats.[737] Declines in coral reef cover typically lead to declines in the abundance of the majority of fish species associated with the coral reefs. There is high confidence that the availability of fish and invertebrate species associated with coral reefs that are important in many tropical coastal fisheries is very likely to be reduced.[738]

The social, economic, and nutritional requirements of the still growing human population till at least 2100[739] is already driving heavy exploitation of capture fisheries and rapid development of aquaculture. For instance, the world fish production is

Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 500.

[735] Id., p. 507.

[736] Ove Hoegh-Guldberg (2011) Coral reef ecosystems and anthropogenic climate change, Regional Environmental Change, Volume 11, Supplement 1, pp. S215-S227.

[737] Lauretta Burke, Kathleen Reythar, Mark Spalding and Alison Perry (2011) Reefs at Risk Revisited, World Research Institute, Washington, DC, p. 1.

[738] Wilson, S.K., N.J. Graham, M.S. Pratchett, G.P. Jones, and V.C. Polunin (2006) Multiple disturbances and the global degradation of coral reefs: are reef fishes at risk or resilient? Global Change Biology, Volume 12, Issue 11, pp. 2220-2234.

[739] United Nations (2015b) World Population Prospects: The 2015 Revision: Key Findings and Advance Tables. Population Division, Department of Economic and Social Affairs, United Nations, New York, p. 3.

projected to reach 194 million tonnes in 2026 or 15% increase as compared to the base year 2014. The main driver of this increase in world fish production will be aquaculture. The expected output of aquaculture in 2026 is 102 million tonnes of cultured fish, which is 34% higher relative to 2014. 90% of this production will come from Asian countries with China accounting for 63% of the total production by 2026.[740] The impacts of population growth adding to and compounding the climate change threats will be a big challenge for humankind to ensure sustainability of fisheries and aquaculture development. Bio-economic modeling has been used to forecast the feasibility of sustaining current and higher per capita fish consumption rates stretching into 2050. The findings show that meeting such consumption rates is highly dependent on the steady growth of aquaculture. Despite a growing population and the impacts of climate change on current and potential fish production, meeting the expected growth in fish production is still feasible provided fisheries and aquaculture are managed sustainably and the animal feeds industry reduces its reliance on captured fish. Ineffective management and rising fishmeal prices driven by greater demand could compromise future aquaculture production and availability of fish products.[741]

2.2.7. Impact of Changes on Agriculture and Livestock

There is medium confidence in the detection and attribution of climate change impacts on agriculture and livestock in all the inhabited continents. Unlike the aquatic food systems, it is, however, more challenging to detect and attribute climate change impacts on agriculture because its outcomes are equally driven by a large number of non-climatic factors, including cultivar improvement, increased use of synthetic fertilizers, herbicides, and pesticides, and of irrigation, as well as policy decisions.[742]

2.2.7.1. Impact on Agriculture

[740] FAO (2018) Fish projections in the OECD-FAO Agricultural Outlook 2017-2026, GLOBEFISH – Analysis and Information on world fish trade, Food and Agriculture Organization (FAO) of the United Nations. Accessed on 17July 2018 at: http://www.fao.org/in-action/globefish/news-events/details-news/en/c/1032635/

[741] Merino, G., M. Barange, J.L. Blanchard, J. Harle, R. Holmes, I. Allen, E.H. Allison, M.C. Badjeck, N.K. Dulvy, J. Holt, S. Jennings, C. Mullon, and L.D. Rodwell (2012) Can marine fisheries and aquaculture meet fish demand from a growing human population in a changing climate? Global Environmental Change, Volume 22, pp. 795-806.

[742] IPCC (2017b) Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (SR2): Background report for the scoping meeting. Working Group III Technical Support Unit, Inter-Governmental Panel on Climate Change (IPCC), London, UK, p. 8.

At the global scale, the increase in annual maximum daytime temperatures and the frequency of unusually hot nights have been observed to affect negatively agriculture.[743]

Emissions of carbon dioxide from fossil fuel combustion are usually accompanied by the emissions of tropospheric ozone precursors, namely nitrogen oxides, carbon monoxide and volatile organic compounds. Elevated levels of tropospheric ozone since the pre-industrial era have very likely suppressed the global output of major crops, with reductions estimated at about 10% for wheat and soy and about 3-5% for maize and rice.[744] The impact of tropospheric ozone pollution on crop yields is most severe in the highly polluted countries of India and China[745,746] but it is also evident for soybean and maize in the US.[747] However, it is virtually certain that the increase in atmospheric carbon dioxide concentrations since the pre-industrial era has improved water use efficiency and increased crop yields.[748] These positive effects are, however, of relatively minor importance when explaining total yield trends.[749] Another positive effect of climate warming has been the significant reductions in frost occurrences since 1961, which have been observed and attributed to anthropogenic GHG emissions. Frost damage is an important constraint on crop growth, especially for high-value crops.[750]

---

[743] Porter, J.R., L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso (2014) supra note 734, pp. 492-493.

[744] Van Dingenen, R., F.J. Dentener, F. Raes, M.C. Krol, L. Emberson and J. Cofala (2009) The global impact of ozone on agricultural crop yields under current and future air quality legislation, Atmospheric Environment, Volume 43, Issue 3, pp. 604-618.

[745] Avnery, S., D.L. Mauzerall, J. Liu and L.W. Horowitz (2011a) Global crop yield reductions due to surface ozone exposure: 1. Year 2000 crop production losses and economic damage, Atmospheric Environment, Volume 45, Issue 13, pp. 2284-2296.

[746] Avnery, S., D.L. Mauzerall, J. Liu and L.W. Horowitz (2011b) Global crop yield reductions due to surface ozone exposure: 2. Year 2030 potential crop production losses and economic damage under two scenarios of O_3 pollution, Atmospheric Environment, Volume 45, Issue 13, pp. 2296-2309.

[747] Fishman, J., J.K. Creilson, P.A. Parker, E.A. Ainsworth, G.G. Vining, J. Szarka, F.L. Booker and X. Xu (2010) An Investigation of widespread ozone damage to the soybean crop in the upper Midwest determined from ground-based and satellite measurements, Atmospheric Environment, Volume 44, Issue 18, pp. 2248-2256.

[748] Hatfield, J.L., K.J. Boote, B.A. Kimball, L.H. Ziska, R.C. Izaurralde, D. Ort, A.M. Thomson and D. Wolfe (2011) Climate impacts on agriculture: Implications for crop production, Agronomy Journal, Volume 103, Issue 2, pp. 351-370.

[749] Justine M. McGrath and David B. Lobell (2011) An independent method of deriving the carbon dioxide fertilization effect in dry conditions using historical yield data from wet and dry years, Global Change Biology, Volume 17, Issue 8, pp. 2689-2696.

[750] Francis W. Zwiers, Xuebin Zhang and Yang Feng (2011) Anthropogenic Influence on Long Return Period Daily Temperature Extremes at Regional Scales, Journal of Climate, Volume 24, Issue 3, 1 February 2011, pp. 881-892.

Many studies have been conducted covering a wide range of regions for the world's major commodity crops of wheat, maize, rice and soybean. There is high confidence that the negative impacts of climate change on crop yields have been more common than positive impacts.[751] There is medium confidence that the current climate trends have negatively affected wheat and maize production for many regions. Many of these studies are regional studies for major producers. However, a global study had also estimated negative impacts on these crops. Hence, there is medium confidence that there are negative impacts on the global aggregate production of wheat and maize.[752] The effects of current climate trends on rice and soybean yields have been found to be smaller in major production regions as well as globally. There are far fewer data for soybean as compared to the other crops.[753] A smaller number of studies had shown with high confidence that global warming actually benefitted crop production in some high-latitude regions, such as northeast China, UK and parts of northern Europe.[754,755]

The projection of crop yields based on future emission scenarios remains the most studied. These studies confirm many of the patterns already identified, such as negative yields for all the major crops when average local surface warming exceeds 3°C without adaptation, even with the benefits of higher carbon dioxide levels and rainfall.[756] The summary data from these studies also indicate that negative impacts on average crop yields become likely from the 2030s onwards, and that negative impacts greater than 5% are more likely than not from the 2050s onwards, and likely by 2100. From 2080s onwards, negative yield impacts in the tropics are very likely, regardless of adaptation or emission scenario.[757] For instance, according to a 2009 Report of a Joint Inquiry by Bangladesh Parliament's All Party Group on Climate Change and Environment and the

[751] Porter, J.R., L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso (2014) supra note 734, p. 488.

[752] David B. Lobell, Wolfram Schlenker and Justin Costa-Roberts (2011) Climate Trends and Global Crop Production since 1980, Science, Volume 333, Issue 6042, pp. 616-620.

[753] Porter, J.R., L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso (2014) supra note 734, p. 491.

[754] Chao Chen, Enli Wang, Qiang Yu and Yongqiang Zhang (2010) Quantifying the effects of climate trends in the past 43 years (1961-2003) on crop growth and water demand in the North China Plain, Climatic Change, Volume 100, Issue 3-4, pp. 559-578.

[755] Supit, I., C.A. van Diepen, A.J.W. de Wit, P. Kabat, B. Baruth and F. Ludwig (2010) Recent changes in the climate yield potential of various crops in Europe, Agricultural Systems, Volume 103, Issue 9, November 2010, pp. 683-694.

[756] Porter, J.R., L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso (2014) supra note 734, p. 505.

[757] Id., pp. 504-505.

UK All Party Parliamentary Climate Change Group,[758] the combination of change in weather patterns and rising sea levels is projected to result in the loss of 8% of Bangladesh's rice production and 32% of its wheat production by 2050.

2.2.7.2. Impact on Livestock

It is also more challenging to detect and attribute climate change impacts on livestock as compared to the aquatic food systems because its outcomes are equally driven by a large number of non-climatic factors, including selective breeding, increased use of animal feeds, and of irrigation, as well as policy decisions. Climate change impacts on livestock will include the direct impact of changes in temperature and water availability on animals, the indirect effects on the availability of forage and feed, and the spread of livestock diseases. In comparison to both fish and crop production, there has been much less work published on the observed impacts of climate change on livestock. However, it does not necessarily mean a lack of evidence on the impacts of climate trends on livestock. For example, some studies have shown with high confidence that high temperatures tend to reduce animal feeding and growth rates.[759] There is also some evidence that the existing challenges of supplying water for an increasing livestock population will be exacerbated by climate change, especially in parts of Africa.[760]

Meanwhile, warming climate trends in North America is expected to lengthen forage growing season but decrease forage quality, with important variations due to rainfall changes.[761] A study of the bluetongue virus, an important ruminant disease, in which the effects of both past and current climate trends on the transmission risk of this viral disease in Europe was evaluated, concluded that climate changes have facilitated the recent rapid spread of the virus into Europe.[762]

---

[758] Saber Hossain Chowdhury and Collin Challen (2009) Climate change equity: is it a plan, an aspiration or a fashion statement? A Report of a Joint Inquiry by Bangladesh Parliament's All Party Group on Climate Change and Environment and the UK All Party Parliamentary Climate Change Group, Dhaka, London and Copenhagen, December 2009, p. 7.

[759] D. Renaudeau, J. Gourdine and N. St-Pierre (2011) A meta-analysis of the effects of high ambient temperature on growth performance of growing-finishing pigs, Journal of Animal Science, Volume 89, Issue 7, 1 July 2018, pp. 2220-2230.

[760] Sennye Masike and Peter Urich (2008) Vulnerability of traditional beef sector to drought and the challenges of climate change: the case of Kgatleng District, Botswana, Journal of Geography and Regional Planning, Volume 1, Number 1, pp. 12-18.

[761] Craine, J.M., A.J. Elmore, K.C. Olson and D. Tolleson (2010) Climate change and cattle nutritional stress, Global Change Biology, Volume 16, Issue 10, pp. 2901-2911.

[762] Guis, H., C. Caminade, C. Calvete, A.P. Morse, A. Tran and B. Baylis (2012) Modelling the effects of past and future climate on the risk of bluetongue emergence in Europe, Journal of the Royal

CHAPTER 3: EVOLUTION OF GLOBAL COMMONS GOVERNANCE

"From the very earliest age, we should make environmental awareness a major theme of education and a major theme of political debate, until respect for the environment comes to be as fundamental as safeguarding our rights and freedoms. By acting together, by building this unprecedented instrument, the first component of an authentic global governance, we are working for dialogue and peace,"

Jacques Chirac[763]

"The leaders in the world at that time were at a stage where they were all looking how to seem like they were supporting the policy without having to make hard commitments that would cost their nations serious resources."

John Sununu[764]

The stark difference in both content and tone of the remarks by Jacques Chirac, President of France, and John Sununu, White House Chief of Staff of President George H. W. Bush's US administration is reflective of the US-Europe political divide, which had a significant bearing on the evolution of international climate change governance.

The focus of Chapter 3 is on the evolution of international climate change governance, however, its meaningful analysis would require analyses of the international governances of other global environmental issues interconnected with climate change,

Society Interface, Volume 9, Number 67, pp. 339-350.

[763] Jacques Chirac's comments on the Kyoto Protocol during his speech at the Sixth COP of the UNFCCC held in The Hague, Netherlands on 20 November 2000 in which he acknowledged that for the first time, humanity is instituting a genuine instrument of global governance.

[764] Quoted in Nathaniel Rich (2018) Losing Earth: The Decade We Almost Stopped Climate Change, The New York Times Magazine, 1 August 2018. This narrative by Nathaniel Rich addressed the 10-year period from 1979 to 1989, which was the decisive decade when the key actors in the United States first came to a broad understanding of the causes and dangers of climate change. It tracks the efforts of a small group of American scientists, activists and politicians to raise the alarm and stave off catastrophe and how close they were to solving the climate change problem. Accessed on 4 August 2018 at: https://www.nytimes.com/interactive/2018/08/01/magazine/climate-change-losing-earth.html?src=longreads&utm_source=Longreads+Newsletters&utm_campaign=8bd2e726a7-Longreads_Top_5_August_3_2018&utm_medium=email&utm_term=0_bd2ad42066-8bd2e726a7-241689933&mc_cid=8bd2e726a7&mc_eid=b1f927fc66

namely the ocean commons and the atmosphere global commons, which includes transboundary air pollution and substances that deplete the stratospheric ozone layer. Due to the interconnectedness of our planetary system and the systemic effects of climate change, other global environmental governance issues like loss of biodiversity, deforestation, desertification, and the linked planetary tipping point thresholds, associated with the hydrosphere, cryosphere, and biosphere of the Earth system will also be mentioned, albeit in brief.

3.1. OCEAN GLOBAL COMMONS GOVERNANCE

The governance of the ocean global commons by the international community has co-evolved with international law over the past 400 years. Hence, an early examination of the evolution of the governance of the ocean global commons is essential background knowledge for the international law research student to understand the conventional (product or rule) approach to the use of 'market' and 'state' to avoid the tragedy of the commons, and the evolution of climate change governance.

3.1.1. The Freedom of the Seas

The oceans were the original global commons and the original solution was the use of international law to define the global commons. The Dutch jurist Hugo Grotius, who is widely regarded as the founding father of modern international law,[765] devised the classic legal doctrine of *mare liberum* or the freedom of the seas[766] in 1608, as opposed to John Selden, who espoused *mare clausum* or 'closed sea'.[767] Grotius advocated allowing a narrow territorial sea under sovereign jurisdiction while leaving an extensive area of high seas (deep oceans) as having the characteristics of an open access commons for free navigation. It soon became the customary law of the freedom of the seas with the four associated freedoms of free navigation, overflight, extraction of marine

[765] Hugo Grotius (1609) The Free Sea, Elzevier, Leiden, Holland [Translated by Richard Hakluyt and republished by Liberty Fund, Indianapolis, IN, USA].

[766] John Selden (1652) Mare Clausum of the Dominion, Or, Ownership of the Sea, William Du-Gard, London, UK. *Mare Clausum* or Dominion of the Sea was the most famous British reply to the argument of Hugo Grotius' *Mare Liberum*, which denied the validity of England's claim to the high seas south and east of England.

[767] Monica Brito Vieira (2003) Mare Liberum vs. Mare Clausum: Grotius, Freitas, and Selden's Debate on Dominion over the Seas, Journal of the History of Ideas, Volume 64, Number 3 (July 2003), pp. 361-377.

resources and the laying cables and pipelines, which had survived intact for 400 years.

This long-standing legal doctrine of the freedom to extract marine resources on a 'first come, first served' basis, however, came under considerable pressure in the 20th century due to increased human population growth and rapid technological innovations in the harvesting of marine resources, e.g. whales and fishes. In the process of regulating the freedom of unconstrained harvesting of fishery stocks from the ocean global commons, the international community has been encroaching on the doctrine of the freedom of the seas and moving closer towards the doctrine of a closed sea.[768]

3.1.2. Unilateral Declaration by State of Extended National Territory

One viable solution to the increased rivalry on fishing in the ocean was for the nation-States to use the constitutive principle of national sovereignty to exclude the ocean global commons as extended national territory by unilateral declaration. Efforts to control and protect fish stocks as well as to exploit mineral resources on the continental shelf resulted in the unilateral declarations by nation-States of sovereign rights over a 200-nautical mile Exclusive Economic Zone (EEZ) from their coastlines.

President Harry S. Truman was the first to use the customary international law principle of a nation's right to ownership of natural resources by extending exclusive jurisdiction over its continental shelf beyond territorial waters with the Truman Proclamation of 28 September 1945.[769] It had proven under certain conditions to be effective for this legal initiative taken by the US was quickly followed by a series of unilateral actions by other nation-States in the second half of the 20th century to enclose significant portions of the ocean global commons with the EEZ,[770] which extends beyond the 12-nautical mile Territorial Sea. It was the South American nation-States of Chile and Peru who followed soon after with claims of maritime zones of 200-nautical miles with the

[768] John Vogler (2000) supra note 185, p. 44.

[769] Harry S. Truman (1945) 1945 US Presidential Proclamation No. 2667, Policy of the United States with Respect to the Natural Resources of the Subsoil and Sea Bed of the Continential Shelf, Washington, USA, 28 September 1945.

[770] An Exclusive Economic Zone (EEZ) is a concept adopted at the Third United Nations Conference on the Law of the Sea (1982), whereby a coastal State assumes jurisdiction over the exploration and exploitation of marine resources in its adjacent section of the continental shelf, taken to be a band extending 200 miles from the shore. Source: Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997. Accessed on 11 August 2019 at: https://stats.oecd.org/glossary/detail.asp?ID=884

Presidential Declaration Concerning Continental Shelf of 23 June 1947[771] and the Presidential Decree No. 781 of 1 August 1947[772] respectively.

The nature of the EEZ is that of a CPR excluded within national jurisdiction, e.g. fishery, mining of oil and gas, or minerals, the governance approach in this instance is basically the solution of 'state' using the provisions available in international law to 'privatize' part of the ocean global commons for themselves. In fact, about one-third of the original high seas had been so 'allocated' to individual nation-States. However, a significant two-third portion still remain *res nullius* because the enclosure of the high seas is physically impossible, economically irrational or difficult to enforce respectively.[773] As to the prevention of overexploitation of the CPR within the national jurisdiction, it is completely dependent on the formal rules of use established by the respective domestic legal systems.

3.1.3. Common Property Resources

Another solution, which was first attempted during the first half of the 20th century, that worked fairly well but with room for improvement was the exclusion of the regional seas that were already naturally enclosed and the resources within, e.g. inshore fisheries. Similarly, international law was used to create the exclusive regional CPR in the form of 'common property resources, e.g. regional fisheries commission, by regional treaties so that the marine resource can be sustainably managed by the regional communities.[774]

Hence, the nature of the regional fisheries commission is that of a regional CPR or even that of a regional club good and the governance approach is closer to that of the socio-ecological approach, as advocated by Ostrom. There are clear physical boundaries of the

[771] United Nations (1951a) Chile: Presidential Declaration concerning continental shelf, 23 June 1947, Chapter 1: National Legislation, Part I: Continental Shelf, Book 1: Laws and Regulations on the Regime of the High Seas, Volume 1 (1951), p. 6.

[772] United Nations (1951b) Presidential Decree No. 781, concerning submerged continental or insular shelf, 1 August 1947, Chapter 1: National Legislation, Part I: Continental Shelf, Book 1: Laws and Regulations on the Regime of the High Seas, Volume 1 (1951), p. 16.

[773] Liz Kazan (2018) 5 Surprising Stats Show Why High Seas Need Protection: Region covers two-thirds of the ocean and supports millions of species—including ours, PEW, 7 June 2018. Accessed on 11 August 2019 at: https://www.pewtrusts.org/en/research-and-analysis/articles/2018/06/07/5-surprising-stats-show-why-high-seas-need-protection

[774] Michael W. Lodge, David Anderson, Terje Løbach, Gordon Munro, Keith Sainsbury and Anna Willock (2007) Recommended Best Practices for Regional Fisheries Management Organizations, The Royal Institute of International Affairs, Chatham House, London, UK.

regional CPR (Design Principles 1A & 1B) and the community of independent nation-States in the regional CPR established the formal rules of use by treaty for the regional CPR based on provisions available in international law.[775]

Again, because of the nature of the high seas, such exclusion of the outshore fisheries would not work well because the fishes in the high seas largely do not stay in any one specific region. Similarly, it would neither work for marine or air pollution, including GHG emissions, because the pollutants introduced into one region would spread rapidly via ocean currents and atmospheric circulation to the other regions of the high seas and global atmosphere respectively.

3.1.4. Common Heritage of Mankind

In 1967, Arvid Pardo, who was then the Permament Representative of Malta to the United Nations, proposed a new radical concept, similar to common property resources, in which international law would play an even more decisive role in managing the oceans global commons. The legal term is *res communis humanitatis* or the common heritage of mankind.[776] The rules for its use are to be established by international means taking into account the concepts of justice and equitable distribution along with compensation for those who may be excluded from enjoying it fully, to overcome the difficulties due to the nature of the oceans global commons. Although it has been considered and discussed since the 1960s for the regulated development of seabed mining of the deep oceans, it is still been debated.[777]

The nature of the deep seabed is therefore truly a global commons and the governance approach proposed by Arvid Pardo is very similar to the ISPO approach of this thesis in which the international community of independent nation-States as a whole establishes the formal rules of use in an international treaty via diplomatic negotiation based on the provisions of public international law but recognizing the intended social goals of distributive justice and equity.[778]

[775] See Section 1.2.3.3.4.

[776] Kemal Baslar (1998) The Concept of the Common Heritage of Mankind in International Law, Martinus Nijhoff Publishers, The Hague, The Netherlands, p. 42.

[777] Michael Orbach (2003) Beyond the Freedom of the Seas: Ocean Policy for the Third Millennium, Oceanography, Volume 16, Number 1, pp. 24-25.

[778] See Section 1.2.4.

3.1.5. Governance of Ocean Global Commons by International Law

In the governance of the ocean global commons via national privatization (private good), regional CPR (club good or CPR) or common heritage of mankind (public good) as described above, the instrument of international law was used to establish formal rules of use in the governance of the ocean global commons for the nation-States, natural regional grouping of countries, or the international community respectively.

3.1.5.1. The UN Conferences on the Law of the Sea (UNCLOS)

In response to all these unilateral declarations, the United Nations held its first multilateral diplomatic conference at Geneva, Switzerland in 1956 to modify and refine the existing Law of the Sea (UNCLOS I).[779] It concluded in 1958 with the establishment of four treaties in four different issue-areas:

(1) Convention on the Territorial Sea and Contiguous Zone
(2) Convention on the Continental Shelf
(3) Convention on the High Seas
(4) Convention on Fishing and Conservation of Living Resources of the High Seas

Soon after, the United Nations held its second Conference on the Law of the Sea (UNCLOS II) again at Geneva, Switzerland in 1960, which, however, did not result in any new multilateral agreements.[780] Both these attempts were viewed as further acts encroaching on the old customary international law of the freedom of the seas.[781]

In the late 1960s, the United States and the Soviet Union, as great naval powers, began extensive diplomatic efforts to organize a new UN conference on the territorial sea in order to check the rush towards enclosure of the ocean global commons. They were primarily concerned that the *ad hoc* extensions of national jurisdiction 'contained the threat that up to 114 key straits would be overlapped by territorial seas', which would hinder navigation rights of their naval ships.[782]

[779] Tulio Treves (2019) 1958 Geneva Conventions on the Law of the Sea, Geneva, 29 April 1958. Accessed on 18 August 2019 at: http://legal.un.org/avl/ha/gclos/gclos.html

[780] UNCLOS II (1960) Final Act of the Second United Nations Conference on the Law of the Sea, A/CONF.19/L.15, Geneva, Switzerland 17 March – 26 April 1960. Accessed on 18 August 2019 at: http://legal.un.org/diplomaticconferences/1960_los/docs/english/vol_1/a_conf19_l15.pdf

[781] John Vogler (2000) supra note 185, p. 44.

[782] Anthony D'Amato and John Lawrence Hargrove (1975) Who Protects the Ocean? Environment

Meanwhile, the technology-poor majority of the coastal nation-States were mainly concerned that the technology-rich developed nation-States would use their advance technologies to exploit their shares of the maritime resources in the ocean global commons and were, therefore, ardent supporters of the 200-nautical mile limit to pre-empt such unfair exploitation.[783]

Then on 1 November 1967, Arvid Prado, the Permanent Representative of Malta to the United Nations, made an electrifying speech before the General Assembly calling for the establishment of international means to prevent marine pollution and to regulate the mining of mineral resources on the deep seabed. He proposed that the deep seabed should be a part of the 'common heritage of mankind'. It resonated with the broader objectives of the New International Economic Order, which was espoused by many members in the Group of 77.[784] However, the establishment of 200-nautical mile EEZ for a privileged group of coastal nation-States reduces significantly by one-third the commons areas open for incorporation into a common heritage of mankind.

3.1.5.2. Comprehensive International Governance of the Sea

The two initiatives converged and the ensuing discussions eventually produced the decision in the UN General Assembly to hold a comprehensive conference on the law of the sea. This third UN Conference on the Law of the Sea (UNCLOS III) began formally with a procedural session at New York in late 1973. With more than 160 nation-States participating, the conference required a decade of arduous negotiations before it was finalized at Montego Bay, Jamaica, on 10 December 1982.[785] It involved 93 weeks of formal negotiations and innumerable number of preliminary and informal meeting to produce a comprehensive international governance on the Law of the Sea (LoS), which comprises of 320 Articles divided among 16 Parts, and with 9 Annexes, ranging across the whole spectrum of issue-areas associated with the ocean global commons, governing all aspects of ocean space, such as delimitation, environmental control, marine scientific research, economic and commercial activities, transfer of technology and the settlement of disputes relating to ocean matters.

---

and the Development of the Law of the Sea [John Lawrence Hargrove (ed.)], The American Society fo International Law, West Publishing Co., St Paul, MINN, USA, p. 27.

[783] Id., p. 26.

[784] Michael Orbach (2003) supra note 777, p. 24.

[785] United Nations (1982) United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982 [hereinafter UNCLOS III].

The Parties at the Conference basically acknowledged that the problems of the oceans and seas, including pollution, are closely interrelated, and hence these problems had to be addressed as a systemic whole with the oceans (high seas) as a global commons. It provides a unique yet comprehensive framework of rules for the protection of the marine environment and marine living resources, including detailed institutional arrangements, as well as provisions for environmental impact assessment, for the transfer of technology, and on environmental damage and liability. These provisions had significant influence on the language and approach of subsequent international environmental agreements. Only Part XII of this Convention addresses directly the issue of atmospheric GHG emissions from marine transport. [786]

From the perspective of international politics, it was a multilateral diplomatic epic, the likes of which may never be seen again. In an attempt to reduce the possibility of groups of nation-States dominating the negotiations, the conference used consensus rather than majority vote for approval of the Convention text in the decision-making process. The negotiators had also agreed from the offset on a 'package deal' in which nothing would be finally decided in the Conference until everything in the Conference was decided in *toto*.[787] It was a mechanism for reconciling the varied interests of the Parties at the Conference. If a party's interests in one particular issue were not fully satisfied, it could look at the whole package and find other issues where its interests were more fully represented, thereby mitigating the negative effect of the former. Thus, UNCLOS III became a highly elaborately document built on trade-offs, large and small.

3.1.5.3. The Exclusive Economic Zone (EEZ)

The concept of the exclusive economic zone (EEZ) was one of the most important pillars of UNCLOS III. Although the formal adoption of the EEZs by UNCLOS III was novel, the fact is that there was already widespread adoption of national EEZs by the 1976–1977 period before the completion of the Convention in 1982, which means that

[786] Jacqueline Peel (2014) International Law and the Protection of the Global Environment. In The Global Environment: Institutions, Law and Policy, 4th Edition [Regina S. Axelrod and Stacy D. VanDeveer (eds.)], CQ Press, Thousand Oaks, California, USA, p. 59.

[787] S.N. Nandan (1986) The Exclusive Economic Zone: A Historical Perspective, View of the Under Secretary-General, Special Representative of the Secretary-General for the Law of the Sea. Accessed on 18 August 2019 at: http://www.fao.org/3/s5280t/s5280t0p.htm

the adoption of EEZs in the Convention was a formality.[788] Today, it is treated as part of customary international law by international courts and tribunals, and governments.[789]

3.1.5.4. The Common Heritage of Mankind

The truly novel feature of UNCLOS III was the attempt to establish a common heritage of mankind regime for the specific issue-area of the mining of the deep seabed.[790] It was apparently the controversial seabed provisions and not the other provisions of the Convention that provoked the refusal of the new Reagan administration in the US government to even sign the LoS Convention. The US was later joined by Britain and the then West Germany in failing to ratify the LoS Convention. As a result, for 11 years, the LoS Convention failed to acquire the necessary ratifications until 16 November 1993 when Guyana became the 60th nation-State to deposit an instrument of ratification with the United Nations for entry into force on 11 November 1994.[791]

3.1.6. International Politics in Governance of Ocean Global Commons

After nearly two decades of support for the 'common heritage of mankind' principle by the United States, and the US efforts behind the LoS Convention, the new Reagan Administration rejected the Convention in 1982.[792]

3.1.6.1. Fear of a Supranational Authority

President Reagan made it clear that the final U.S. acceptance of the LoS Convention was premised on the satisfaction of six key objectives in the Convention's deep seabed provisions.[793] He instructed the U.S. delegation to negotiate a treaty that:

(1) Would not deter development of any deep seabed mineral resources to meet

[788] John Vogler (2000) supra note 185, p. 47.

[789] J. Ashley Roach (2014) Today's Customary International Law of the Sea, Ocean Development and International Law, Volume 45, Issue 3, pp. 239-259.

[790] John Vogler (2000) supra note 185, p. 47.

[791] D. H. Anderson (1995) Legal Implications of the Entry into Force of the UN Convention on the Law of the Sea, International and Comparative Law Quarterly, Volume 44, Issue 2 (April 1995), pp. 313-326.

[792] President Reagan announced his decision not to sign the treaty on July 9, 1982. Statement on the Convention on the Law of the Sea, 18 WEEKLY COMP. PRES. Doc. 887 (1982).

[793] Statement by the President, 18 WEEKLY COMP. PRES. D3c: 94 (Jan. 29, 1982).

national and world demand

(2) Would assure national access to these resources by current and future qualified entities to enhance U.S. security of supply, to avoid monopolization of the resources by the operating arm of the International Seabed Authority, and to promote the economic development of the resources

(3) Would provide a decision-making role in the deep seabed regime that fairly reflected and effectively protected the political and economic interests and financial contributions of participating states

(4) Would not allow for amendments to come into force without approval of the participating states, including in our case the advice and consent of the Senate

(5) Would not set other undesirable precedents for international organizations, and

(6) Would be likely to receive the advice and consent of the Senate. In this regard, the Convention should not contain provisions for the mandatory transfer of private technology and participation by, and funding for, national liberation movements.

It was unfortunate that the LoS Convention had "to encounter one of the most dramatic reversals in American political history."[794] Defending the rejection of the Convention, Reagan's ambassador to the United Nations Conference on the Law of the Sea (UNCLOS III) declared: "[T]he political, economic and ideological assumptions which underlay the treaty are essentially antithetical to American values [and promote] a thinly disguised world collectivism."[795]

In 1983, President Reagan continued his ocean policy with a Proclamation and an adjoining statement calling for the establishment of a 200-nautical mile Exclusive Economic Zone and reiterating that deep seabed mining is a 'high seas' freedom.[796]

3.1.6.2. Turn from Classical Liberalism to Neoliberalism in US Domestic Politics

The economic 'neoliberal' ideology of market capitalism associated with President Ronald Reagan in the US administration and Prime Minister Margaret Thatcher in the

[794] Roderick Ogley (1984) Internationalizing the Seabed, Gower Publishing Co., Aldershot, UK, p. 239.

[795] Cited in D. Brian Hufford (1983) Ideological Rigidity vs. Political Reality: A Critique of Reagan 's Policy on the Law of the Sea, Yale Law and Policy Review, Volume 2, Issue 1, p. 127. Remarks of James Malone, Assistant Secretary of State and the United States Representative to UNCLOS under Reagan, quoted by Curtis, Sign the Sea-Law Treaty, N.Y. Times, Feb. 21, 1983, at A17, Col. 4.

[796] Statement by the President, 10 March 1983, Proclamation No. 5030, 48 Federal Register, 10,605 (1983).

UK administration in the 1980s was all about competitive free market economics, relying solely on the 'market' solution and minimizing the role of the 'state'.[797]

Neoliberalism ideology is more aligned to conservatism than to liberalism, and President Reagan of the conservative Republican Party, which had enthusiastically embrace neoliberalism, was advocating a much smaller role for the 'State' (both domestic and international). In fact, neoliberalism advocates that the conditions necessary for a competitive free market to operate must be won politically so that the State should be re-designed to play a much smaller role. The lawmaker (both domestic and international) was not allowed to distort the natural actions of the marketplace. The ideal domestic or international political system should just provide a fixed, neutral, universal legal framework within which market forces operate spontaneously. The teological purpose of the State was never preferred to the price system of the Market, which is not only efficient but maximises liberty, or the opportunity for men and women to make free choices about their own lives.[798]

The Reagan administration had little interest in pursuing the concept of the common heritage of mankind and the North-South dialogue, which are essentially associated with the liberal-internationalist spirit of international law and not with neoliberalism.[799] The sixth key objective of President Reagan's instructions to the US delegation in negotiating the LoS Convention was that the Convention should not contain provisions for the mandatory transfer of private technology and participation by, and funding for, national liberation movements.[800]

With the collapse of the Soviet Union, the United States was the only superpower left in the international political system in the 1990s. There was no issue of mutual vulnerability (interdependence) as far as the US is concerned. In fact, the other nation-States were far more dependent on the US hegemony of the international political

[797] John Vogler (2000) supra note 185, p. 64.

[798] See Section 1.3.3.2.3.

[799] Liberal internationalism is based on the belief that international progress as a movement towards increasing levels of harmonious cooperation between political communities is possible. Hence, theories on liberal internationalism address how best to organize and reform the international system. In general, they advocate diplomacy and multilateralism as the most-appropriate strategies for nation-States to pursue and tend to champion supranational political structures, e.g. European Union, and international organizations, e.g. United Nations. Extracted from Encylopaedia Britannica (online). Accessed on 18 August 2019 at: https://www.britannica.com/topic/liberal-internationalism

[800] See Section 3.1.6.1.

system and its free and open economic market system.[801] Hence, the international institutional machinery of the seabed regime as agreed upon at UNCLOS III was seen by the US as setting a wholly undesirable legal precedent, in which US as the lone superpower has now to concede power to a supranational authority.[802]

In fact, these three issues that were responsible for the non-implementation of the deep seabed regime in UNCLOS III were exactly the same obstacles encountered in the evolutionary path of climate change governance at roughly the same time, namely:

(1) US political history turning from classical liberalism to neoliberalism
(2) The North-South economic divide
(3) Conceding national sovereignty and power to a supranational authority

3.1.6.3. Difference between Neoliberalism and Classical Liberalism

Neoliberalism is essentially an economic ideology, which is characterized by its belief in sustained economic growth as the means to human progress, its reliance on free competitive markets for the most-efficient allocation of resources, its emphasis on minimal state intervention in economic affairs, and its commitment to the freedom of trade and capital. The dramatic fall of the Berlin Wall in 1989 and the eventual collapse of the centralized planning Soviet Union in 1991 were held up as prime examples of the superiority of the 'market' over the 'state' for collective action.

Classical liberalism is a comprehensive political philosophy with the central importance of individual liberty in the economic, political and social spheres of human society. In the economic sphere, the classical liberals agree with the neoliberals on the importance of the free competitive market system to maximize individual liberty in the economic sphere. However, in the political sphere, the classical liberals recognize that the legitimacy of a government is with the people, and although the government should minimize intervention and adhere to the rule of law, the classical liberals were not against state-led welfare programmes and moderate taxation. Since their primary concern was for individual liberty, therefore if the state had to intervene to protect individual liberty, it is acceptable to the classical liberal. On the other hand, one of the

[801] Daniel Deudney and G. John Ikenberry (2012) Democratic Internationalism: An American Grand Strategy for a Post-exceptionalist Era, Working Paper, November 2012, International Institutions and Global Governance Program, Council on Foreign Relations, New York, NY, USA.

[802] See Section 3.1.6.1 on objective (5) of the Statement by the President, 18 WEEKLY COMP. PRES. D3c: 94 (Jan. 29, 1982).

main objectives of the neoliberals is to dismantle state welfare systems so as to enable private capital to flow freely globally.

The neoliberals are not as concerned about individual liberty as they are about the existence of free competitive markets without barriers. In the social sphere, the classical liberals consider mutual tolerance, free and open discussion, and the freedom for the individual to act as long as nobody else is harmed in the process as virtues to be cultivated in human society. Neoliberalism, however, sees competition as the defining characteristic of human interactions. It re-defines individuals as mere consumers, whose democratic choices are best exercised by buying and selling, an exchange process that rewards merit and punishes inefficiency. It essentially maintains that 'the market' delivers benefits that could never be achieved by planning. "Inequality is recast as virtuous. The market ensures that everyone gets what they deserve."[803]

3.2. INTERNATIONAL ENVIRONMENTAL GOVERNANCE

The evolution of international environmental governance can be divided into three periods, namely: traditional period before 1972, modern period from 1972 to 1992, and post-modern period after 1992.[804] The turning points in the evolution of international environmental governance were linked to the two UN conferences – the United Nations Conference on the Human Environment (UNCHE)[805] held in Stockholm, Sweden, in June 1972, and the United Nations Conference on Environment and Development (UNCED)[806] held in Rio de Janeiro, Brazil, in June 1992. Both of these conferences were also critical milestones in the evolution of international climate change governance.

[803] George Monbiot (2016) supra note 371.

[804] Peter H. Sand (2007) The Evoluton of Environmental Law. In The Oxford Handbook of Envrionmental Law [Daniel Bodansky, Jutta Brunee and Ellen Hey (Eds.)], Oxford University Press, Oxford, UK, pp. 30-41.

[805] The United Nations Conference on the Human Environment held in Stockholm from Jun 5-16, 1972 was the first United Nations (UN) conference that focused on environmental issues [hereinafter Stockholm Conference]. See Günther Handl (2016) Declaration of the United Nations Conference on the Human Environment, United Nations Audiovisual Library of International Law. Accessed on 10 May 2016 at: http://legal.un.org/avl/ha/dunche/dunche.html#3

[806] United Nations (2018a) United Nations Conference on Environment and Development (UNCED), Earth Summit, Sustainable Development Knowledge Platform, Department of Social and Economic Affairs, United Nations. Accessed on 22 May 2018 at: https://sustainabledevelopment.un.org/milestones/unced

3.2.1. Traditional Period of International Environmental Governance

The traditional period of international environmental governance was characterized by the application of the doctrines of general international law to natural resource management. Before 1900, which coincided with the ascendancy of international law as a social force in the international community,[807] the discourse on 'environmental' governance was the extent of national sovereignty over natural resources within the nation-States's territory or jurisdiction.[808] Hence, the international agreements then were essentially bilateral and primarily concerned with the issues of boundary waters, navigation, and fishing rights.[809] After 1900, the Western nation-States did adopt a few international environmental agreements with the intent to protect or constrain the exploitation of natural resources in the form of animal species, which were of commercial value, including migratory birds, birds useful to agriculture, seals for their valuable furs, marine fish, and whales.[810] There were also international agreements aimed at protecting wild fauna and flora in specific regions of Western nation-States.[811]

Transboundary pollution issues were generally not addressed during this period with a few exceptions. One notable transboundary pollution treaty was the 1909 United States-United Kingdom Boundary Waters Treaty, which specified that water "shall not be polluted on either side to the injury of health or property on the other."[812] The other

[807] Martti Koskenniemi (2001) The Gentle Civilizer of Nations: The Rise and Fall of International Law 1870-1960, Cambridge University Press, Camridge, UK.

[808] Richard B. Bilder (1981) International Law and Natural Resources Policy, Natural Resource Journal, Volume 20, pp. 451-486.

[809] Edith Brown Weiss (2011) The Evolution of International Law, Japanese Yearbook of International Law, Volume 54 (2011), pp. 1-27.

[810] Canada-United States of America: Convention for the Protection of Migratory Birds in the United States and Canada, 16 August 1916, in Charles Bevan, Treaties and Other International Agreements of the United States of America 1776-1949, Volume 12, p. 375 (Treaty Series No. 628); Convention for the Protection of Birds Useful to Agriculture, 19 March 1902, in Clive Parry (ed.), Consolidated Treaty Series, Volume 191, p. 91; Treaty for the Preservation and Protection of Fur Seals, 7 June 1911, in Statues at Large of the United States of America, Volume 37, p. 1542; Washington International Convention for the North-West Atlantic Fisheries, 8 February 1949, in United Nations Treaty Series, Volume 157, p. 157 (No. 2053); and Washington International Treaties for the Regulation of Whaling, 2 December 1946, in United Nations Treaty Series, Volume 161, p. 72 (No. 2124).

[811] Washington Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, 12 October 1940, in United Nations Treaty Series, Volume 161, p. 193 (no. 485); and London Convention for the Protection of Wild Animals, Birds and Fish in Africa, 19 May 1900, in British and Foreign State Papers, Volume 94, p. 715.

[812] Washington Treaty Relating to Boundary Waters between the United States and Canada, 11 January 1909, in Charles Bevans, Treaties and Other International Agreements of the United States 1776-1949, Volume 12, p. 319 (Treaty Series No. 548).

notable transboundary pollution issue, which was settled through arbitration, was the 1938 Trail Smelter Arbitration between Canada and the United States concerning air pollution, which also dealt with the obligation not to cause transboundary harm.[813]

However, international concerns about transboundary pollution issues started to occupy centre court in international environmental governance at the turn of the second half of the 20th century. For instanced, nation-States began to establish MEAs or treaties on marine pollution from oil[814] and the damage from the civilian use of nuclear energy.[815]

3.2.2. Beginning of Modern International Environmental Governance

The international environmental agreements during the traditional period were static. They were no or little provisions for adjustment to advances in our scientific knowledge of the environment, the continual improvement in our understanding of the complexity of human interactions in the socio-economic system, and the impact of human interactions on the environment. It is analogous to a Newtonian worldview of the relationships between matter and energy, which could be analyzed separately, and their respective interactions took place within an absolute framework of space-time (natural environment), in which the impact of matter and energy interactions on the absolute space-time framework is one-way and negligible.

The modern period of international environmental governance was much influenced by many non-legal areas of enquiry due to the rapid advancement in the diverse academic spheres of physical and social sciences. The recognition of the significant of scientific uncertainty in all spheres of the physical sciences, including ecology and climate science, the complexity of human interactions in the socio-economic system, and the significant impacts of human interactions on the natural biophysical system warrant the provision of means in these international environmental agreements for adjusting their rules to continuous new understanding of the natural biophysical and human socio-economic systems. It is thus analogous to an Einsteinian worldview of the interactions of matter and energy, which is also interacting with the relative framework of space-

[813] Trail Smelter Case (United States v. Canada), Ad Hoc International Arbitral Tribunal, 11 March 1941. In United Nations Reports of International Arbitral Awards, Volume 3 (1949), p. 1938.

[814] International Convention for the Prevention of Pollution of the Sea by Oil, 12 May 1954, in United Nations Treaty Series, Volume 327, p. 3 (No. 4714).

[815] Vienna Convention on Civil Liability for Nuclear Damage, 21 May 1963, in United Nations Treaty Series, Volume 1063, p. 265 (No. 16197).

time (natural environment). Human interactions in the socio-economic system are two-way, and human interactions with the natural biophysical system are also two-way.

3.1.2.1. United Nations Conference on the Human Environment (UNCHE)

The 1972 United Nations Conference on the Human Environment (UNCHE) in Stockholm, Sweden, from June 5-16, 1972, is widely recognized as the landmark event inaugurating the modern era of international environmental governance.[816] It was the first global environmental conference, marking the beginning of organized international efforts to devise a comprehensive plan to safeguard the planetary environment. Hence, the international community did its first stock take of the global human impact on the environment and established a process to forge a basic common outlook on how to address the challenge of preserving and enhancing the human environment.

3.2.2.2. The Stockholm Declaration

Although no binding treaty was adopted, the 113 nation-States participating at the UNCHE adopted the Stockholm Declaration,[817] which serves as the first of two 'charters' for international environmental governance. Paragraph 2 in the Preamble to the Declaration proclaims that "protection and improvement of the human environment is a major issue which affects the well-being of peoples and economic development throughout the world" and that "it is the urgent desire of the peoples of the whole world and the duty of all Governments" to see to its attainment.[818] The Declaration essentially espouses broad environmental policy goals and objectives rather than provides detailed normative positions. It articulates the 26 principles applicable to modern international environmental governance in the form of Articles in the Declaration.

For instance, Principle 6 in the Declaration emphasizes that "we must shape our actions throughout the world with a more prudent care for their environmental consequences" and acknowledges that "through ignorance or indifference" we could do "massive and irreversible harm to the earthly environment".[819] It directly addresses the issues of air pollution and the release of greenhouse gases for "the discharge of toxic substances or of other substances and the release of heat, in such quantities or concentrations as to

[816] Peter H. Sand (2007) supra note 804, pp. 30-41.

[817] UNEP (1972) Declaration of the United Nations Conference on the Human Environment, United Nations Environmental Programme, Stockholm, 16 June 1972 [hereinafter Stockholm Declaration].

[818] Id., Preamble, Paragraph 2.

[819] Id., Principle 6.

exceed the capacity of the environment to render them harmless, must be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems", which foreshadowed the existential threat of systemic climate change confronting humankind today. Meanwhile, the contentious issue of inter-generational justice and equity in international climate change governance was foreshadowed in Principle 2 of the Declaration, which states that "the natural resources of the earth, including the air, water, land, flora and fauna … must be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate."[820]

One of the most significant development during this modern period was the recognition by the International Court of Justice of Principle 21, which states that "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction", as part of international law.[821,822]

3.2.2.3. United Nations Environmental Programme (UNEP)

The participants at the UNCHE also proposed the creation of an intergovernmental organization to act as the voice on the environment for the United Nations (UN). In response, the UN General Assembly (UNGA) adopted Resolution 2997 on 15 December 1972 establishing the United Nations Environmental Programme (UNEP)[823] in Nairobi, Kenya. It was the major impetus for the rapid evolution of the modern era of international environmental governance[824] and much has been achieved in the 40-odd years through the leadership of the UNEP.[825]

3.2.2.4. Concept of Sustainable Development

[820] Id., Principle 2.

[821] ICJ (1996) Legality of the Threat of Nuclear Weapons, Advisory Opinion, ICJ Reports 1996, p. 226.

[822] ICJ (1997) Gabcikovo-Nagymaros Project (Hungary v. Slovakia), Judgement, ICJ Reports 1997, p. 7.

[823] Stanley Johnson (2012) UNEP The First 40 Years: A Narrative, United Nations Environmental Programme, Nairobi, 2012.

[824] Peter H. Sand (2007) supra note 804, pp. 33-35.

[825] UNEP (2016) 40 Decades of Environmental Leadership, United Nations Environmental Programme. Accessed on 22 July 2016 at http://web.unep.org/exhibit/

The potential conflict between economic development and environmental protection was already foreseen during the preparations for the Stockholm Conference. The developing countries were especially concerned that international efforts to protect the environment could come at the expense of their economic development. Hence, shortly before the commencement of the Stockholm Conference, a team of experts from governments, academia, and non-governmental organizations met in Founex, Switzerland, to discuss the potential conflicts and develop a conceptual framework for reconciling environmental protection and economic development, recognizing that these two objectives must proceed in tandem.[826] It laid the foundation for the later acceptance of the twinning of 'sustainable development' and 'environmental protection' by the international community, which greatly facilitated the rapid evolution of international environmental governance as both the developing and the developed countries now have a stake in its evolution.

3.2.3. Rapid Evolution of International Environmental Governance

Hence, after UNCHE, international environmental agreements proliferated. During this modern period, international environmental lawmaking evolved rapidly due to the following three parallel developments:

(1) Dramatic increase in global awareness of environmental issues,
(2) Instrumental role of UNEP in setting the stage and facilitating the diplomatic negotiation process,
(3) Both developing and developed countries have a stake in its evolution.

Fourth, the proliferation of international environmental agreements was also partly due to the adoption of the international regime approach, which called for the establishment of specific international agreements for specific global environmental problems. These international agreements adopted, after 1972, usually take on a framework/protocol format to allow wider latitude for adjustments to changes in our scientific knowledge of the environment and our understanding of the human impact on the environment. Often in the framework/protocol agreements, provisions are made for regular technical assessments by expert panels, for simplified procedures to make rapid adjustments to the phasing out of quantity/time of pollutants, for the use of annexes and of simplified

[826] Miguel Ozorio de Almeida (1972) Environment and Development: The Founex Report on Development and Environment [1971], Carnegie Endowmnet for International Peace, Washinton, DC, USA, 84 pp.

procedures adding to annexes, for the regular meetings of the parties to the agreement to address these changes. Each of these international environmental regimes comprises of a legal core of framework/protocol agreement, each with its own system of monitoring, review and reporting, its won secretariat, and often its own separate financial facility to assist the parties in the implementation of the regime.[827]

During this period, there was not only increase in the quantity of the international environmental agreements but also in the quality of these agreements – scope and actors. The scope of these international agreements also expanded from controlling regional transboundary pollution to global pollution problems, e.g. the depletion of the ozone layer and climate change. Even in the conservation issue-area, the scope of these agreements expanded from protection of individual wildlife species to the conservation of whole ecosystems, e.g. wetlands and biologically diverse areas.[828] There was also a continuous increase in the number of actors (State and non-State) involved in the establishment of these international agreements through the multilateral process of parliamentary diplomacy facilitated by UNEP.

Meanwhile, the legal obligations in these international agreements became more intrusive on national sovereignty as the provisions in them became more complex.[829] For instance, in the case of transboundary air pollution, the international legal argument essentially requires juxtaposition of the liberties (freedoms) of both the source-State and the victim-State. On the one hand, there is the source-State's sovereign right to exploit the natural resources within its own jurisdiction in accordance with its own environmental policies. On the other hand, there is the victim-State's sovereign right to prohibit harmful acts taking place within its territories. Hence, the former's liberty to pursue economically beneficial uses of its territories is not mutually exclusive to the latter's liberty to enjoy a pure environment within its own jurisdiction.

In almost every branch of international law, the international law research student can discern a pattern of specific actors and related events that catalyzed its growth. In the field of international environmental law, its rapid growth was mainly driven by the United Nations General Assembly calling for a series of UN conferences on the environment and sustainable development. Hence, international environmental law, including international climate change law, evolved rapidly through a proliferation of

[827] Edith Brown Weiss (2011) supra note 809, pp. 6-9.

[828] Canada-United States: Great Lakes Water Quality, 22 November 1978, United States treaties and Other International Agreements, Volume 30, p. 1383.

[829] Edith Brown Weiss (2011) supra note 809, p. 8.

UN resolutions, declarations, action plans, and the adoption of several multilateral environmental agreements (MEAs) by the nation-States at these UN conferences.

3.1.3.1. United Nations General Assembly (UNGA)

The main UN forum for the rapid development of international environmental law during the modern era of international environmental law was the UNGA. Although the United Nations Security Council (UNSC) was and is still completely dominated by the five permanent members with the power of veto (US, China, Russia, France and UK), the UNGA was by this time already dominated by the sheer number of developing countries as compared with the developed countries. Although the UNGA resolutions *per se* are not legally binding, they do have the power to drive global sustainable development and environmental protection programmes.

By the 1970s, the developing countries already had enough clout to put forward through the United Nations Conference on Trade and Development (UNCTAD) a set of proposals known as the New International Economic Order (NIEO) to promote their interests. The NIEO was intended as a revision of the Bretton Woods international economic system, which had benefited the leading developed countries that had created it, especially the US. An agenda for discussions between the developed and developing countries, known as the North-South Dialogue, was set up to restructure the world's economy in order to facilitate greater participation by and with more benefits to the developing countries. The proposal was adopted by the UNGA in 1974.[830]

3.2.3.2. World Commission on Environment and Development (WCED)

In 1987 the World Commission on Environment and Development (WCED) issued its historic report, 'Our Common Future', calling for a new era of 'sustainable development', which included an Annexe of proposed legal principles for both environmental protection and sustainable development.[831] It was the first time at the level of the international community that environmental protection and sustainable development were inextricably linked.

[830] UNGA (1974) Declaration for the Establishment of a New International Economic Order, United Nations General Assembly Resolution, A/RES/S-6/3201, 1 May 1974.

[831] WCED (1987) Report of the World Commission on Environment and Development: Our Common Future, World Commission on Environment and Development (WCED) [Gro Harlem Brundtland (chair)], United Nations, New York, 300 pp.

The UNGA, in responding to the specific recommendations of the World Commission on Environment and Development (WCED) with resolution 44/228 of 22 December 1989, decided to convene the United Nations Conference on Environment and Development (UNCED). The resolution specifically called upon the Conference to promote and further develop international environmental law, and to "examine … the feasibility of elaborating general rights and obligations of States, as appropriate, in the field of the environment".[832]

3.2.3.3. United Nations Conference on Environment and Development (UNCED)

In order to implement the global strategy of addressing both environmental protection and sustainable development, a second global environmental conference, also known as the Earth Summit, was convened in Rio de Janiero, Brazil, in June 1992, with 172 nation-States participating. One characteristic feature of this UN conference was the strong participation of non-governmental organizations (NGO) in its deliberations.[833]

At UNCED, which was also known as the Earth Summit, the nation-States adopted two major MEAs, namely the United Nations Framework Convention on Climate Change (UNFCCC)[834] and United Nations Convention on Biological Diversity (UNCBD).[835] The nation-States at the Earth Summit also issued two declarations of principles, namely the Rio Declaration on Environment and Development[836] and the Statement of Forest Principles,[837] and launched Agenda 21, an action program for implementing sustainable development around the world.[838] It was the turning point in the evolution of international environmental governance into the post-modern period.

---

[832] UNGA (1989) United Nations Conference on Environment and Development, United Nations General Assembly Resolution, A/RES/44/228, 85th plenary meeting, 22 December 1989.

[833] United Nations (2018a) supra note 806.

[834] United Nations (1992a) supra note 16.

[835] United Nations (1992b) Convention on Biological Diversity, Rio de Janeiro, 5 June 1992, United Nations Treaty Series, Volume 1760, p. 79 (No. 30619). Accessed on 7 July 2016 at: https://treaties.un.org/doc/Treaties/1992/06/19920605%2008-44%20PM/Ch_XXVII_08p.pdf

[836] UNEP (1992a) supra note 75.

[837] UNGA (1992) Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests. In Annex III of the Report of the United Nations Conference on Environment and Development, Rio de Janeiro, June 3-14, 1992, A/CONF.151/26 (Vol. III), 14 August 1992. Accessed on 7 July 2016 at: http://www.un.org/documents/ga/conf151/aconf15126-3annex3.htm

[838] United Nations (2018b) Agenda 21, UNCED 1992, Sustainable Development Knowledge Platform, Department of Social and Economic Affairs, United Nations. Accessed on 22 May 2018 at: https://sustainabledevelopment.un.org/outcomedocuments/agenda21

3.2.3.4. World Summit on Sustainable Development

Ten years later, in August 2002, 191 nation-States, businesses and NGOs gathered in Johannesburg for the World Summit on Sustainable Development (WSSD) for the purpose of reassessing and renewing commitments to sustainable development.[839]

The parties at the summit committed themselves to undertake concrete actions and measures at all levels to enhance international cooperation, taking into account the principles set out in the Rio Declaration on Environment and Development, in particular Principle 7 in the Declaration on the common but differentiated responsibilities. These international efforts promote the integration of economic development, social development and environmental protection as interdependent and mutually reinforcing pillars of sustainable development while the overarching objectives of and the essential requirements for sustainable development are poverty eradication, changing unsustainable patterns of production and consumption, and the protection and management of the natural resource base of economic and social development.[840]

3.2.3.5. United Nations Conference on Sustainable Development

Ten years after, in August 2012, governments, businesses and NGOs returned to Rio for the United Nations Conference on Sustainable Development (UNCSD), or Rio+20, which produced a focused political outcome document, 'The Future We Want'[841] containing clear and practical measures for implementing sustainable development.[842]

The member-States also made several new significant decisions to implement sustainable development, including the following:

(1) Launch a process to develop a set of Sustainable Development Goals (SDG), which will build upon the Millennium Development Goals and converge with the post-

[839] United Nations (2018c) World Summit on Sustainable Development (WSSD), Johannesburg Summit, Sustainable Development Knowledge Platform, Department of Social and Economic Affairs, United Nations. Accessed on 22 May 2018 at: https://sustainabledevelopment.un.org/milesstones/wssd

[840] WSSD (2002) Draft plan of implementation of the World Summit on Sustainable Development, World Summit on Sustainable Development (WSSD), A/CONF.199/L.1 (26 June 2002), p. 2.

[841] UNGA (2012) supra note 145.

[842] United Nations (2018d) United Nations Conference on Sustainable Development, Rio+20, Sustainable Development Knowledge Platform, Department of Social and Economic Affairs, United Nations. Accessed on 22 May 2018 at: https://sustainabledevelopment.un.org/rio20.html

2015 development agenda,

(2) Establish an intergovernmental process under the UN General Assembly to prepare options on a strategy for sustainable development financing,

(3) Strengthen the UNEP on several fronts with action to be taken during the 67th session of the General Assembly, and

(4) Establish a high-level political forum for sustainable development with the aim of having the first session of the forum at the beginning of the 68th session of the General Assembly.[843]

3.2.3.6. United Nations Sustainable Development Summit

The most recent UN conference on sustainable development was the United Nations Sustainable Development Summit, which convened as a high-level plenary meeting of the General Assembly in New York on 25-27 September 2015.[844]

The outcome document of the Summit was the UN General Assembly resolution A/RES/70/1, "Transforming our World: the 2030 Agenda for Sustainable Development".[845] This agenda comprises of 17 Sustainable Development Goals (SDG) and 169 targets, demonstrating the scale and ambition of this new universal Agenda. These goals and targets are integrated and indivisible, and they are balanced along the economic, social and environmental dimensions of sustainable development.

3.2.4. General Patterns in International Environmental Governance

Under the sponsorship of the UNGA, there has been an exponential increase in the number of MEAs adopted during the modern and post-modern periods. According to the International Environmental Agreements Database Project, about 80% of the over 1300 multilateral environmental treaties, protocols and amendments adopted during the period 1850-2016 was adopted after 1972.[846] These MEAs, which are sources of

[843] UNGA (2012) supra note 145.

[844] United Nations (2018e) United Nations Sustainable Development Summit, Sustainable Development Knowledge Platform, Department of Social and Economic Affairs, United Nations. Accessed on 6 August 2018 at: https://sustainabledevelopment.un.org/post2015/summit

[844] UNGA (2012) supra note 145.

[845] UNGA (2015) Transforming our World: the 2030 Agenda for Sustainable Development, United Nations General Assembly, New York, A/RES/70/1, 21 October 2015. Accessed on 2 July 2018 at: http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/70/1

[846] Ronald B. Mitchell (2018) *International Environmental Agreements (IEA) Database Project*

international law, form the legal core of their respective international environmental regimes. Certain general patterns are discernible in the negotiation and adoption of the MEAs during the modern era of international environmental governance.

3.2.4.1. The Framework Convention Plus Protocol Model

The first most obvious general pattern is the regular use of the framework convention plus protocol model for MEAs. The concept of such a model emerged in the 1970s under the auspices of UNEP.[847] Nation-States will negotiate and adopted initially a framework agreement setting forth general provisions, which is followed by subsequent negotiations to supplement the framework agreement with one or more protocols to address specific problems in the environmental issue-area. An early example of such a framework convention plus protocol agreement was the 1976 Barcelona Convention for the Protection of the Mediterranean Sea against Pollution.[848] This distinctive pattern of negotiating an international agreement became the archetypal pattern for the establishment of other MEAs, including the long-range transboundary air pollution,[849] the depletion of the ozone layer,[850] climate change[851] and even tobacco control.[852]

As substantive laws on obligations, rights, commitments and sanctions were negotiated in the subsequent protocols, the original requirement of the legal model was that if a nation-State were to become a party to the framework convention, it had also to join one or more of the protocols associated with it to ensure that these agreements have real legal traction. This requirement that a nation-State must join a protocol when becoming a party to the framework convention did not survive,[853] which led to considerable complexity in the administration of the international agreement. It also led to legal

(Version 2018.1), University of Oregon, Eugene, Oregon, USA. Accessed on 17 May 2018 at: https://iea.uoregon.edu/

[847] Edith Brown Weiss (2011) supra note 809, p. 7.

[848] UNEP (1976) Barecelona Convention for the Protectionj of the Mediterranean Sea against Pollution, 16 February 1976, United Nations Treaty Series, Volume 1102, p. 27 (No. 16908).

[849] UNECE (1979) Economic Commission for Europe Convention on Long-Range Transboundary Air Pollution (LRTAP), 13 November 1979, E/ECE/1010 (1979), United Nations Treaty Series, Volume 1302, p. 217 (No. 21623). Accessed on 12 July 2016 at: http://www.unece.org/fileadmin/DAM/env/lrtap/full%20text/1979.CLRTAP.e.pdf

[850] UNEP (1985) Vienna Convention for the Protection of the Ozone Layer, 22 March 1985, United Nations Treaty Series, Volume 1513, p. 293 (No. 26164).

[851] United Nations (1992a) supra note 16.

[852] WHO (2003) World Health Organization Framework Convention on Tobacco Control, 16 June 2003, United Nations Treaty Series, Volume 2302, p. 166 (No. 41032).

[853] Edith Brown Weiss (2011) supra note 809, p. 8.

ambiguity with practical significance in the case of the intended withdrawal of the United States from the 2015 Paris Agreement while being a party to the UNFCCC.[854]

3.2.4.2. Fast Negotiation and Adoption and Slow Implementation of Agreements

A second discernible general pattern in the evolution of MEAs was that the initial negotiation to adopt the framework convention proceeded fairly quickly. Nation-States had become adept at negotiating new international agreements, especially with the framework convention–protocol model, in a relatively short time. Often a period of less than two years is required to establish the framework agreement. However, subsequent negotiation of its supplementary protocols would take much longer time and much more effort. Perhaps more important, the implementation of the substantive obligations of the MEA as provided in the legally binding protocols is slow and there is a strong tendency of purposeful delay or backsliding, making the MEA as a whole ineffective.

For instance, the intergovernmental negotiations for the United Nations Framework Convention on Climate Change (UNFCCC) took only 16 months from December 1990 to reach agreement in June 1992.[855] It then took 21 months for the UNFCCC to enter into force in March 1994, 45 months for the signing of the Kyoto Protocol with legally binding rules in December 1997,[856] and another 86 months for the Kyoto Protocol to enter into force in February 2005. The first commitment period of the Protocol started in 2008 and ended in 2012. The Doha Amendment to the Kyoto Protocol was drafted on 8 December 2012 to inaugurate the second commitment period of the Protocol, which will end in 2020. To date, it has not entered into force.[857] From the perspective of effective implementation of the objective to stabilize anthropogenic carbon dioxide emissions, carbon dioxide emissions have continued its inexorable rise without any clear signs of peaking for the past 30 years from 1990 when intense intergovernmental negotiations started on establishing the international climate change agreement.

3.2.4.3. Fragmentation of International Environmental Regimes

[854] David A. Wirth (2017) The Paris Agreement as a New Component of the UN Climate Regime, International Organizations Research Journal, Volume 14, Number 4, pp. 185-214.

[855] United Nations (1992a) supra note 16.

[856] United Nations (1998) supra note 17.

[857] UNFCCC (2012) Doha Amendment to the Kyoto Protocol, Doha, 8 December 2012, Decision 1/CMP.8. Accessed on 25 January 2019 at: https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-7-c&chapter=27&clang=_en

The third general pattern in the evolution of international environmental governance is the adoption of specific MEAs for specific environmental problems, which is characteristic of an international regime approach. International environmental law, which has evolved rapidly over the past half-century, has become a 'patchwork' of rules and institutional arrangements, with narrow focus and operating sometimes at cross-purposes, due to the piecemeal, fragmented and ad hoc responses to environmental issues as they emerged.[858] Often, each agreement has its own system of internal decision-making, its own secretariat, its own system of monitoring, verification and reporting, and even its own financial facility to provide financial assistance to member-States for implementing the agreement. This state of affairs had led to the observation by Edith Brown Weiss as early as 1993 that there was already "treaty congestion" and that the international environmental legal system needed to be much more efficient.[859]

This fragmented pattern of international environmental law can be traced to two seemingly distinct phenomena occurring in the international community. The first phenomenon is the "the lack of an international legislative supreme body"[860] for creating international rules. Even as early as 1953, C. Wilfred Jenks had already highlighted the need for such "a general legislative body"[861] to create international rules. Because our nation-States are equal units of an anarchical system, there is no supreme body existing at the global level. There is, therefore, no supreme body to determine at what level of human organization – international, transnational, national or local – rules for coordinating the interactions among the nation-States and the planetary environment should be created, executed, or adjudicated. There is also no international executive body to direct how plans should be delegated for action, and there is no adjudicating body to resolve intra- and inter-level disputes pertaining to such issues.[862]

In order to address the limitations in the absence of a general supreme legal body, nation-States have creatively established international organizations or other international institutional arrangements within the MEAs. These nation-States have vested in each of these international organizations or institutions with limited legal powers sufficient to create rules, to implement action plans, and to mediate in dispute settlement in order to achieve the specific objectives of these MEAs respectively.

[858] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 11.

[859] Edith Brown Weiss (2011) supra note 809, p. 7.

[860] Beatriz Martinez Romera (2017) Regime Interaction and Climate Change: The Case of International Aviation and Maritime Transport, Routledge, London and New York, pp. 36-37.

[861] C. Wilfred Jenks (1953) The Conflict of Law-Making Treaties, British Year Book of International Law (BYBIL), Volume 30, p. 403.

[862] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 10.

The second phenomenon is due to the scientific complexity of the global environmental issue-areas, which requires the "emergence of technically specialized cooperation networks of global scope" (international regimes) to address [such] global environmental issues that transgress national boundaries, in which "national laws seem insufficient owing to the transnational nature of the networks while international law only inadequately take account of their specialized objectives and needs."[863]

Of special concern is in the issue-area of climate change because although many of the global commons go beyond the limits of national jurisdiction, e.g. the high seas, outer space and Antarctica, and have broad-based regimes to govern these global commons, there is, however, no comparable 'atmosphere regime' established by the international community to govern the atmosphere as a global commons. Instead the international community has evolved more specific and narrowly focused international regimes to address the various global environmental issues of the atmosphere, which include transboundary air pollution, substances that deplete the ozone layer, and climate change. Meanwhile, other international regimes, not originally established to address environmental concerns, are also addressing climate change due to the multiplier effect of climate change on the global political economy, e.g. G7, G20;[864] on human rights issues, e.g. UNHCR, IOM;[865] and on international transport, e.g. ICAO, IMO.[866]

In its report on the fragmentation of international law, the study group of the International Law Commission emphasized the importance of the 'principle of systemic integration' as expressed in Article 31 (3) (c) of the Vienna Convention of the Law of Treaties, that for the purpose of the interpretation of a treaty, there shall be taken into account, together with the context, "any relevant rules of international law applicable in the relations between the parties."[867] If global environmental governance is not to remain a 'patchwork' of specific international regimes, the need for 'systemic integration' is crucial for the constructive development of international organizations with lawmaking tasks. To allow these international organizations to be fully isolated from each other and for them to pay attention only to their own objectives and

[863] ILC (2006) supra note 48, p. 244.

[864] John J. Kirton and Ella Kokotsis (2015) The Global Governance of Climate: G7, G20, and UN Leadership, Ashgate Publishing, Aldershot, UK.

[865] Nina Hall (2016) Displacement, Development and Climate Change: International Organizations Moving Beyond Their Mandates, Routledge, London, UK.

[866] Beatriz Martinez Romera (2017) supra note 860.

[867] United Nations (1969) supra note 300.

preferences is to think of law only as an instrument for attaining specific regime objectives. "But law is also about protecting rights and enforcing obligations, above all [the] rights and obligations that have a backing in something like a general, public interest." Without the principle of 'systemic integration' it would be impossible to give expression to and to keep alive any sense of the common good of humankind, which is not reducible to the sum of the goods of all the specific regimes.[868]

3.2.5. International Agreements of the Atmosphere Global Commons

Today, a multilateral environmental framework agreement and its supplementary protocols would form the legal core of an international environmental regime. In the case of the global climate change regime, it is the 1992 UNFCCC and its 1997 Kyoto Protocol. The 2015 Paris Agreement although adopted as a multilateral agreement under the UNFCCC is not considered a 'protocol' of the UNFCCC.[869]

Because the international community has evolved highly specific international regimes to address the various international environmental issues, it is necessary to understand some of the key bilateral and multilateral environmental agreements that are related to the atmospheric commons and therefore closely linked to international climate change governance. These international environmental agreements are briefly described below:

3.2.5.1. Trail Smelter Arbitration

A student of international law or international environmental law would be familiar with the *Trail Smelter* arbitration of 1938[870] to settle the dispute between Canada and the United States, in which the appointed Tribunal was asked to decide for the first time on the limits of the fundamental legal concept of the sovereignty of States and the application of the general principles of international law on State liability for cross-border damage caused by transboundary air pollution.[871]

The resounding declaration by the Tribunal that, "under principles of international law,

[868] ILC (2006) supra note 48, pp. 243-244.

[869] David A. Wirth (2017) supra note 854, pp. 201-205.

[870] Canada and United States (1938) Trail Smelter Arbitral Decision, 16 April 1938. In Trail Smelter Case (United States v. Canada), Ad Hoc International Arbitral Tribunal, 11 March 1941, in United Nations Reports of International Arbitral Awards, Volume 3 (1949), p. 1938.

[871] Xue Hanqin (2003) Transboundary Damage in International Law, Cambridge University Press, Cambridge, 368 pp, p. 118.

as well as of the law of the United States, no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence" became the wellspring of legal concepts and principles of international environmental law.[872]

The classical reformulation of the Tribunal's declaration from a political perspective is enshrined in Principle 21 of the 1972 Stockholm Declaration on the Human Environment, which reads, "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."[873]

Principle 21 was restated 20 years later at the Earth Summit with the inclusion of development policies to environmental policies in the Rio Declaration[874] at the Earth Summit[875] and quoted verbatim in the preambles of both the Desertification Convention (UNCCD)[876] and UNFCCC.[877] It also spawned its own progeny as it was incorporated verbatim in Article 3 of the UN Convention on Biological Diversity (UNCBD)[878] as well as in the Principle 1(a) of the United Nations Statement of Principles for Forests[879].

3.2.5.2. Convention on Long-Range Transboundary Air Pollution (CLRTAP)

The same international law student would also be familiar with the landmark

[872] Stephen C. McCaffrey (2006) Of Paradoxes, Precedents, and Progeny: The Trail Smelter arbitration 65 Years Later. In: Transboundary Harm in International Law: Lessons from the Trail Smelter Arbitration [Rebecca M. Bratspies and Russel A. Miller (eds.)], Cambridge University Press, Cambridge, 347 pp, p. 35.

[873] UNEP (1972) supra note 817, Principle 21.

[874] UNEP (1992a) supra note 75.

[875] The Earth Summit is the informal name of the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, June 3-14, 1992 [hereinafter UNCED]. Accessed on 22 July 2016 at: https://sustainabledevelopment.un.org/milestones/unced

[876] UNGA (1994) United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, United Nations General Assembly, New York, A/AC.241/27, 12 September 1994. Accessed on 7 July 2016 at: http://www.unccd.int/Lists/SiteDocumentLibrary/conventionText/conv-eng.pdf

[877] United Nations (1992a) supra note 16.

[878] United Nations (1992b) supra note 835, Article 3.

[879] UNGA (1992) supra note 837.

Convention of Long-Range Transboundary Air Pollution (hereinafter CLRTAP) of 1979[880], which was the first legally binding international treaty dealing with air pollution on a broader regional basis. It was signed in 1979 and entered into force in 1983. Canada ratified it in 1981, and the United States accepted it with qualifications in the same year. It has since been extended by eight specific protocols, and 51 countries have ratified the Convention as of 24 May 2012.[881] The history of CLRTAP can be traced back to the early 1960s, when scientists demonstrated the interrelationship between sulfur emissions in continental Europe and the acidification of the Scandinavian lakes in northern Europe.

At the 1972 Stockholm Conference, the conference participants took up the challenge of fostering regional cooperation to combat acid rain. This regional effort was facilitated and strengthened by the findings of several scientific studies after the Stockholm Conference, between 1972 and 1977, which confirmed the long-range transport of air pollutants over several thousand kilometers before deposition and damage.[882]

The success of the CLRTAP was in no small part due to the pioneering efforts of the Scandinavian States, based on their experience with the acidification of their lakes, to sensitize the international community to the hazards of acid rain.[883] The Convention started with the coordination of efforts on research, monitoring and the development of emission reduction strategies on regional air pollution. It is noteworthy that both the States in which the air pollution originated (perpetrator) and the States that were mainly receivers (victims) of the transboundary air pollution co-operated in research and monitoring for environmental protection of the region.[884] In fact, CLRTAP contributed substantially to the development of modern international environmental law, first by providing a broad framework to signal general intent to control and reduce the damage to the environment by air pollutants, and second by establishing a process for

[880] UNECE (1979) supra note 849.

[881] UNECE (2012) Status of ratification of the 1979 Geneva Convention on Long-range Transboundary Air Pollution as of 24 May 2012. Accessed on 29 Apr 2016 at: http://www.unece.org/env/lrtap/status/lrtap_st.html

[882] UNECE (2016) The 1979 Geneva Convention on Long-range Transboundary Air Pollution, United Nations Economic Commission on Europe, 2016. Accessed on 12 July 2016 at: http://www.unece.org/env/lrtap/lrtap_h1.html

[883] Valentin Sokolovsky (2004) Fruits of the Cold War. In: Clearing the Air: 25 years of the Convention on Long-range Transboundary Air Pollution [Johan Sliggers and Willem Kakebeeke (eds.)], United Nations Economic Commission on Europe, New York and Geneva, 2004, pp. 7-15.

[884] Reuters (1983) Around the World; Acid Rain Study On Scandinavian Lakes, The New York Times, 6 September 1983. Accessed on 6 May 2016 at: http://www.nytimes.com/1983/09/06/world/around-the-world-acid-rain-study-on-scandinavian-lakes.html

negotiating concrete measures to control air pollutants through specific agreements called Protocols. It is a good example of what can be achieved with the right process in place for intergovernmental co-operation.[885]

3.2.5.3. Vienna Convention for the Protection of the Ozone Layer

Another landmark multilateral environmental agreement, again not related to the burning of fossil fuels and carbon dioxide emissions, is the Vienna Convention for the Protection of the Ozone Layer, which had achieved universal ratification.[886] However, there is an overlap in the substance of the Vienna Convention and its supplementary Montreal Protocol with the substance of international climate change law, as many of the ozone layer depleting substances, under their purview, are also powerful GHG.

Similar to the CLRTAP, it started with the adoption by the international community of a framework agreement in which nation-States agreed to cooperate in relevant research and scientific assessments of the ozone problem, to exchange information, and to adopt "appropriate measures" to prevent activities that harm the stratospheric ozone layer. It is the first environmental agreement to cite the precautionary principle[887] in preventing activities that have or are likely to have adverse effects on ecosystems.[888]

3.2.5.3.1. Depletion of Stratospheric Ozone Layer

The stratosphere lies above the troposphere in the atmosphere surrounding the Earth and, depending on the latitude, starts from 10 – 18km and continues to about 50km above sea level. In general, the ozone concentration is greatest in a layer between 20-30km although this layer falls to 10-20km at the Poles (lower stratosphere). While ozone in the troposphere is considered a pollutant, the ozone layer in the stratosphere, by absorbing the high-energy ultraviolet radiation from the Sun, acts as a shield to protect the biosphere from the harmful solar ultraviolet radiation.[889]

---

[885] UNECE (2004) 1979-2004: Twenty five years of International Cooperation on the Convention on Long-range Transboundary Air Pollution, Secretariat for the Convention on Long-range Transboundary Air Pollution, United Nations Economic Commission on Europe, Geneva, 2004, p. 1. Accessed on 12 July 2016 at: http://www.unece.org/fileadmin/DAM/env/lrtap/ExecutiveBody/2004_lrtap_eng.pdf

[886] UNEP (1985) supra note 850.

[887] Id., Preamble.

[888] Id., Articles 2.1 & 2.2(b).

[889] A detailed explanation of stratospheric ozone is available at: http://www.ozonelayer.noaa.gov/science/basics.htm

In 1974, Professors Molina and Rowland[890] published their findings in *Nature* that the chlorofluorocarbon (CFC) gases, which were widely used then as refrigerants, dry cleaning agents, blowing agents in production of foamed plastics, electrical insulators, and fire extinguishing agents, were depleting the ozone in the stratosphere, creating an "ozone hole", especially over the Antarctica. These CFC gases are released in the troposphere. However, because they have very long residence times (in the decades to centuries),[891] these CFC gases can gradually diffuse up into the lower stratosphere layer where the ozone concentration is at its greatest. When the CFC gases reach the stratosphere, high-energy ultraviolet radiation from the sun can cleave the molecular bonds of these CFC gases, releasing highly reactive chlorine atoms that break down the ozone molecules, thereby depleting the ozone in the stratosphere.

In 1977, UNEP adopted a World Plan of Action on the Ozone Layer, which called for intensive international research and monitoring of the stratospheric ozone shield, and in 1981, the UNEP Governing Council authorized the drafting of a global framework convention for stratospheric ozone protection.[892] The Vienna Convention, which was adopted on 22 March 1985 and entry into force on 22 September 1988, expressed only general aspirations, but it did provide for an annual Conference of the Parties (COP) and the subsequent creation of Protocols, which focused on specifying limits on the chemicals that can deplete the stratospheric ozone layer.[893]

3.2.5.3.2. Montreal Protocol

In a similar approach to that of CLRTAP, the COP of the Vienna Convention also negotiated a possible Protocol that would provide specific targets for certain chemicals. However, no consensus was reached during the Convention itself.

A year later, in 1984, Joseph Farman, Brian Gardiner and Jonathan Shanklin had discovered a dramatic seasonal depletion in the stratospheric ozone shield, resulting in an "ozone hole" over Antarctica, which usually lasts from September to November during the Southern Hemisphere spring. The results of this discovery were published in

[890] Mario J. Molina & F. S. Rowland (1974) Stratospheric sink for chlorofluoromethanes: chlorine atom catalyzed destruction of ozone, Nature, Volume 249, Issue 5460, 28 June 1974, pp. 810-812.

[891] Richard P. Tuckett (2016) The Role of Atmospheric Gases. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, The Netherlands, p. 387.

[892] Edith Brown Weiss (2009) The Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Audiovisual Library of International Law. Accessed on 30 April 2016 at: http://legal.un.org/avl/ha/vcpol/vcpol.html

[893] UNEP (1985) supra note 850.

Nature on 16 May 1985.[894] Soon after, scientists discovered that, besides the two essential ingredients of the presence of CFCs in the stratosphere over the Antarctica and the high-energy ultraviolet radiation from the Sun during Antarctica springtime, the third essential ingredient was the presence of thin polar stratospheric clouds, comprising of ice, nitric acid and sulfuric acid mixtures, formed during the previous winter in June, providing the surfaces for accelerated breakdown of the ozone molecules by the highly reactive chlorine atoms. By December of each year as the stratosphere over the Antarctica warms up with summer in the Southern Hemisphere, these stratospheric clouds would disappear, and the Antarctic ozone hole will start filling up again.[895]

Although the depletion of the stratospheric ozone layer requires the confluence of multidinal factors and involves complex chemical interactions, it was also clear that the anthropogenic factor in the equation was the release of man-made CFC gases into the atmosphere. Hence, these scientific discoveries triggered a quick response from the COP to the Vienna Convention, and a working group under UNEP began work on a protocol in December 1986. The drafting work was substantially completed within a short nine months, and the Montreal Protocol[896] was signed on 16 September 16 1987 at the Headquarters of the International Civil Aviation Organization (ICAO)[897] in Montreal. It entered into force on 1 January 1989.[898]

The Montreal Protocol controls the production, trading and consumption of specific chemicals that deplete the ozone layer, namely: CFCs, halons, other fully halogenated CFCs, carbon tetrachloride, methyl chloroform, hydrochlorofluorocarbons (HCFCs), hydrobromoflurocarbons, methyl bromide, and bromochloromethane. It also sets specific targets for reduction of these chemicals as well as the timelines for the reduction of these chemicals. The COP continues to adapt the provisions of the Protocol to new scientific evidences and technological developments over the years. It has been

[894] J. C. Farman, B. G. Gardiner and J. D. Shanklin (1985) Large losses of total ozone in Antarctica reveal seasonal ClO_x/NO_x interaction, Nature, Volume 315, 16 May 1985, pp. 207-210.

[895] Charles Welch (2016) The Ozone Hole, Ozone Hole Inc. Accessed on 8 July 2016 at: http://www.theozonehole.com/

[896] UNEP (1987) The Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, 16 September 1987 [hereinafter Montreal Protocol], United Nations Treaty Series, Volume 1522, p. 3 (No. 26369).

[897] The International Civil Aviation Organization (ICAO) is a UN specialized agency, established by States in 1944 to manage the administration and governance of the Convention on International Civil Aviation (Chicago Convention) and its Headquarters is in Montreal, Canada.

[898] Edith Brown Weiss (2009) supra note 892, p. 1.

adjusted on six occasions and amended on four.[899]

On 16th September 2009, the Vienna Convention and its concomitant Montreal Protocol became the first treaties in the history of the United Nations to achieve universal ratification. To date, 197 countries have ratified the Vienna Convention and the Montreal Protocol with its four Amendments.[900]

3.3. INTERNATIONAL CLIMATE CHANGE GOVERNANCE

Although the possibility of anthropogenic global climate change was one of the justifications for the United Nations to call for the UN Conference on the Human Environment at Stockholm in 1972 (UNCHE), it was not the primary motive. The international community was then still focused on the "impairment of the quality of the human environment caused by such factors as air and water pollution, erosion and other forms of soil deterioration, waste, noise and the secondary effects of biocides, which are accentuated by rapidly increasing population and accelerating urbanization."[901]

Today, the international community sees anthropogenic climate change as the most profound challenge confronting humankind. Climate change not only impacts on the biophysical environment of planet Earth, it will also affect the social, economic, political, legal and ethical interests of all nation-States and have profound implications for virtually every aspect of the human environment for many generations of humanity to come.[902] No nation-State alone can hope to arrest climate change. Unlike some other environmental issues, climate change is a global problem requiring global concerted collective action. It is in the interests of the nation-States to co-operate in order to solve the global climate change problem. Yet the interests of nation-States to act autonomously, as exemplified by the paradigms of international policy and law-making processes carried out by sovereign states, and underpinned by the traditional international law concepts of state responsibility, state consent, and sovereign equality,

[899] Achim Steiner (2015) Foreword to the Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme Ozone Secretariat. Accessed on 30 April 2016 at: http://ozone.unep.org/en/handbook-montreal-protocol-substances-deplete-ozone-layer/2

[900] UNEP (2015) Ozone Secretariat: Treaties and Decisions: Status of Ratifications, United Nations Environmental Programme. Accessed on 7 May 2016 at: http://ozone.unep.org/en/treaties-and-decisions

[901] UNGA (1968) supra note 410.

[902] John S. Dryzek, Richard B. Norgaard and David Schlosberg (2013) supra note 818, pp. 3-17.

have proven unequal to the tasks of mitigating climate change.[903]

A number of unique factors, including the scientific uncertainties, the complexity of causes, the time lag between cause and effect, the potentially irreversible changes, the long planning horizons, regional variations, and the geographical discrepancies between those who pollute and those who are most vulnerable to its impact, have made such action by nation-States even more challenging. Notwithstanding all these difficulties, the international community, through its political negotiation process, has managed to negotiate three major international climate change agreements over the past 25 years with near universal participation of sovereign states – the 1992 United Nations Framework Convention on Climate Change (UNFCCC),[904] the 1997 Kyoto Protocol (KP) to UNFCCC,[905] and the 2015 Paris Agreement to the UNFCCC,[906] which are the three major milestones in the evolution of international climate change governance.

3.3.1. Conventional and Process-Oriented Analytical Approaches

The legal aspects of the 1992 UNFCCC document and, more particularly, its most important legal instrument, the 1997 Kyoto Protocol, constitute the international legal framework to address the climate change problem and to adapt to its consequences.

3.3.1.1. The Conventional Analytical Approach

Hence, the conventional approach to the analysis of the evolution of international climate change governance is purely from an international law perspective. The duration of its governance is divided into 2 periods – Pre-Kyoto Protocol and the Post-Kyoto Protocol Periods – pivoting around the legal instrument of the 1997 Kyoto Protocol.

3.3.1.1.1. The Pre-Kyoto Protocol Period

The pre-Kyoto Protocol Period was a long and convoluted evolution of the international climate change governance transiting from climate change science to climate change law, and the apparent success in the application of international law to solving the climate change problem with establishment of the UNFCCC and its supplementary

[903] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 1-2.
[904] United Nations (1992a) supra note 16.
[905] United Nations (1998) supra note 17.
[906] United Nations (2015a) supra note 18.

Kyoto Protocol. According to Daniel Bodansky, the pre-Kyoto Protocol period can be divided roughly into five epochs:[907]

(1) The Scientific Discovery Epoch (1957-1984) in which the climate scientists gradually unfolded the dangers of global warming and climate change.

(2) Political Agenda Setting Epoch (1985-1987) when global warming and climate change moved from the realm of scientific evidences into the arena of political interests. This move into the political arena was essentially prompted by the grave concerns of the climate scientists.

(3) Political Pre-Negotiation Epoch (1988-1990) when the policymakers first became directly involved in the climate change issue-area; first in the setting up of an intergovernmental panel on climate change (IPCC) and second in the climate change negotiation process (INC/FCCC). The first big opportunity to stop climate change by the developed nation-States was missed at the Ministerial Conference on Atmospheric Pollution and Climate Change held on 6-7 November 1989 in Noordwijk, the Netherlands. It was marked by the turn in US political economy from liberalism to neo-liberalism and the fear in loss of national sovereignty to a supranational authority, which also affected the evolution of the ocean commons governance during this period. The unifying force of climate science research faded into the background and the divisive tension of international politics, in the form of the US-Europe political divide, loomed into the foreground.

(4) Formal Intergovernmental Negotiation Epoch (1990-1992) commenced in 1990 as the policymakers took over the INC/FCC negotiation process resulting in the adoption of UNFCCC in May 1992. This framework convention was established by near universal participation of nation-States despite the emergence of another divisive tension of international politics in the form of the North-South economic divide.

(5) Post-UNFCCC Agreement Epoch (1992-1997) focusing on the elaboration and implementation of the provisions of UNFCCC and subsequent negotiation and adoption of the legally binding Kyoto Protocol in December 1997, which

[907] Daniel Bodansky (2001) The History of the Global Climate Change Regime. In International Relations and Global Climate Change, [Urs Luterbacher and Detlef F. Sprinz (eds.)], MIT Press, Cambridge, USA, pp. 23-40.

marked the apparent triumph of international law to solve the climate change problem.

3.3.1.1.2. The Post-Kyoto Protocol Period

Similarly, the post-Kyoto Protocol Period was also a long and convoluted period, which can be divided roughly into three epochs:

(1) The post-Kyoto Protocol Epoch (1997-2009) was similarly affected by the two characteristics of the North-South economic divide and the fear in the loss of national sovereignty to a supranational authority, which had affected the latter two epochs of the Pre-Kyoto Protocol Period. By this time, the neoliberal ideology had spread beyond the US and significantly influenced the international diplomatic negotiations to implement the provisions of the Kyoto Protocol. It resulted in the abject failure to extend the commitment period of the Kyoto Protocol to 2020 at the Copenhagen Conference.

(2) The post-Copenhagen Epoch (2009-2015) witnessed the turning from a top-down international law approach to a bottom-up international political approach. The power-States at the Copenhagen Conference negotiated the Copenhagen Accord, which essentially inaugurated the bottom-up approach to the negotiation of an international agreement to curb GHG emissions, which led eventually to the universal adoption of the Paris Agreement at Paris in 2015.

(3) The post-Paris Agreement Epoch (2016 onwards) will require the nation-States to urgently draw up and implement concrete plans to cut GHG emissions and reduced it by 55% of its 2017 level by 2030 in order to keep the rise in temperature below 1.5°C above the pre-industrial level by 2100.[908]

3.3.1.2. Integrated Systemic Process-Oriented (ISPO) Analytical Approach

To analyze the evolution of international climate change governance from a purely international law perspective is far too restrictive a view to gain an adequate understanding of the social forces driving the evolution of international climate change governance and what social forces are responsible for its failure to curb GHG emissions thus far. The integrated systemic process-oriented (ISPO) approach, which utilizes the

[908] UNEP (2018a) supra note 50, p. 6.

ISPO general analytical framework developed for this thesis[909] is a more comprehensive approach for the analysis of international climate change governance. The insights gained from such an ISPO approach can help the international law research student understand the multi-factorial, multilevel climate change problem and furnish him with insights to propose new ways to move climate change governance forward.

The schematic diagram of the ISPO general analytical framework for analysing the evolution of international climate change governance is repeated here in Figure 8:

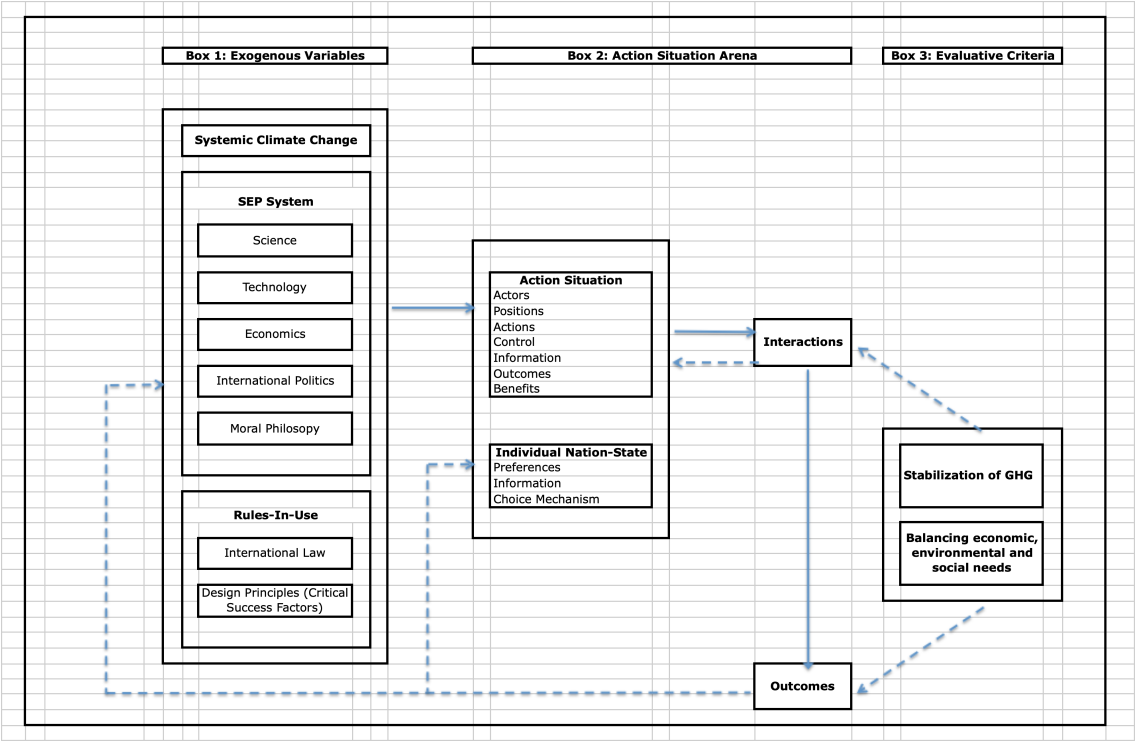

Figure 5: The ISPO General Analytical Framework for the Analysis of the Evolution of International Climate Change Governance (Figure 1 repeat)

The first box of the ISPO general analytical framework comprises of the three building blocks of broad exogenous variables, namely the biophysical climate ecosystem, the SEP system (which includes the science, technology economics, international politics and moral philosophy of the international community), and the rules-in-use, which includes international law and the design principles (critical success factors).

The agents in the second box for analysis of international climate change governance

[909] See Section 1.2.4.

[CPR] are the nation-States and international institutions set up by the nation-States [agent] and the action situation arena is the series of UN conferences [structure], called for by the United Nations General Assembly [scientific-technological-social-economic-political-moral attributes of the international community] to establish multilateral environmental agreements [rules-in-use] for abating the adverse effects of changes in the Earth's climate system [biophysical conditions]. The domestic politics of the nation-States [agent preference] have a significant influence on the position of the nation-States in the UN parliamentary negotiation process [process] while the history [evolution] and context [scientific-technological-social-economic-political-moral attributes of the international community] affect significantly the interactions and outcomes of the multilateral diplomatic negotiations and *vice-versa*.

The third box of the ISPO framework comprises of a specific set of evaluative criteria, which will be based on achieving the end-point or social goals, namely the stabilization of "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"[910] and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations.[911]

From an ISPO approach, the evolution of international climate change governance can be divided into four periods, according to the main social forces driving its evolution during that specific period, namely:

(1) The Scientific Period (1957–1989)
(2) The International Law Period (1990–1997)
(3) The International Politics Period (1998–2015)
(4) The Post-International Politics Period (2015 onwards)

The first Scientific Period from 1957 to 1989 was a long period, which was clearly driven by the epistemic community of climate scientists [agent]. Their findings of the complex Earth's climate system [structure], the interactions [interaction] with the socio-economic system, and the systemic impacts of climate change on both the natural biophysical climate system and the human socio-economic system [structure] were multi-factorial and gradual, as summarized in Chapter 2. There were essentially three epochs within this long and gradual Period, namely the Scientific Discovery epoch, and

[910] United Nations (1992a) supra note 16, Article 2.
[911] UNEP (1992a) supra note 75.

the Political Agenda Setting epoch, which culminated in the 1989 Noordwijk Ministerial Conference epoch.

The second International Law Period from 1990 to 1997 was mainly driven by the UN General Assembly with its Resolution 44/228 of 22 December 1989 to convene the United Nations Conference on Environment and Development (UNCED) and calling upon the Conference to promote and further develop international environmental law, and to "examine … the feasibility of elaborating general rights and obligations of States, as appropriate, in the field of the environment".[912] The policymakers [agent] of the nation-States succeeded through multilateral political diplomatic conferences [action situation arena – structure] to establish the international legal regime of the UNFCCC and its Kyoto Protocol [rules-in-use], which marked the peak of the International Law Period, to address the climate change problem. There were four epochs within this short but intense period, namely the Pre-UNFCCC epoch, the 1992 UNFCCC epoch, and the Pre-Kyoto Protocol epoch, which culminated in the 1997 Kyoto Protocol epoch.

The conflicts of the US-Europe political divide, the fear in the loss of national sovereignty to a supranational authority, and the North-South economic divide [SEP system], which had its beginnings in the 1970s and reaching their peaks in the 2000s, were the main driving forces in the relatively long third International Politics Period from 1998 to 2015. As a result, the implementation of the legally binding Kyoto Protocol was ineffective and the international diplomatic efforts to extend the validity period of the Kyoto Protocol to 2020 [rules-in-use] failed abjectly at the 2009 Copenhagen Climate Change Conference [action situation arena – structure]. The international diplomatic negotiation [process] eventually picked up but it took a one hundred eighty degrees turn from a top-down international law approach to a bottom-up international politics approach with voluntary national contributions. There were also four epochs within this relatively long and turbulent period, namely the Post-Kyoto epoch, the Copenhagen Conference epoch, and the Post-Copenhagen epoch, which culminated in the 2015 Paris Agreement epoch.

The first epoch of the fourth Post-International Politics Period, the Post-Paris Agreement epoch, will have to path the way for climate change governance to go beyond international politics. Humankind will have till 2020 to gather the required political will and take the necessary political steps to cut GHG emissions so that GHG emissions will be reduced by 55% in 2030 from 2017 level in order to keep the rise in

[912] UNGA (1989) supra note 832.

GMST of the Earth to below 1.5°C above the pre-industrial level by 2100.[913] The only way forward in such a short time from 2020 to 2030 is to adopt a polycentric approach to climate change governance to curb GHG emissions.

3.3.2. The Scientific Period (1957–1989)

Global warming and climate change only attracted the attention of policymakers long after research in the climate-related sciences, including the various branches of geophysical sciences, meteorology and climatology, and computer modeling had made significant advances in comprehending this specific environmental issue-area. The epistemic community of climate scientists inaugurated the scientific period in the evolution of international climate change governance.

More importantly, the liberal spirit of that age was clearly evident with the US taking the lead in climate science research. The OECD countries were generous in their funding of scientific endeavors and there was the prevailing understanding among policymakers that advancement in science and technology will be instrumental in solving the complex global commons problems. The characteristic feature in the evolution of climate science was one of unification.

The Scientific Period was inaugurated with the UN General Assembly declaring Year 1957-1958 as the International Geophysical Year.[914] The international law research student would notice the ascendancy of climate science from then onwards and the rational voice of its practitioners during the early stages of the pre-Kyoto Protocol. However, by 1989, the same student would also have noticed the waning influence of science and the waxing influence of international law and international politics in the evolution of international climate change governance.

The end of the Scientific Period correlates with the turn in the US political economy from classical liberalism to neo-liberalism. President Reagan of the conservative Republican Party had enthusiastically embraced neoliberalism and advocated a much smaller role for the 'State' (both domestic and international). The ideal domestic or international political system should just provide a fixed, neutral, universal legal framework within which market forces operate spontaneously. The teological purpose of the State was

[913] UNEP (2018a) supra note 50, p. 6.

[914] Spencer R. Weart (2012) The Evolution of International Cooperation in Climate Science, Journal of International Organization Studies, Volume 3, Number 1, pp. 41-59.

never preferred to the price system of the Market, which is not only efficient but maximises liberty, or the opportunity for men and women to make free choices about their own lives. This turn in the US political economy not only delayed the entry into force of the Law of the Sea Convention, it was also responsible for the US-Europe political divide that derailed the signing of the international agreement to freeze GHG emissions at 1990 levels by 2000 at the 1989 Ministerial Conference on Atmospheric Pollution and Climate Change in Noordwijk, the Netherlands. From then on, the baton of the multilateral negotiation process to mitigate climate change passes from the UNEP, which was pro-science, to UN, which was clearly an international political arena.

3.3.2.1. The Scientific Discovery Epoch

It started in the mid-1950s, when a small band of scientists came together to push for a higher level of international cooperation in all areas of geophysics. Their main objectives were to coordinate data gathering from different regions of the world and to persuade their governments to spend more money on research. It prompted the United Nations to declare Year 1957-1958 as the International Geophysical Year.[915] One signal outcome of this initiative was the development of a new high-precision method based on the infrared gas analyzer for measuring the amount of carbon dioxide in the atmosphere by Charles David Keeling. One of these infrared gas analyzers was installed on Mauna Loa in Hawaii, an isolated spot, to measure the pristine air over the Pacific Ocean.[916] Keeling found that an oscillating pattern of carbon dioxide measurements peaked in May just before plants in the temperate northern hemisphere put on leaves and reached a minimum at the end of the growing season in September. He concluded from these observations that "we were witnessing for the first time nature's withdrawing carbon dioxide from the air for plant growth during the summer and returning it each succeeding winter."[917] By 1969, Keeling was able to show that this annual oscillating pattern was clearly imposed on a rising trend.[918] In the 50 odd years since the installation of the infrared gas analyzers on Mauna Loa, the annual oscillations superimposed on a rising trend (known as the Keeling curve) has shown increase in atmospheric carbon dioxide of ~0.7ppm/year in 1960 and is now ~2.0ppm/year.[919]

[915] Id., pp. 41-59.

[916] Daniel C. Harris (2010) Charles David Keeling and the Story of Atmospheric CO_2 Measurements, Analytical Chemistry, Volume 82, pp. 7865-7870.

[917] Charles David Keeling (1998) Rewards and Penalties of Monitoring the Earth, Annual Review of Energy and the Environment, Volume 23, pp. 25–82.

[918] Id., p. 47.

[919] Daniel C. Harris (2010), supra note 916, p. 7868.

The precise measurement of carbon dioxide in the atmosphere with a land-based instrument was followed by another signal outcome of a bird's-eye observation of the earth's weather from a space-based instrument with the launch of the first meteorological satellite, TIROS 1 on April 1st, 1960, by the US.[920] This new satellite tool for observing the Earth's weather had profound political importance as it offered an opportunity for peaceful global cooperation amidst the escalating geopolitical tension at the height of the Cold War in the space race between the US and the USSR.[921] In fact, US President John F. Kennedy seized the opportunity and called on all nations to cooperate in weather prediction and eventually weather control during his address to the General Assembly of the United Nations on 25 September 1961.[922] His appeal resulted in the adoption of the General Assembly Resolution 1721 (XVI) on 20 December 1961 calling upon the World Meteorological Organization (WMO) … "to advance the state of atmospheric science and technology so as to provide greater knowledge of basic physical forces affecting climate and the possibility of large-scale weather modification."[923] The World Meteorology Organization (WMO) quickly took up the challenge by organizing a World Weather Watch using the new satellites together with the traditional instruments. The World Weather Watch, which evolved into the Global Observing System (GOS), has continued down to the present as the core activity of this organization.[924] These two tools ushered in a new era in meteorology and climatology.

3.3.2.1.1. World Meteorological Organization (WMO)

Meteorologists had long cooperated across national borders in the typical informal fashion of all scientists, with the possible exception of scientists working on weaponry. A meteorologist cannot predict the weather within one's national border without knowing the weather beyond one's national border. By 1879, the meteorologists had come together to form the International Meteorological Organization, which was

[920] US NASA (2010) TIROS: the Nation's first Weather Satellite, NASA Explorer/Early Satellites, 2 April 2010. Accessed on 27 September 2016 at: https://www.nasa.gov/multimedia/imagegallery/image_feature_1627.html

[921] Bert Bolin (2007) A History of the Science and Politics of Climate Change: The Role of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, p. 19.

[922] John F. Kennedy (1961) Address at the United Nations General Assembly, 25 September 1961, John F. Kennedy Presidential Library and Museum. Accessed on 27 September 2016 at: https://www.jfklibrary.org/Asset-Viewer/DOPIN64xJUGRKgdHJ9NfgQ.aspx

[923] UN General Assembly (1961) Resolution 1721 (XVI): International cooperation in the peaceful uses of outer space, United Nations General Assembly, 1085th Plenary Meeting, 20 December 1961. Accessed on 27 September 2016 at: http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/resolutions/res_16_1721.html

[924] Spencer R. Weart (2012) supra note 914, p. 45.

succeeded by the World Meteorological Organization (WMO), with intergovernmental status under the United Nations, in 1951.[925] The organization encouraged the spread of meteorological stations and exchange of data among the national weather bureaus. It made ceaseless efforts at standardizing meteorological measures. For instance, there is only limited value in exchanging data when different national weather bureaus measure the Earth's surface temperature at different times of the day. To impose international standards on its members, the WMO had to overcome entrenched national interests, diverging legal requirements, new instrument costs, unintended human errors, and sheer bureaucratic inertia. This standardization work, which was gradually achieved with the GOS, capped more than a century of difficult negotiations under the auspices of WMO.

It also laid the foundation for climatologists to compare data gathered decades ago with recent data for detection and attribution purposes in climate change studies. In fact, reliability of knowledge on climate change is dependent on commensurability of meteorological data in space and time.[926] More importantly, the meteorological data standardization proved invaluable in the future during discussions among climate scientists in reaching consensus on the process and impact of climate change, and in negotiations with policymakers on abating climate change.

3.3.2.1.2. Inspiration for the Concept of International Environmental Regime

The rapid scientific and technological advancement also had a significant influence on international law. For instance, John Gerald Ruggie, in his 1975 classic paper focusing on the need to restructure international organizations (the other significant actor in the international law forum besides nation-States) to go beyond rules and regulations in order to deal with the increasing scope of scientific and technological developments, Ruggie defined the "international regime [as] a set of mutual expectations, rules and regulations, plans, organizational energies, and financial commitments, which have been accepted by a group of states." Such international regimes organized around specific global environmental issues, e.g. climate change, are the institutions (both intergovernmental and non-governmental) for international environmental governance. Ruggie had even cited the international system of national weather bureaus of the WMO exercising their capabilities "in accordance with a collectively defined and agreed-to

[925] WMO (2016) History of IMO, World Meteorological Organization. Accessed on 3 October 2016 at: http://public.wmo.int/en/about-us/who-we-are/history-IMO

[926] Paul N. Edwards (2004) A "Vast Machine": Standards as Social Technology, Science, Volume 304 (7 May 2004), pp. 827-28.

plan and implementation program" as a good example of such a regime.[927]

As Paul N. Edwards pointed out, "It marked the successful transfer of standard-setting and coordinating powers from national weather services to a permanent, globalist intergovernmental organization . . . a genuinely global infrastructure."[928] The critical success factor in binding together these national weather bureaus was neither the traditional command and control system of domestic law and politics (hierarchical structure) nor the consent and compliance of nation-States in international law (anarchical structure), but rather the behavioral norms and procedural rules (process) adopted and tried out by the scientific community to reach consensus. These systems of standardizing data and using committees to make decisions by consensus could not have functioned well if scientists had not long been familiar with such practices in their routine scientific work. Such familiar modes of working were later carried into the intergovernmental institutions associated with the climate change regime, i.e. IPCC.[929]

In trying to grasp the expansive concept of international regimes, it is helpful to think in terms of a continuum of international regimes. At one extreme of this continuum is an integrated regime with fully integrated institutions that impose regulation through comprehensive, hierarchical rules, e.g. GATT. At the other extreme is a fragmented regime with highly fragmented collections of institutions (both intergovernmental and non-governmental) around the same issue-area but without clear hierarchy or an identifiable core, and with no or weak linkages. The international climate change issue-area is governed by a regime complex, which is in-between an integrated regime and a fragmented regime. It is clustered around the core legal institutions of the United Nations Framework Convention on Climate Change (UNFCCC) and its most important legal instrument, the Kyoto Protocol.[930]

3.3.2.1.3. Cooperation between International Scientific Organizations

An additional Resolution 1802 (XVII) was adopted by the General Assembly the following year, in which WMO was asked "… to develop in greater detail its plan for an expanded programme to strengthen methodological services and research, placing

[927] John Gerard Ruggie (1975) supra note 497, pp. 557-83.

[928] Paul N. Edwards (2010) supra note 498, p. 242.

[929] The Intergovernmentnal Panel on Climate Change (IPCC) was jointly created by the WMO and UNEP in 1988, and was endorsed by the UN General Assembly in its Resolution A/RES/43/53 on 6 December 1988.

[930] Robert O. Keohane and David G. Victor (2010) supra note 502, pp. 3-5.

particular emphasis on the use of meteorological satellites …" and the International Council of Scientific Unions (ICSU) was invited, through its unions, especially the International Union of Geodesy and Geophysics (IUGG) and national academies, "… to develop an expanded programme of atmospheric science research which will complement the programme fostered by the World Meteorological Organization."[931]

The International Council of Scientific Unions (ICSU) was a union of independent, mostly academic, scientific groups, and the International Union of Geodesy and Geophysics (IUGG) is one of its members. The strength of the ICSU lies in its dual membership of National Scientific Members and International Scientific Unions, covering a wide spectrum of scientific expertise, which allows the ICSU to address international interdisciplinary issues, which its Members alone cannot handle.[932] In accordance with the General Assembly resolution, the ICSU and IUGG jointly established the Committee on Atmospheric Sciences (CAS) in June 1964. It marked the beginning of the development of a series of global research programs in the field of environmental sciences with CAS instrumental in securing resources for these global research efforts.[933] CAS, at its first meeting in 1965, defined its objective as developing a research-oriented co-operative international meteorological and analytical programme, known as the Global Atmospheric Research Programme (GARP), with the goal of producing a greatly improved understanding of the general circulation of the global atmosphere. It further proposed that the year 1972 be designated for such an intensive, international, observational study and analysis of the global circulation of the troposphere and lower stratosphere (below 30km).[934]

This proposal of a single global experiment in 1972 was found to be unrealistic.[935] Hence, CAS organized a study conference, co-sponsored by WMO, in Skepparholmen, near Stockholm, from June 28-July 11, 1967. It was attended by some 70 scientists,

[931] UN General Assembly (1962) Resolution 1802 (XVII): International cooperation in the peaceful uses of outer space, United Nations General Assembly, 1192nd Plenary Meeting, 14 December 1962. Accessed on 27 September 2016 at: http://www.un-documents.net/a17-5217.pdf

[932] ICSU (2016a) A Brief History of ICSU, International Council of Science. In 1998, Members agreed that the Council's current composition and activities would be better reflected by modifying the name from the International Council of Scientific Unions to the International Council for Science, while its rich history and strong identity would be well served by retaining the existing acronym, ICSU. Accessed on 1 October 2016 at: http://www.icsu.org/about-icsu/about-us/a-brief-history

[933] Brian C. Black and David M. Hassenzahl (2013) Global Atmospheric Research Programme. In Climate Change: An Encyclopedia of Science and History, Volume 1: A-D [Black, B. C., D. M. Hassenzahl, J. C. Stephens, G. Wiesel, and N. Gift (eds.)], ABC-CLIO, p. 764.

[934] Bert Bolin (2007) supra note 921, p. 22.

[935] Brian C. Black and David M. Hassenzahl (2013) supra note 933, p. 764.

which included a number of researchers from USSR. After much deliberation, the study group recommended that GARP should be a long-term program, without a foreseeable end date, with multiple experiments.[936] The conference report was submitted to both ICSU and WMO. As a union of independent scientific groups, ICSU often took a different view from that of WMO, an UN-administered intergovernmental agency, and hence negotiations between the two organizations were often slow. However, this time both the ICSU and WMO responded quickly, and a Joint Organizing Committee (JOC) was appointed by the two parent organizations to launch GARP, following the good preparative work done by both sides to ensure mutual cooperation.[937]

When the JOC met for the first time in Geneva in April 1968, the primary task of GARP was carefully spelled out as coordinating international research projects to gather specialized sets of data via an improved observational network on a global scale to test the models that were being developed for weather forecasting. These data, however, were also important prerequisites for the development of climate models. The JOC even planned for a First Global GARP Experiment (FGGE) from the beginning of its existence but the time was not ripe to launch a truly global experiment. Several sub-programs were initiated by JOC instead. The FGGE eventually took place only from 1 November 1978 to 30 June 1980 and the results of FGGE were presented at a study conference held in Geneva in 1985. There has not been such a complete global research program since then.[938] The intensification of international cooperation among scientists, and among international organizations took place in that decisive decade of 1979 to 1989 when humankind first came to a broad understanding of climate change.[939]

3.3.2.1.4. Environmental Issues Receiving the Attention of the United Nations

Meanwhile, from the 1950's, large-scale industrial pollution, the growing threat of nuclear radiation, and the documented mass destruction of entire ecosystems around the globe, had triggered widespread international concern about a global environmental crisis.[940] This early wave of environmental protection activity focused on the local, acute, and relatively reversible forms of pollution and the regulation of these specific

[936] Bert Bolin (2007) supra note 921, p. 23.

[937] Spencer R. Weart (2012) supra note 914, p. 46.

[938] Bert Bolin (2007) supra note 921, p. 26.

[939] Nathaniel Rich (2018) supra note 764.

[940] Andreas Grieger (2012) Only One Earth: Stockholm and the Beginning of Modern Environmental Diplomacy, Environment & Society Portal, Arcadia, No. 10, Rachel Carson Center for Environment and Society. Accessed on 2 October 2016 at: http://www.environmentandsociety.org/node/3867

pollutants. However, with the international environmental movement on the rise, policymakers could no longer ignore environmental concerns at all scales – local, regional, and global. Both WMO and ICSU then started to promote the global monitoring of global atmospheric pollutants, including carbon dioxide.[941]

Global environmental concerns soon reached the UN, and it decided in 1968 to organize an international conference at Stockholm in 1972 (UNCHE). Although the possibility of an anthropogenic global climate change was one of the justifications for calling such a conference, it was, however, not the primary motive. The international political lens then was still focused on the "impairment of the quality of the human environment caused by such factors as air and water pollution, erosion and other forms of soil deterioration, waste, noise and the secondary effects of biocides, which are accentuated by rapidly increasing population and accelerating urbanization."[942]

3.3.2.1.5. The Tide Turned Towards the Study of Climate Change

Earlier, in 1969, Carroll Wilson at the Massachusetts Institute of Technology in the USA had taken the initiative to organize a study to provide an up-to-date assessment of the critical environmental issues in preparation for the 1972 Stockholm Conference. Several participants of the study felt that a more thorough study of man's impact on climate was needed. Hence, another study conference was held at Stockholm in 1971 prior to the UNCHE. The output of this study conference was The Study on Man's Impact on the Climate (SMIC) report, which became 'required reading' for delegates to the 1972 Stockholm Conference.[943] The SMIC report was a careful assessment of the state of knowledge on the climate. It emphasized that our ignorance is greater than our knowledge of the climate and although the threat of man's impact on the climate is real, it was not yet possible based on the available knowledge then to determine the magnitude of its effect.[944] In a latter report on the Stockholm Conference itself, which was written for the laymen, Barbara Ward and Rene Dubos essentially came to the same conclusion. In the concluding section on global climate change, they expressed the need

[941] Spencer R. Weart (2012) supra note 914, p. 47.

[942] UN General Assembly (1968) Resolution 2398 (XXIII): Problems of the human environment, United Nations General Assembly, 1733rd Plenary Meeting, 3 December 1968. Accessed on 2 October 2016 at: https://documents-dds-ny.un.org/doc/RESOLUTION/GEN/NR0/243/58/IMG/NR024358.pdf?OpenElement

[943] William W. Kellogg (1987) Mankind's Impact on Climate: The Evolution of an Awareness, Climate Change, Volume 10, p. 121.

[944] SMIC (1971) Inadvertent Climate Modification: Report of Conference, Study of Man's Impact on Climate (SMIC), Stockholm, MIT Press, Cambridge, USA, pp. 125-29.

to coordinate efforts for a better overview, to conduct more research on climate change, and to develop new capacities for decision-making on global issues.[945]

In response to Recommendation 79 (d) from the Stockholm Conference[946] that GARP should continue and, if needed, the WMO and ICSU should "establish new programs to understand better the general circulation of the atmosphere and the causes of climate change and whether the causes are natural or the results of man's activities", the JOC, at its eighth meeting in March 1973, decided that GARP climate studies should focus on those aspects of the climate system that lend themselves to physical-mathematical model studies and understand the mechanisms responsible for climate fluctuations will help determine the nature of climate change caused by man-made or natural factors to the general circulation system of the atmosphere-ocean-earth.[947] The JOC also decided at its eighth meeting that an international study conference on the physical basis of climate and climate modeling should be organized, which took place near Stockholm in mid-1974. This conference represented a major step towards the formulation a global research program leading to a deeper understanding of the general circulation system, in which key scientists who had not yet taken an active part in the work of GARP could join the program and widen the scientific basis for dealing with climate change.[948]

3.3.2.1.6. Early Scientific Assessments of Climate Change

With the focus on aspects of the climate system that lend themselves to physical-mathematical model studies, the scientific assessment of climate change took a great leap forward with advances in computer technology during the mid-1970s. In 1975, Syukuro Manabe and Richard T. Wethereld presented the results obtained by employing for the first time a simplified three-dimensional general circulation model (GCM), in which the heat transport by large eddies was computed with variables rather than by parameterization. They were able to reproduce a stable equilibrium climate, in which an external forcing of double the carbon dioxide concentration in the atmosphere was not large enough to force the climate model out of its stable equilibrium, which attested to the robustness of the model. More importantly, the average rise in the Earth's surface temperature was computed to be about 3°C with doubling of carbon dioxide

[945] Bert Bolin (2007) supra note 921, p. 28.

[946] United Nations (1972) Report of the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972, United Nations, A/CONF.48/14/Rev.1, Recommendation 79 (d), p. 21. Accessed on 3 October 2016 at: http://www.un-documents.net/aconf48-14r1.pdf

[947] Bert Bolin (2007) supra note 921, pp. 28-29.

[948] Id., p. 29.

concentration in the atmosphere.[949]

3.3.2.1.7. First World Climate Conference

The first World Climate Conference was organized by WMO, and the United Nations Environmental Programme (UNEP), which was established by the 1972 UN Conference on the Human Environment in Stockholm. This conference took place in Geneva in 1979 and was attended by more than 300 experts from over 50 countries. The conference was largely technical and the experts' views were diverse, but they managed to reach a consensus with the 'Declaration of the World Climate Conference', which spelled out that there was a "… serious concern that the continued expansion of man's activities on earth may cause significant extended regional and even global changes in climate …", that the "… burning of fossil fuels, deforestation and changes of land use have increased the amount of carbon dioxide in the atmosphere …" and that the "… increased amount of carbon dioxide in the atmosphere can contribute to a gradual warming of the lower atmosphere …".[950] Although the Declaration was worded with great caution, it was, nevertheless, the first time that an official international document has identified carbon dioxide as the cause of global warming.

With increased attention now from policymakers, the World Climate Research Programme (WCRP) was established as the successor to the part of GARP concerned with climate change in 1980. Like GARP, it was under the joint sponsorship of WMO and ICSU and inherited GARP's organization and logistics, including the WMO administrative support, and an independent scientific planning committee.[951] As in GARP, the main task of the new organization was the planning of complex international research projects. For example, an International Satellite Cloud Climatology Project was initiated to collect streams of raw data from weather satellites of several nations, channel the massive data through several government and university groups for processing and analysis before transfer to a central archive, managed by a US government agency. Other important projects that gathered data internationally were the

[949] Syukuro Manabe and Richard T. Wethereld (1975) The Effects of Doubling the CO_2 Concentration on the Climate of a General Circulation Model, Journal of the Atmospheric Sciences, Volume 32, Number 1, pp. 3-15.

[950] WMO (1979) Declaration of the World Climate Conference, World Meteorological Organization, IOC/SAB-IV/INF.3. Accessed on 3 October 2016 at: http://unesdoc.unesco.org/images/0003/000376/037648eb.pdf

[951] John Lanchbery and David Victor (1995) The Role of Science in the Global Climate Negotiations. In Green Globe Yearbook of International Cooperation on Environment and Development [Helge Bergesen and Georg Parmann (eds.)], Oxford University Press, Oxford, pp. 29-39.

Tropical Ocean and Global Atmosphere Programme (TOGA), the World Ocean Circulation Experiment (WOCE) and the Joint Global Ocean Flux Study (JGOFS) under the auspices of WCRP.[952] The organization continues to coordinate such complex international projects till today with an additional co-sponsor in the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), who joined in 1993.[953]

Evidence mounted in the 1980s that climate change was part of a larger phenomenon of global change affecting both natural and human ecosystems, which required an even wider scientific view with inter-disciplinary research in geophysics, chemistry and biology. It led to the launch of the ICSU-sponsored International Geosphere-Biosphere Programme (IGBP) at the ICSU General Assembly in 1986.[954] The significance was that the IGBP marked the first time an international research programme was created to assess planet Earth as a system of globally interacting phenomena, and to understand the physical, chemical and biological processes that regulate the Earth system, the changes that occurring in these processes, and the role of human activities in these processes. However, much of the IGBP research efforts were focused on global ecology and biogeochemistry while climate change was not as high on the IGBP agenda.[955]

3.3.2.2. The Political Agenda Setting Epoch

Meanwhile, from 1980 onwards, a series of scientific meetings, by invitation only, took place in Villach, Austria, for meteorologists sponsored by WMO, UNEP and ICSU. This initiative received particular impetus from the far-sighted UNEP Director, the Egyptian Mostafa Tolba, who was keen to continue with a more extensive scientific assessment of climate change.[956] In 1985, 89 scientists with a wide range of scientific disciplines from 29 developed and developing countries, at the International Conference on the Assessment of the Role of Carbon Dioxide and of other Greenhouse Gases in Climate Variations and Associated Impacts, exchanged and reviewed evidences that had accumulated over the past 6 years and "recast climate change as a problem for

[952] Spencer R. Weart (2012) supra note 914, pp. 50-53.

[953] WCRP (2016) World Climate Research Programme. Accessed on 3 October 2016 at: https://www.wcrp-climate.org/

[954] ICSU (2015) The International Council for Science and Climate Change: 60 Years of Facilitating Climate Change Research and Informing Policy, International Council for Science (ICSU), Paris, p. 14.

[955] Bert Bolin (2007) supra note 921, p. 39.

[956] Spencer R. Weart (2012) supra note 914 p. 50.

today."[957] The findings were summarized by the Scientific Committee on Problems of the Environment (SCOPE) in a seminal report, entitled 'The Greenhouse Effect, Climatic Change and Ecosystems'.[958] It was the first comprehensive international assessment of the environmental impact of GHG,[959] which helped shape the 1987 WCED Report "Our Common Future" on action to protect the earth's climate.[960]

3.3.2.2.1. Epistemic Scientific Community on Climate Change

The Villach scientists, acting as the epistemic international scientific community on climate change, declared that "in the first half of the next century, a rise in global mean temperatures could occur which is greater than any in man's history". They also warned for the first time that the likelihood of this catastrophe happening would be "profoundly affected by government policies on energy conservation, use of fossil fuels, and the emission of some greenhouse gases" and called the three parent organizations to initiate, if deemed necessary, "consideration of a global convention" to tackle the climate change threat.[961] Climate change became an issue for policymakers from then onwards.

With these recommendations in their report, the scientists at the Villach conference had stepped beyond the field of scientific expertise into the realm of political advice. It implied that the consensus-making process should now be harnessed to explicitly address not just science but policy as well.[962] What prompted this epistemic international scientific community to "stick their necks out"?

3.3.2.2.2. Scientific Community Dispensing Policy Advice

From several accounts of the conference participants, it seemed that the tipping point was "the claim that other greenhouse gases could be as important as carbon dioxide in determining future climate change".[963] Mostafa Tolba, UNEP Director, noted in the

[957] Fred Pearce (2005) The Week the Climate Changed, New Scientist, Volume 188, Issue 2521, 12 October 2005, pp. 52-53.

[958] WMO (1986) Report of the International Conference on the Assessment of the Role of Carbon Dioxide and of other Greenhouse Gases in Climate Variations and Associated Impacts, Villach, Austria, 1985, WMO No. 661, WMO/UNEP/ICSU.

[959] ICSU (2016b) History: ICSU and Climate Change, Climate Change, Science for Policy, International Council for Science (ICSU). Accessed on 5 October 2016 at: http://www.icsu.org/science-for-policy/climate-change/history-icsu-and-climate-change

[960] ICSU (2015) supra note 954, p. 13.

[961] WMO (1986) supra note 958, p. 1.

[962] Joshua P. Howe (2014) Behind the Curve, University of Washington Press, Seattle, p. 156.

[963] Wendy E. Franz (1997) The Development of an International Agenda for Climate Change:

conference report that "it is now estimated that by adding in the warming effect of the other trace gases the equivalent of such a [carbon dioxide] doubling may occur as early as 2030."[964] "Suddenly the climate change issue became much more urgent," agreed Bert Bolin, the leading Swedish meteorologist who oversaw the meeting's 560-page scientific report, and later became the first chair of the Intergovernmental Panel on Climate Change (IPCC).[965] In fact, a careful study of the proceedings of the Villach Conference suggests that there was actually little evidence to support the claim that it marked a significant change in the scientific consensus. However, a paradigm shift did seem to have occurred in the policy consensus reached by the epistemic international scientific community in Villach based on the scientific findings. In addition, the conference participants concluded that government policies on energy, fossil fuels, and GHG emissions could strongly affect the rate and extent of future global warming.[966]

3.3.2.2.3. Attracting Attention of the US Government

The Villach conference report did not attract the attention of the press. It did, however, attract the attention of national governments, especially of the United States. The conference report received more attention in the US Government than expected due to the disagreement with the report conclusions by officials in the US Department of Energy (DOE). It was during this period that the US federal energy R&D expenditures fell by more than 50% in real terms, from US$6.64 billion in 1981 to US$3.15 billion in 1988. The pro-fossil fuel Reagan Administration terminated a number of energy development programs such as the breeder reactor program, the synthetic fuels program and the program of large-scale solar energy demonstrations.[967]

There were many competing interests within the US Government itself on the issue of climate change. The US Environmental Protection Agency (EPA) and the State Department were in agreement with UNEP on the need to call for a global convention. The DOE officials, however, questioned the adequacy of the earlier UNEP-sponsored assessment reports. Regardless, most of the US officials objected to the fact that these reports were not prepared by government-appointed scientists. They considered the

connecting Science to Policy, ENRP Discussion Paper E-97-07, Kennedy School of Government, Harvard University, August 1997, p. 15.

[964] WMO (1986) supra note 958, p. 11.

[965] Fred Pearce (2005) supra note 957, p. 52.

[966] Wendy E. Franz (1997) supra note 963, p. 18.

[967] J. J. Dooley (2008) U.S. Federal Investments in Energy R&D: 1961-2008, PNNL-17952 (October 2008), Pacific Northwest National Laboratory, US Department of Energy, pp. 11-13.

Villach scientists to be not representative of the nation-States to be able to dictate terms of international action. The Villach scientists were also perceived as too activist in their call for the potentially expensive control of GHG emissions.[968]

3.3.2.2.4. Advisory Group on Greenhouse Gases (AGGG)

Meanwhile, Mostafa Tolba, the UNEP Director, James Bruce, the conference chairman, and Bert Bolin, the conference report editor, made sure that the conference conclusions caught the attention of the international scientific leadership.[969] The Villach report called upon the parent organizations to establish a task force on GHG and to ensure periodic scientific assessment was undertaken. Besides Bert Bolin, they agreed to form a small elite committee of experts, known as the Advisory Group on Greenhouse Gases (AGGG) with two scientists selected by each of the three parent organizations.[970]

The two main tasks of the AGGG were to carry out biennial reviews of the "international and regional studies related to greenhouse gases" as well as the "aperiodic assessments of the rates of increases in the concentrations of greenhouse gases and of the effects of such increases." It was particularly conscious of the need to develop a effective mechanism that would provide up-to-date information on climate change to a wider audience.[971] The AGGG started organizing international workshops and published several reports on the policy implications of climate change. It also took initial steps to engage policy makers. For instance, the AGGG invited not only scientists but also politicians and policy experts to the two-part workshop in Villach, Austria and Bellagio, Italy, in 1987. The first meeting in Villach in October focused on the global and regional impacts of greenhouse and addressed the "technical, financial, and institutional options for limiting or adapting to climatic changes" while the second meeting in Bellagio in November used the initial assessment as a platform for proposing policies and institutional arrangements that could help implement these policies.[972] The workshop participants introduced a new rubric for evaluating rising carbon dioxide

[968] Alan D. Hecht and Dennis Tirpak (1995) Framework Agreement on Climate Change: A Scientific and Policy History, Climate Change, Volume 29, pp. 371-402.

[969] Spencer R. Weart (2012) supra note 914, p. 51.

[970] The AGGG consisted of K. Hare, Canada (chairman), B. Bolin, Sweden, G. Golitsin, USSR, G. Goodman, Sweden and UK, M. Kassas, Egypt, S. Manabe, USA, and G. White, USA.

[971] Thomas D. Potter (1986) Advisory Group on Greenhouse Gases Established Jointly by WMO, UNEP, and ICSU, Environmental Conservation, Volume 13, Number 4, January 1986, p. 365.

[972] Jill Jaeger (1988) Developing Policies for Responding to Climate Change: A Summary of the Discussion and Recommendations of the Workshops Held in Villach (28 Sep – 2 Oct, 1987) and Bellagio (9-13 Nov, 1987) under the Auspices of the Beijer Institute, Stockholm, World Meteorological Organization, Geneva; United Nations Environmental Programme, Nairobi; p. i.

levels based on the potential average Earth's surface temperature increase and related sea-level rise it might cause. The participants then took the first tentative steps of proposing global policy targets of not warming up faster than 0.1°C per decade[973] and limiting the sea-level rise to 20–50 millimeters per decade.[974] They even suggested preventive measures for mitigating climate change, including measures that increased the efficiency of energy use and the substitution of CFCs with alternatives available. This latter suggestion was noteworthy because CFCs are significant GHG besides have deleterious effects on the ozone layer.[975]

These three fields of enquiry at the workshop, namely scientific assessments, climate change policy advice, and suggestions for preventive measures of the AGGG could thus be viewed as antecedents to the work of the Intergovernmental Panel on Climate Change (IPCC), which was established in 1988. Understanding climate and its changes is one of the most difficult challenges in modern science because of the complexity of the physical, chemical and biological interactions taking place in the atmosphere, ocean and land at the widest range of space and timescales. Meanwhile, the work of data generation, collection, compilation, processing, analysis, integration and reporting, which involves coordinating the time and effort of hundreds of scientists and support staff from a variety of institutions spread across the globe, are themselves highly complex tasks. Even with the use of supercomputers, the scientific and coordinating work required are not exempt from this trend. The complexity, however, does not end there. The final product of scientific assessment is usually an article of just a few pages in a leading scientific journal or a report of hundreds of pages for the sponsoring organizations. Whether it is an article of a few pages or a report of hundreds of pages, each of the authors have to sign off on the article or report. Hence, there is usually intense negotiation over the precise wording of the text among the various authors. Once consensus is reached, the draft paper or report still has to be approved by peer reviewers and editors, which usually entails additional negotiation over the text. Hence, the final product usually contained an array of tightly worded statements, ranging from the specific to the general. This discipline of the peer review process and the presenting conclusions via consensus negotiation during these formative years of climate science was an essential foundation for the later success that international scientific bodies, e.g. IPCC, achieved in arriving at definitive statements and policy advice.[976]

[973] Spencer R. Weart (2012) supra note 914, p. 51.
[974] Joshua P. Howe (2014) supra note 962, p. 156.
[975] Thomas D. Potter (1986) supra note 971, p. 365.
[976] Spencer R. Weart (2012) supra note 914, p. 53.

However, the attempt at policy actions of scientific assessments, climate change policy advice, and suggestions for preventive measures by the independent AGGG was viewed as 'aggressive' by the US. It had been suggested that it was the US concern with the AGGG that provoked the US to seek, via the WMO, the establishment of an intergovernmental mechanism to conduct scientific assessments, which would include national government representatives for vetting climate change policy advice as well as suggestions for preventive measures in mitigating climate change prior to publication.[977] As a result, the impact of an epistemic international scientific community on climate change policy waned as we moved towards the end of the Scientific Period.

3.3.2.2.5. World Conference on the Changing Atmosphere, Toronto, 1988

The momentum gained by the epistemic international scientific community at the Villach and Bellagio workshops did carry over into the 1988 World Conference on the Changing Atmosphere: Implications for Global Security, held in Toronto, Canada, in 1988. There were 341 delegates, including politicians, ambassadors, senior government officials, policy and legal advisors, physical scientists, industrial representatives and energy specialists, social scientists and environmental activists, from 46 developed and developing countries and 24 international organizations.[978] The background information for the conference was a summary paper of the workshop findings.[979]

The Call to Action of the Toronto Conference were: "… to counter the ongoing degradation of the atmosphere … An Action Plan for the Protection of the Atmosphere needs to be developed, which includes an international framework convention, encourages other standard-setting agreements and national legislation to provide for the protection of the atmosphere."[980] The most cited statement in the conclusions was the need to "reduce CO_2 emissions by approximately 20% of the 1988 levels by the year 2005 as an initial global goal." Unlike the Villach/Bellagio workshop policy advice, which was based on an extensive summary of the state of scientific findings available at that time, the contribution of science to the policy advice of the Toronto conference on targets and timetables was, however, minimal. The sources of "approximately 20% of the 1988 levels by the year 2005" as target and timetable respectively was probably

[977] Shardul Agrawala (1998) Context and Early Origins of the Intergovernmental Panel on Climate Change, Climate Change, Volume 39, Issue 4 (August 1998), p. 610.

[978] Wendy E. Franz (1997) supra note 963, p. 25.

[979] Jill Jaeger (1988) supra note 972.

[980] WMO (1989) Proceedings of the World Conference on the Changing Atmosphere: Implications for Global Security, Toronto, Canada, 27-30 June 1988, WMO No. 710, World Meteorological Organization, Geneva; United Nations Environmental Programme, Nairobi; p. 296.

some combination of the suggestions of the energy specialists and the initiatives of non-governmental organizations (NGOs) present at the conference.[981]

By the time the Toronto Conference convened in June 1988, the climate change issue had already moved to the specialized agencies of the United Nations and into the political realm of the United Nations General Assembly, as well as to the government and legislative offices of a number of nations. What transpired in June 1988 was also instrumental in bringing the climate change issue to the attention of the NGOs and into the public arena. As a result, the expanding international work of the climate scientists met a growing public demand for information on climate change, and the effect of this nexus made it difficult for national governments to avoid the issue.[982]

The scientists at the Villach Conference had stepped beyond their field of scientific expertise with their explicit concerns on the issue of increasing GHG emissions; both the scientists and policymakers at the Villach/Bellagio workshops introduced policy advice and suggestions for preventive measures against GHG; and the NGOs and the press at the Toronto Conference pressed for answers to the climate change issues. It was a significant milestone in the evolution of international climate change governance.

3.3.2.2.6. World Commission on Environment and Development (WCED)

The UN General Assembly, in its Resolution 38/161 of 19 December 1983, had earlier established a special commission, under the chairmanship of Gro Harlem Brundtland, to report on the global environment issues as well as to propose strategies for sustainable development.[983] The commission later adopted the name World Commission on Environment and Development (WCED).[984] In the same resolution, the Assembly also decided that, on matters within the mandate and purview of UNEP, this special report should in the first instance be considered by the Governing Council of UNEP, for transmission to the Assembly together with its comments, and for use as basic material in the preparation, for adoption by the Assembly, of the Environmental Perspective to the Year 2000 and Beyond.[985] This special report entitled 'Our Common Future' was

[981] Wendy E. Franz (1997) supra note 963, p. 27.

[982] Id., p. 26.

[983] UNGA (1983) Process of Preparation of the Environmental Perspectives to Year 2000 and Beyond, United Nations General Assembly Resolution A/RES/38/161, 19 December 1983, Meeting No. 102.

[984] WCED (1987) supra note 831.

[985] UNGA (1983) supra note 983.

accepted by the General Assembly in its Resolution 42/187 of 11 December 1987.[986]

Gro Harlem Brundtland in the Report of the World Commission on Environment and Development (WCED) in 1987 decried in her Chairman's Foreword that when, "… scientists bring to our attention urgent but complex problems bearing on our very survival: a warming globe … we respond by demanding more details, and by assigning the problems to institutions ill-equipped to cope with them …" and "… of the widespread feeling of frustration and inadequacy in the international community about our own ability to address the vital global issues and deal effectively with them …" and that "there is no alternative but to keep on trying to find them."[987] These sentiments and others expressed in the report were much influenced by the Villach Conference report[988], which was cited in WCED report. It helped shape the recommendations of the 1987 WCED Report "Our Common Future" to protect the earth's climate[989] and in the creation of the Intergovernmental Panel on Climate Change (IPCC).[990]

3.3.2.2.7. Creation of the Intergovernmental Panel for Climate Change (IPCC)

By this time in 1988, policymakers were starting to understand the serious long-term implications of the scientific findings. Few governments, however, were ready to accept the conclusions reached at the Villach Conference or subsequent conclusions under the auspices of the AGGG as the final word on climate change, least of all the United States government. Meanwhile, the different US government agencies continued to disagree on the nature and magnitude of the issue, and the pro-fossil fuel Reagan administration was reluctant to support any bold action. In any case, there was no official from the DOE or from the EPA present at the Villach Conference, and the US State Department would not accept an international scientific assessment consensus that did not involve US government scientists, who could speak for the interests of the US government administration when establishing an international climate change assessment.[991]

At about the same time, a severe drought hit the Midwest and other parts of the US, which led to crop damages estimated at about USD 78.8 billion. The US government had estimated its farmers would produce 7.3 billion bushels of corn but instead they

[986] UNGA (1987) Report of the World Commission on Environment and Development, United Nations General Assembly Resolution A/RES/42/187, 11 December 1987, 96th Plenary Meeting.

[987] WCED (1987) supra note 831.

[988] WMO (1986) supra note 958.

[989] ICSU (2015) supra note 954, p. 13.

[990] Bert Bolin (2007) supra note 921, p. 28.

[991] Joshua P. Howe (2014) supra note 962, p. 158.

produced only 4.9 billion bushels – a staggering 33% below expectations. In Illinois alone, farmers lost 44% of their expected yields. At its peak, it covered 36% of the US (compared to the Dust Bowl's 70%), and led to extensive forest fires across the West, including a series of catastrophic fires in Yellowstone National Park.[992] Mindful of these happenings and the publicity that ensued, and not wishing to lose momentum for an international climate change agreement and to overcome the objections of the different domestic agencies, the policy board of the US National Climate Program (NCP) recommended that a new intergovernmental body, this time led by official national government representatives rather than by independent scientists, to oversee another comprehensive assessment of climate change.[993]

The AGGG was thus superseded by a new, independent official group under the direct control of representatives appointed by each nation-State. Responding to this request, WMO and UNEP soon parlayed this NCP proposal into a permanent mechanism for building consensus on climate change and jointly created the Intergovernmental Panel on Climate Change (IPCC) in 1988, which was tasked to take stock on a regular basis of the science of climate change for government purposes and examine options for responding to human-induced climate change.[994]

It was endorsed by the United Nations General Assembly and its initial tasks as outlined in the General Assembly Resolution A/RES/43/53[995] were to prepare a "comprehensive review and recommendations with respect to the state of knowledge of the science of climate and climatic change; programs and studies on the social and economic impact of climate change, including global warming; possible response strategies to delay, limit or mitigate the impact of adverse climate change; identification and possible strengthening of relevant existing international legal instruments having a bearing on climate; elements for inclusion in a possible future international convention on climate."

Creation of the IPCC provided the institutional base for a more focused, better-coordinated examination of needed science-policy interactions at the international level. Bert Bolin, who was a member of AGGG and an author of the SCOPE report, was

[992] David J. Unger (2013) Billion-dollar weather: The 10 most expensive US natural disasters, the Christian Science Monitor, 27 June 2013. Accessed on 7 October 2016 at: http://www.csmonitor.com/Environment/2013/0627/Billion-dollar-weather-The-10-most-expensive-US-natural-disasters/Drought-and-heat-wave-1988-78.8-billion

[993] Alan D. Hecht and Dennis Tirpak (1995) supra note 968, p. 381.

[994] Joshua P. Howe (2014) supra note 962, p. 158.

[995] UNGA (1988) A/RES/43/53, United Nations General Assembly, 6 December 1988. Accessed on 3 September 2016 at: http://www.un.org/documents/ga/res/43/a43r053.htm

appointed the first IPCC chairman while the other appointees were scientists from government agencies and mid-level diplomats in the three Working Groups of the IPCC.[996] The first meeting of the IPCC was held in Geneva in November 1988 and 28 countries responded to the call.[997] The key to the IPCC was its intergovernmental status. The IPCC consensus was more than an agreement among scientists; it was an agreement among governments. The intergovernmental status was, in part, to address the concerns of the US government administration but apart from that, Bert Bolin, the IPCC chairman, and Mostafa Tolba, the UNEP director, also recognized the importance of establishing a consensus process that gave international political actors the ownership over the issue of climate change. By participating in the IPCC, many skeptical governments tacitly agreed that the problem merited some sort of international solution.[998] The IPCC was another good example of an international regime.

For example, the choice of chairmen of the IPCC and its working groups reflected how both scientific competence and political considerations played a role. Most of the work would have to be carried out in the working groups and invitations would have to be extended to key scientists to take the lead in the assessments of current knowledge in the relevant fields of research. However, it is also important that the working group structure was agreed upon. Two vice-chairmen were elected for each of the Working Groups I and II, but because of interest of the appointees to work in Working Group III, there were five chairmen for that group. In viewed of the fact that only 28 countries attended the first meeting, it was further agreed that each country could choose to be a member of one of the working groups. This allocation prevented conflicts and the first meeting went very smoothly.[999]

The IPCC as a panel does not directly support new research or monitor climate-related data. Instead, the IPCC reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide, relevant to the understanding of climate change. It then provides, through its reports, a clear scientific view on the current state of knowledge on climate change and its potential environmental and socio-economic impacts. However, the IPCC process of synthesis and assessment has often inspired scientific research leading to new findings. However, since the IPCC is both scientific and intergovernmental, it does provide rigorous and balanced scientific

[996] Joshua P. Howe (2014) supra note 962, p. 158.

[997] IPCC (1988) Report of the First Session of the WMO/UNEP Intergovernmental Panel on Climate Change, World Meteorological Organization, Geneva.

[998] Joshua P. Howe (2014) supra note 962, p. 159.

[999] Bert Bolin (2007) supra note 921, p. 50.

information to the governments, and the governments in turn acknowledge the authority of the panel and of the scientific content when they endorse the IPCC reports. Hence, the work of the IPCC is policy relevant yet neutral, and not policy-prescriptive.[1000]

3.3.2.2.8. The IPCC Reports on Climate Change

The main activity of the IPCC is to provide on a regular basis an assessment of the state of knowledge on climate change, and these findings are published as the IPCC Assessment Reports. On request from international organizations, the IPCC also prepares Special Reports and Technical Papers on topics for which independent scientific information and advice is deemed necessary, and it also supports the United Nations Framework Convention on Climate Change (UNFCCC) through its work on methodologies for the National Greenhouse Gas Inventories.

To ensure these assessment reports are comprehensive and objective, and are produced in an open and transparent way, the IPCC call upon hundreds of leading scientists who volunteer their time and expertise as Coordinating Lead Authors and Lead Authors in drafting these reports. These Lead Authors in turn enlist hundreds of other experts as Contributing Authors to provide complementary expertise in specific areas during the report drafting. Thousands of other experts meanwhile contribute as reviewers to ensure the reports reflect the full range of views in the scientific community. These assessment reports undergo multiple rounds of drafting and review before they are published.[1001] In the drafting and reviewing process, the authors and reviewers use a common calibrated language to articulate their expert judgments and to communicate the degree of uncertainty of the findings in the assessment reports. Hence, policymakers and general public can have confidence in the unequivocal assertion of the IPCC in AR5 that "the human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history."[1002] Since 1990, the IPCC has delivered on a regular basis the most comprehensive Assessment Reports on the science of climate change, its impacts, adaptation and vulnerability, and the mitigation of climate change.

It has also responded to the need for information on scientific and technical matters

[1000] A detailed description of the IPCC is available at: http://www.ipcc.ch/organization/organization.shtml

[1001] IPCC (2013b) IPCC Factsheet: What is the IPCC? Intergovernmental Panel on Climate Change Secretariat, 30 August 2013. Accessed on 10 June 2016 at: http://www.ipcc.ch/news_and_events/docs/factsheets/FS_what_ipcc.pdf

[1002] IPCC (2014a) supra note 135, p. 2.

from the UNFCCC through Methodology Reports and Special Reports, and from governments and international organizations through Special Reports and Technical Papers. A Special Report for UNFCCC is an assessment of a specific issue and generally follows the same structure as a volume of the IPCC Assessment Report. It is subjected to the same writing, review and approval process as that of an Assessment Report. While Methodology Reports serve as methodologies and guidelines to help Parties to the UNFCCC prepare their National Greenhouse Gas Inventories. A typical IPCC Special Report is 'Aviation and the Global Atmosphere', which was prepared in collaboration with the Scientific Assessment Panel to the Montreal Protocol on Substances that Deplete the Ozone Layer.[1003]

Following its establishment, the work of the IPCC was divided into three Working Groups with Working Group I focusing on the Scientific Assessment of Climate Change, Group II on Impacts Assessment on Climate Change, and Group III on IPCC Response Strategies. In addition, a smaller, less formal fourth working group tackled the specific concerns and problems of developing nations, and an administrative bureau oversaw the larger process.[1004] UNEP and WMO asked for reports from each group by 1990, at which point they convened as a larger body to compile the reports into a single, authoritative assessment under the leadership of Bert Bolin (IPCC Chair) and to hash out an overview chapter of that assessment. The reports from the three Working Groups, including their respective Policymaker Summaries, an Overview Chapter, and the Report from the IPCC Special Committee on the Participation of Developing Countries. These reports were known collectively as the IPCC First Assessment Report (FAR).[1005]

The Report of Working Group I under the leadership of John T. Houghton of UK (WGI chair) contained merely 365 pages with eight color plates. Although much of the findings were non-quantitative, it made a persuasive case of anthropogenic interference with the climate system.[1006] Since few scenarios had been worked out before the

[1003] IPCC (1999) Aviation and the Global Atmosphere. Prepared in collaboration with the Scientific Assessment Panel to the Montreal Protocol on Substances that Deplete the Ozone Layer [J. E. Penner, D. H. Lister, D. J. Griggs, D. J. Dokken, M. McFarland (eds.)], Cambridge University Press, Cambridge, 373 pp.

[1004] Alan D. Hecht and Dennis Tirpak (1995) supra note 968, p. 385.

[1005] IPCC (1990a) First Assessment Report. [Houghton, J. T., G. J. Jenkins, J. J. Ephraums, Tegart, WJ. McG., G. W. Sheldon, D. C. Griffiths and F. M. Bernthal (eds)]. Digitized by the Digitization and Microform Unit, UNOG Library, 2010. Accessed on 4 September 2016 at: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

[1006] Le Treut, H., R. Somerville, U. Cubasch, Y. Ding, C. Mauritzen, A. Mokssit, T. Peterson and M. Prather (2007) Historical Overview of Climate Change. In Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel

assessment, the Report of Working Group II under the leadership of Yuri Izrael of the USSR (WGIII chair) was largely qualitative and expressed in terms of sensitivities to prescribed changes of climate. Because several Soviet scientists led the assessment process, scientific as well as practical difficulties arose with language. The report was finally completed when one of the co-chairmen, M. Tegart, and his Australian colleagues took on the task of compiling and editing the final report.[1007]

Meanwhile, the Task B sub-group on 'Legal and Institutional Mechanisms' of Working Group III under the leadership of Federick M. Bernthal of USA (WGIII chair) was given the responsibility to review and identify the relevant existing international legal instruments have a bearing on climate and to prepare recommendations for possible strengthening of these international legal instruments. The general view expressed in the coordinators' report was that while existing legal instruments and institutions with a bearing on climate should be fully utilized and further strengthened, they were insufficient to meet the challenges of climate change. The report emphasized the need for a framework convention on climate change. Hence, the Working Group III, in its Policymakers Summary, recommended that a framework convention should be established, following the format of the Vienna Convention for the Protection of the Ozone Layer, and should include, as a minimum, the general principles and obligations. The report also recommended that the convention should be framed in such a way as to "gain the adherence of the largest possible number and most suitably balanced range of countries while permitting timely action to be taken" and "should contain provision for separate annexes /protocols to deal with specific obligations".[1008]

As part of the commitment of parties to take action on global warming and its adverse effects, the report also suggested that the convention address the particular financial needs of the developing countries, the question of the access to and transfer of technology, and the establishment of institutional requirements. The possible elements for inclusion in this framework convention, which was the fifth objective of the IPCC,

---

on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[1007] Bert Bolin (2007) supra note 921, pp. 63-64.

[1008] R. Rochon, D. Attard and R. Beetham (1990) Legal and Institutional Mechanisms. In Climate Change: IPCC Response Strategies. Contribution of Working Group III to the First Assessment Report of the Intergovernmental Panel on Climate Change [Federick M. Bernthal (ch.)], pp. 261-268. Digitized by the Digitization and Microform Unit, UNOG Library, 2010. Accessed on 4 September 2016 at: http://www.ipcc.ch/ipccreports/far/wg_III/ipcc_far_wg_III_full_report.pdf

were also detailed in the report and appended to the Policymakers Summary.[1009]

The scientific evidence cited in FAR underlined the need for a high degree of international cooperation to deal with the global issue of climate change. It played a decisive role in the creation of the United Nations Framework Convention on Climate Change (UNFCCC)[1010], the key international treaty to reduce global warming and cope with the adverse effects of climate change, and the parent treaty of the Kyoto Protocol.[1011] The UNFCCC and its Kyoto Protocol provide the overall policy framework and legal basis for addressing climate change issues.

The creation of the IPPC, which is an intergovernmental panel under the direct control of representatives appointed by each nation-State, to supersede the AGGG comprising of independent scientists to conduct scientific assessments, to provide climate change policy advice and suggestions for preventive measures in mitigating climate change meant that the epistemic international scientific community had been relegated to an important but clearly supporting role and not as equal partners with policymakers on climate change policy and law. This was a turning point in the evolution of climate change governance, which foresaw the ascendancy of international politics and the use of international law to govern climate change.

3.3.2.3. The Noordwijk Conference Epoch

The Ministerial Conference on Atmospheric Pollution and Climate Change, held on 6-7 November 1989 in Noordwijk, the Netherlands, with representatives from 67 countries and the Commission of the European Community, was the first high-level intergovernmental meeting focusing specifically on the climate change issue.[1012]

3.3.2.3.1. Opportunity Lost to Curb GHG Emissions

[1009] IPCC (1990b) Policymakers Summary: Formulation of the Response Strategies. In Climate Change: IPCC Response Strategies. Contribution of Working Group III to the First Assessment Report of the Intergovernmental Panel on Climate Change [Federick M. Bernthal (ch.)], pp. liii-lvii. Digitized by the Digitization and Microform Unit, UNOG Library, 2010. Accessed on 4 September 2016 at: http://www.ipcc.ch/ipccreports/far/wg_III/ipcc_far_wg_III_full_report.pdf

[1010] United Nations (1992a) supra note 16.

[1011] United Nations (1998) supra note 17.

[1012] Netherlands Ministry of Housing, Physical Planning and Environment (1989) Noordwijk Conference Report, Ministerial Conference on Atmospheric Pollution and Climate Change, 6-7 November 1989, Noordwijk, Netherlands, organized by the Minister of Housing, Physical Planning, and Environment of the Netherlands in cooperation with UNEP and WMO.

There was a general feeling among the invited delegates to the conference that the environmental ministers present would at least agree to the target proposed by the Dutch environmental minister, which was a more modest proposal than that raised at the 1988 Toronto Conference: a freezing of greenhouse-gas emissions at 1990 levels by 2000. Nevertheless, it was still a binding target/timetable of emissions reduction. Most ministerial delegates present were ready to sign on the Dutch proposal.[1013] However, at the final negotiating session with just the environment ministers present, the US ministerial delegate, with the acquiescence of the ministerial delegates of Britain, Japan and the Soviet Union, forced the ministerial conference to abandon the commitment to freeze emissions.

The Noordwijk Ministerial Declaration on Climate Change stated that it "recognizes the need to stabilize, while ensuring stable development of the world economy, CO_2 emissions and emissions of other greenhouse gases not controlled by the Montreal Protocol" and that "industrialized nations agree that such stabilization should be achieved by them as soon as possible".

Although the declaration emphasized that, "in the view of many industrialized nations such stabilization of CO_2 emissions should be achieved as a first step at the latest by the year 2000", it did not indicate which nations or at what emissions level.[1014]

All the years of hard work, since the 1960s, put together by scientists, policymakers and activists, especially in the Western countries, to solve the climate change problem turned immediately into hot air. It marked the end of the first epoch of international climate change governance in which science took the lead to understand and solve the climate change problem. It was a crucial turning point in the evolution of climate change governance. The influence of science soon waned and the anarchical structure of international politics came to the fore, first with the fundamental split in abatement policy among the Western countries, followed soon after by the North-South economic divide between developed countries and developing countries with their fundamental differences in perspective on equity in dealing with the climate change problem.

3.3.2.3.2. US-Europe Political Divide in Mitigation Approach

[1013] Nathaniel Rich (2018) supra note 764.

[1014] Noordwijk Ministerial Declaration on Climate Change (1989) is often referred to as the Noordwijk Declaration on Atmospheric Pollution and Climate Change. It was reprinted in American University Journal of International Law and Policy, Volume 5 (1990), pp. 592-601.

At the conference, a fundamental split in the abatement approach to solving the climate change problem became apparent among the developed countries, which essentially comprised most of the industrialized nations, where most of the scientific research on climate change had been conducted, and where most of the active government departments and environmental constituencies addressing climate change governance were located.

Most of the European countries had actually expressed support for adopting the proposed international 'top-down' policy, which had proven effective in solving the transboundary air pollution and the depletion of the ozone layer issue-areas. This international policy essentially entailed establishing 'top-down' quantitative limitations on national emission levels of greenhouse gases (targets and timetables) and stabilizing the total carbon dioxide levels at the then current levels.

The essence of the international approach was exemplified by later comments of the former President of France Jacques Chirac during his speech at the Sixth COP of the UNFCCC held in The Hague, Netherlands on 20 November 2000, where he electrified the participants at the conference by praising the Kyoto Protocol as "the first step toward global governance."[1015] Based on their geopolitical experience with the tragedy of international conflicts within Europe during the Twenty Years Crisis (1919 – 1939),[1016] the modern-day diplomats of Europe are generally pro-unification when negotiating environmental issues or otherwise.

The United States, supported by Britain, Japan and the former Soviet Union, had, however, questioned the need to establish such emission targets and timetables. The United States was especially adamant that such targets and timetables were too rigid, that they did not take into account the differing national circumstances, and claimed that they would be largely symbolic. Instead, the United States argued that emphasis should be given to further scientific research and developing national rather than international strategies and programs. Based on their geopolitical experience over that same period of history, the modern-day diplomats of the United States of America are largely pro-isolationism when negotiating on environmental issues or otherwise.

[1015] Christopher C. Horner (2000) Chirac: Kyoto "First Step towards Global Governance", Op-Eds and Articles, Competitive Enterprise Institute, 19 November 2000. Accessed on 24 August 2018 at: https://cei.org/content/chirac-kyoto-first-step-toward-global-governance

[1016] Edward Hallett Carr (1939) The Twenty Years Crisis: 1919-1939, [1964 Edition], Harper Perennial, New York, USA.

The essence of the US approach was exemplified by later comments of Dr. John Sununu, who was then White House Chief of Staff under the administration of US President George H. W. Bush, when he was later interviewed by Nathaniel Rich for the New York Times article, "Losing Earth: The Decade We Almost Stopped Climate Change" of 1 August 2018 as to whether he considered himself personally responsible for killing a global warming treaty during the Bush administration, and he responded:

"It couldn't have happened," he said, "because, frankly, the leaders in the world at that time were at a stage where they were all looking how to seem like they were supporting the policy without having to make hard commitments that would cost their nations serious resources." He added, "Frankly, that's about where we are today."[1017] These sentiments voiced by John Sununu quite correctly reflected the views of the policymakers in the United States; these sentiments, however, did not correctly reflect the views of the policymakers in Europe.

This fundamental split in the politics of mitigating climate change between US and Europe was further exacerbated at the subsequent regional 1990 UNECE Bergen Conference and the global 1990 WMO/UNEP Second World Climate Conference, which led into the UNCED.[1018] At both conferences, the ministerial declarations did not include any agreed target/timetable for the reduction of carbon dioxide emissions.

3.3.2.3.3. Correlation to Spread of Neoliberalism in US and Europe

This fundamental split in the politics of mitigating climate change between US and Europe is highly correlated with the fundamental difference in political ideology between the US and Europe during the 1980s and 1990s. For instance, the US had consecutive conservative Republican administrations [Right] under President Ronald Reagan and President George H. W. Bush from 1981 to 1993 while France had a social government [Left] under President Francois Mitterrand from 1981 to 1995. George H. W. Bush, who served as the Vice-President to President Reagan in both his presidential terms from 1981-1988, went on to win the US presidential election in 1989 with the support of Reagan and served for one term. He lost the US presidential election to Bill Clinton in 1993. During his term, President Bush essentially continued with neoliberal

[1017] Nathaniel Rich (2018) supra note 764.

[1018] The 1990 UNECE Bergen Conference was accessed on 24 August 2018 at: https://unfccc.int/resource/ccsites/senegal/fact/fs220.htm and the 1990 WMO/UNEP Second World Climate Conference was accessed on 24 August 2018 at: https://unfccc.int/resource/ccsites/senegal/fact/fs221.htm

ideology, espoused by President Reagan. In his acceptance speech at the Republican National Convention in August 1988, George Bush stressed the successes of the Reagan years and his ability to continue to build on them, and famously promised not to raise taxes: "Read my lips: no new taxes."[1019]

Although President Bill Clinton and Prime Minister Tony Blair were critical of the excesses of Reagan and Thatcher when they came to power in the United States and Britain respectively, yet it was during their terms in office that neoliberalism ideology, especially its economic strand, spread beyond the American epicenter to the rest of the world. [1020] In fact, economic neoliberalism was even codified in international organizations, such as the World Trade Organization,[1021] and negotiators accepted the introduction of market-based mechanisms into the provisions of the Kyoto Protocol.

Europe was also strongly affected by the neoliberal ideology during the 1980s and 1990s yet, with the exception of Thatcher's UK, it was not an unambiguous triumph for neoliberalism in continental Europe. In fact, although all the Western European countries had to liberalize their markets, which were required for membership in the European Union, the continental European countries also retained the protective social democratic institutions built during the "Golden Age"[1022] of embedded liberalism.[1023] This pattern of the pragmatic adoption of an extensive range of distinctly "neoliberal" economic reforms, which was combined with welfare-enhancing public policies, was quite widespread in continental Europe and had survived till today.[1024]

3.3.3. The International Law Period (1990–1997)

The International Law Period was inaugurated with the UN General Assembly's Resolution of 44/228 of 22 December 1989 to convene the United Nations Conference on Environment and Development (UNCED) and calling upon the Conference to

[1019] Stephen Knott (2019) George H. W. Bush: Campaigns and Elections, Miller Centre, University of Virginia (2019). Accessed on 31 August 2019 at: https://millercenter.org/president/bush/campaigns-and-elections

[1020] Peter Evans and William H. Sewell, Jr. (2013) supra note 466, p. 47.

[1021] Neil Brenner, Jamie Peck and Nik Theodore (2010) Variegated Neoliberalism: Geographies, Modalities, Pathways, Global Networks, Volume 10, Issue 2 (April 2010), pp. 182-222.

[1022] Peter Evans and William H. Sewell, Jr. (2013) supra note 466, p. 52.

[1023] John Gerard Ruggie (1982) International Regimes, Transactions and Change: Embedded Liberalism in the Postwar Economic Order, International Organization, Volume 36, Issue 2, International Regimes (Spring 1982), pp. 379–415.

[1024] Peter Evans and William H. Sewell, Jr. (2013) supra note 466, p. 55.

promote and further develop international environmental law, and to "examine … the feasibility of elaborating general rights and obligations of States, as appropriate, in the field of the environment".[1025]

Despite the difficulties inherent in international politics in the form of the US-Europe political divide, which was quickly followed by the North-South economic divide, the nation-States did succeed with multilateral political diplomacy to negotiate and adopt the international legal regime of UNFCCC and its Kyoto Protocol, which marked the peak of the International Law Period, to address the climate change problem.

3.3.3.1. The Pre-UNFCCC Epoch

With the failure of the Ministerial Conference on Atmospheric Pollution and Climate Change in Noordwijk, the Netherlands, to reduce carbon dioxide emissions in 1989, the baton of international negotiations to solve the climate change problem under the auspices of the UNEP, which was pro-science, to that of the United Nations, which was clearly an international political arena.

The UNGA had already decided to convene the United Nations Conference on Environment and Development (UNCED), which called upon the Conference to promote and further develop international environmental law with resolution 44/228 of 22 December 1989. As climate change is also an environmental issue, it was logical that the General Assembly should resolve to establish an International Negotiating Committee for a Framework Convention on Climate Change (INC/FCCC)[1026] to prepare a multilateral treaty for signature at the UNCED in Rio de Janeiro on 4 June 1992.[1027]

3.3.3.1.1. Possible Models for the UNFCCC

There were, at that juncture, two competing models for establishing the UNFCCC. There was the general comprehensive agreement on the 'law of the atmosphere', modeled after the 1982 UN Convention on the Law of the Sea Convention, which would acknowledge the notion that all problems of the atmosphere, including atmospheric pollution, are closely interrelated and need to be addressed in a comprehensive manner. The other was the framework convention plus protocol model,

[1025] UNGA (1989) supra note 832.
[1026] UNGA (1990) supra note 118.
[1027] United Nations (1992a) supra note 16.

focusing specifically on climate change, which would be modeled after the recently established 1985 Vienna Convention for the Protection of the Ozone Layer [1028] and its 1988 Montreal Protocol.[1029]

The tedious and complex negotiations over substantive issues for the Law of the Sea, which took more than 14 years to complete and another 12 years for entry into force,[1030] compared unfavorably with the rapid and stepwise negotiations over general principles and largely procedural matters and for the Vienna Convention, which took 4 years to complete and 3 years for entry into force.[1031] In fact, it took less than 2 years from the time the UN General Assembly issued Resolution A/RES/45/212 to establish INC/FCCC on 21 December 1990[1032] to the opening for signature of the UNFCCC at UNCED in Rio de Janeiro on 4 June 1992.[1033]

Just prior to the Resolution A/RES/45/212, the Second World Climate Conference, which was the last international climate change conference sponsored jointly by UNEP and WMO, was held in Geneva from 29 October to 7 November 1990 with the main purpose of reviewing the first decade of progress under the UNEP/WMO World Climate Programme (WCP). As the conference was held at a crucial time in the climate change treaty negotiation process and the IPCC had just completed its First Assessment Report (FAR), the secondary purpose of the conference, which emerged relatively late in the planning, was to undertake an initial international review of the FAR as a lead-in to the first session of the INC/FCCC, which was scheduled to begin in Washington DC in February 1991. Although the Ministerial Declaration from this conference, which was adopted by consensus, after lengthy negotiations on the final day, disappointed many conference participants because it did not offer a high level of commitment, it did represent, by virtue of its high political level and widespread participation, the most broadly based call thus far for cooperative international action on climate change.[1034]

3.3.3.1.2. The North-South Economic Divide

[1028] Durwood Zaelke and James Cameron (1990) Global Warming and Climate Change - An Overview of the International Legal Process, American University International Law Review, Volume 5, Number 2, pp. 249-290.

[1029] UNEP (1987) supra note 896.

[1030] See Section 3.1.5.2.

[1031] Edith Brown Weiss (2009) supra note 892.

[1032] UNGA (1990) supra note 118.

[1033] United Nations (1992a) supra note 16.

[1034] John Zillman (2009) A History of Climate Activities, World Meteorological Organization, A History of Climate Activities, Bulletin Volume 58, Number 3 (2009). Accessed on 1 March 2018 at: https://public.wmo.int/en/bulletin/history-climate-activities

The political differences in the abatement approach to solving the climate change problem among the developed countries at the 1989 Noordwijk Ministerial Conference was the first step in the politicizing of the evolution of climate change governance. It was quickly followed by the emergence of the North-South economic divide at the 1990 Second World Climate Conference in which the developed countries of the North and the developing countries of the South held fundamentally different views pertaining to the climate change issue while the former saw it primarily as a scientific and environmental issue while the latter emphasized its implications on poverty and economic development of their countries.[1035]

The influence of science on climate change policy and law quickly waned from then on. Meanwhile, the impact of the anarchical structure of international politics on the evolution of climate change governance became more evident with each new round of negotiation by the international community to resolve the climate change problem.

The main concern of the developing countries was the potential negative impact of climate change policies on their economic development.[1036] The developing countries had formed the G-77, the largest negotiation coalition in the United Nations system, as early as 1964.[1037] In fact, 129 members of the Parties to UNFCCC are members of the G-77 and China. Hence, the G-77 and associate member China were generally united in the argument that the agreement must not obstruct their economic development. However, apart from this unified position, their other interests were highly diversified. For instance, the oil exporting countries feared more for their revenue streams as the agreement could restrict fossil fuels use, and the Small Island States and States with low-lying coastal areas created an alliance (AOSIS) to protect themselves from the threat of rising sea levels.[1038]

In the meantime, there was also no unified position among the developed countries on the climate change issue. As described earlier, there existed the US-Europe political divide with the majority of the Organization for Economic Cooperation and

[1035] Laurence Boisson de Chazournes (2008) United Nations Framework Convention on Climate Change, United Nations Audiovisual Library of International Law. Accessed on 28 February 2018 at: http://legal.un.org/avl/ha/ccc/ccc.html

[1036] Sebastian Oberthur (1993) Politik im Treibhaus: Die Entstehung des internationalen Klimaschutzregimes, Sigma, Berlin, p. 43.

[1037] The G-77 group was formed on 15 June 1964 by the "Joint Declaration of the Seventy-Seven Countries" issued at the United Nations Conference on Trade and Development (UNCTAD).

[1038] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 34-35.

Development (OECD) countries favoring the adoption of an agreement that would reduce global GHG emissions, although there was no agreement as to the actual amount. In contrast, the United States, together with UK, Japan and the Russian Federation, while agreeing in principle to the need for such an agreement, were highly opposed to the incorporation of legally binding targets and timetables.[1039]

The North-South economic divide arose from fundamentally different understanding of what equity means for the different countries in the context of climate change. Although the notion that all people have equal rights and obligations is normally an accepted cornerstone in discussions on equity, achieving equity in the climate change context would imply that there should be equal distributing rights to the use of the atmosphere. However, when it comes to agreeing on what equal distributing rights to the use of the atmosphere actually means, it became obvious that the principle of equal rights, commonly adhered to, is not easily translated into practice.

For instance, the dilemma for the economically poorer countries in the South is that these countries have not contributed to the enhanced greenhouse effect to any significant degree, but would most likely be vulnerable to the impacts of a changing climate, and at the same time lack the capabilities to mitigate adverse impacts or adapt when the need arises. Therefore, these countries uphold the perspective, looking backwards in time, that equal distributing rights to the atmosphere means that those who caused the atmospheric problem should fix it.[1040]

On the other hand, the developed countries in the North often adopt the perspective, looking forward in time, that climate change is too important an issue to let large parts of the world continue to emit greenhouse gases without regulations. In essence, this reasoning underscores that the common heritage of mankind cannot be sacrificed due to Southern envy on past Northern actions. Equality in this connotation means that all share the burden equally regardless of history.[1041]

However, achieving a climate change agreement perceived as equitable by both the

[1039] Daniel Bodansky (1993) The United Nations Framework Convention on Climate Change: A Commentary, Yale Journal of International Law, Volume 18, p. 468.

[1040] Ambuj D. Sagar (2000) Wealth, Responsibility, and Equity: Exploring an Allocation Framework for Global GHG Emissions, Climatic Change, Volume 45, Issues 3/4, p. 511.

[1041] Henrik Selin and Björn-Ola Linnér (2005) The Quest for Global Sustainability: International Efforts on Linking Environment and Development, CID Working Paper 5; Science, Environment and Development Group, Center for International Development, Harvard University, Cambridge, MA, USA, p. 8.

developed and developing countries is crucial because the effectiveness of global governance requires, among other things, "the establishment of common norms of expected behavior for a variety of different actors".[1042]

3.3.3.1.3. INC/FCCC Negotiation Process

The impact of the North-South economic divide was immediately felt during the establishment of the INC/FCCC at the beginning of the negotiation. The developing countries perceived that their concerns would not be properly addressed by the scientifically focused IPCC process and rejected the proposal of an international negotiating committee working under the auspices of WMO and UNEP. Thus, an INC/FCCC was established under the auspices of the UN General Assembly instead.[1043]

The main obstacle in the negotiations arose because economic development is highly dependent on the ever-increasing use of fossil fuel energy. Because fossil fuels are the main source of GHG emissions, an international agreement restricting GHG emissions would have an immediate and highly significant impact not only on the national economies of both developed and developing countries but also the global economy as a whole.[1044] The INC/FCCC negotiation process was exacerbated by at least three other significant factors as well:

(1) During the negotiation process, the differences in perspective on equitable development arising from the North-South economic divide was compounded by the US-Europe political divide on the right approach to mitigate climate change.
(2) The high uncertainty in certain aspects of climate science coupled with the numerous assumptions made in the development of climate change simulations justified the reluctance of many nation-States to negotiate a legally binding agreement.
(3) The participation of nearly all nation-States in the negotiations because of the global nature of the climate change issue made the negotiation process highly complex, which was further exacerbated by the widely diverging views held by the various nation-States on the issue.[1045]

It is therefore not a surprise to note that the INC/FCCC negotiation process started

[1042] Peter Haas (2004) Addressing the Global Governance Deficit, Global Environmental Politics, Volume 4, Issue 4, February 2004, p. 8.
[1043] Laurence Boisson de Chazournes (2008) supra note 1035.
[1044] Daniel Bodansky (1993) supra note 1039, pp. 475.
[1045] Simone Schiele (2014) supra note 218, p. 62.

slowly in the typical fashion of international environmental negotiations. Five meetings of the INC were necessary to negotiate a draft text and the first four meetings, which took place in 1991, achieved little.[1046] Negotiating parties were debating procedural issues and repeated their positions endlessly rather than seeking compromise. However, these initial sessions, although showing little progress, did allow the parties to exchange information, to communicate their views and concerns, and to gauge each other's strategic position. It was only in the final months of the negotiation process before the Earth Summit that real bargaining began in earnest and agreement reached late on the final day of the negotiations.[1047]

Perhaps, the decision of the UN General Assembly in its Resolution 45/212 of 21 December 1990,[1048] in establishing the INC/FCCC to negotiate a convention containing 'containing appropriate commitments for action to combat climate change and its adverse effects,' in time for signature at the UNCED, scheduled for June 1992 in Rio de Janeiro,[1049] saved the day. It was certainly one of the two factors critical for moving the negotiation process rapidly to completion. First, the deadline of June 1992 for the signing of the climate change treaty at the Earth Summit exerted considerable pressure on national governments to compromise on the substantive laws of the treaty. The Earth Summit was the first UN conference with broad-based participation of relevant Non-Governmental Organizations (NGO) from all over the world, invited by the summit organizers.[1050] Given the worldwide visibility of the INC/FCCC process, all government delegations wanted to have the climate change convention ready for signature. None of the government delegations wanted to be judged adversely by worldwide public opinion as the 'culprit' responsible for impeding the successful conclusion of the UNFCCC.

Second, with time pressure and the use of consensus decision-making in the negotiation process gave the big countries, e.g. the United States, substantial leverage over the final outcome because the nation-States were ready to compromise on the substantive laws of the climate change treaty.[1051]

[1046] Daniel Bodansky (1993) supra note 1039, pp. 482, 485, 487 & 488.

[1047] Daniel Bodansky (2001) supra note 907, p. 32.

[1048] UNGA (1990) supra note 118.

[1049] United Nations (2018a) supra note 806.

[1050] UNGA (2001) Reference document on the participation of civil society in United Nations conferences and special sessions of the General Assembly during the 1990s, Prepared by Office of the President of the Millennium Assembly, 55th session of the United Nations General Assembly, 1 August 2001. Accessed on 27 November 2017 at: http://www.un.org/ga/president/55/speech/civilsociety1.htm

[1051] Daniel Bodansky (2001) supra note 907, p. 32.

3.3.3.2. The UNFCCC Epoch

It was a tremendous diplomatic negotiating effort involving more than 140 nation-States. The total time for the formal treaty-making process from the start of negotiations on 4 February 1991 by the INC/FCCC to the adoption of UNFCCC on 9 May 1992 took slightly more than a year, and the entry into force in less than 2 years on 21 March 1994, amounted to just over 3 years, which is a short duration for negotiation, adoption, ratification, and entry into force of a multilateral environmental agreement.[1052]

In accordance with Article 20, the UNFCCC was open for signature at the Earth Summit in Rio de Janeiro from 4 to 14 June 1992, and thereafter at the United Nations Headquarters in New York until 19 June 1993.[1053] By that date, the Convention already had 166 signatories.[1054] Pursuant to its Article 22, the Convention is subject to ratification, acceptance, approval or accession by States and by regional economic integration organizations.[1055] It entered into force, in accordance with Article 23, after the 50th instrument of ratification, acceptance, approval or accession had been deposited on 21 March 1994.[1056] Today, it has near universal membership of 197 Parties.[1057]

3.3.3.3. The Post-UNFCCC Epoch

The first session of the Conference of Parties (COP) took place in Berlin from 28 March to 7 April 1995.[1058] The Parties adopting the Convention, based on the conclusions of the First Assessment Report (FAR) of the IPCC, knew that the commitments agreed in the UNFCCC would not suffice to mitigate climate change to any significant extent. More importantly, the Parties had established UNFCCC as a framework convention, which did not regulate climate change by itself but served as the platform for the Parties to delegate questions that are relevant for achieving the Convention's objectives to

[1052] UNFCCC (2014b) First steps to a safer future: Introducing The United Nations Framework Convention on Climate Change, United Nations Framework Convention on Climate Change. Accessed on 27 November 2017 at: http://unfccc.int/essential_background/convention/items/6036.php

[1053] United Nations (1992a) supra note 16, Article 20.

[1054] UNFCCC (2019a) Status of Ratification of the Convention, United Nations Climate Change. Accessed on 31 August 2019 at: https://unfccc.int/process-and-meetings/the-convention/status-of-ratification/status-of-ratification-of-the-convention

[1055] United Nations (1992a) supra note 16, Article 22.

[1056] Laurence Boisson de Chazournes (2008) supra note 1035.

[1057] UNFCCC (2019a) supra note 1054.

[1058] UNFCCC (1995a) Annotations to the Provisional Agenda, Including Suggestions for the Organization of Work, FCCC/CP/1995/1, English, 20 March 1995, p. 4.

additional regulation in subsequent protocols.[1059]

3.3.3.3.1. The Berlin Mandate at COP-1

Hence, the first and most important decision of COP-1 was the adoption of the Berlin Mandate to begin a process of enabling UNFCCC to take "appropriate action for the period beyond 2000, including the strengthening of the commitments of the Parties included in Annex I to the Convention (Annex I Parties) in Article 4, paragraph 2(a) and (b), through the adoption of a protocol or another legal instrument" as early as 1997.[1060]

Arriving at the decision to adopt the Berlin Mandate was the focal point and the most contentious part of the negotiation at COP-1. It was a highly politicized process. A few countries, especially the oil-exporting countries (OPEC), and powerful US industry groups were opposed to the development of new commitments, and the US industry groups insisted that any new commitments should be global and include commitments for developing countries. At the other end of the spectrum, the Alliance of Small Island States (AOSIS) presented a proposal calling for a 20% cut in industrialized countries' carbon dioxide emissions by 2005, which was a reaffirmation of the Toronto Conference proposal.[1061]

Eventually a new negotiating committee, known as the Ad Hoc Group on the Berlin Mandate (AGBM), was formed. The AGBM was an open-ended group comprising all the Parties to UNFCCC. It met eight times, culminating in the adoption of the Kyoto Protocol in December 1997 at the third session of the COP (COP-3).[1062] Similar to the pattern that prevailed during the INC/FCCC negotiation process, little progress was made initially during the AGBM negotiation process.

Some governments and, particularly, some US constituents had criticized the conclusions of the IPCC SAR for not being fully justified in the light of major uncertainties and the numerous assumptions that were made in the development of

[1059] Nele Matz-Luck (2009) Framework Conventions as a Regulatory Tool, Goettingen Journal of International Law, Volume 1, Issue 3, pp. 439-458.

[1060] UNFCCC (1995b) The Berlin Mandate: Review of the adequacy of Article 4, paragraph 2 (a) and (b), of the Convention, including proposals related to a protocol and decisions on follow-up, Decision 1/CP.1, FCCC/CP/1995/7/Add.1, English, 6 June 1995, pp. 4-6.

[1061] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) The Kyoto Protocol: A Guide and Assessment [Additional contributions from Tim Forsyth, John Lanchbery and Fanny Missfeldt], the Royal Institute of International Affairs, London, UK, pp 43-60.

[1062] Daniel Bodansky (2001) supra note 907, p. 35.

climate change simulations.[1063] Therefore, the SAR findings were not formally adopted at the second session of the COP for UNFCCC (COP-2) in Geneva. However, the Head of the US Delegation, Senator Tim Wirth, stoutly defended the IPCC SAR, "We are not swayed by and strongly object to the recent allegations about the integrity of the IPCC's conclusions … raised by naysayers and special interests bent on belittling, attacking and obfuscating climate change science … let me make it clear the US view: the science calls upon us to take urgent action."[1064] Hence, the Geneva Ministerial Declaration issued during COP-2 endorsed the SAR, which effectively silenced the climate change skeptics and accelerated the pace of AGBM negotiation.[1065]

Just as the FAR of IPCC played a significant role during the INC/FCCC negotiation process leading to the successful adoption of the UNFCCC, the SAR, which was completed in December 1995, also gave impetus to the on-going negotiations in the AGBM during the two years leading to the successful adoption of the Kyoto Protocol.[1066] The essence of the SAR findings was well upheld in the Third Assessment Report (TAR) of the IPCC, which was published 5 years later.[1067] However, the AGBM negotiation process was clearly about international politics.

3.3.3.3.2. COP-2 in Geneva

The second session of the COP (COP-2) for UNFCCC took place in Geneva from 8 July to 19 July 1996 at the midway point of the AGBM negotiation process.

The outgoing President at COP-2, Ms. Angela Merkel, Federal Minister for the Environment, Nature Conservation and Nuclear Safety of the Federal Republic of Germany, indicated, at the start of the meeting, that COP-2 provided the Parties with an opportunity to "carry out an interim evaluation of the implementation of the United Nations Framework Convention on Climate Change". She reminded the Parties that halfway through the AGBM negotiation process "the convergence of views was not yet in sight"; stressed the urgency of taking "consistent precautionary action" in the light of the recent scientific findings contained in the SAR, which confirmed that the global climate was undergoing changes as a result of human activities; expressed the hope that "the Conference of the Parties would make clear statements on the urgency of further

[1063] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 53.
[1064] Cited in Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 54.
[1065] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 24.
[1066] Bert Bolin (2007) supra note 921, pp. 125-126.
[1067] Id., p. 131.

action"; and concluded that a ministerial declaration would be "an important signal of the Parties' joint willingness to take action."[1068]

First, the Geneva Ministerial Declaration endorsed the SAR of the IPCC as "currently the most comprehensive and authoritative assessment of the science of climate change, its impacts and response options now available' and acknowledged that the findings indicated that the continued rise of greenhouse gas concentrations in the atmosphere will lead to dangerous interference with the climate system". The Declaration further expressed the belief that the SAR should be the "scientific basis for urgently strengthening action at the global, regional and national levels" to limit and reduce GHG emissions, particularly by the Annex I Parties, and "for all Parties to support the development of a Protocol or another legal instrument."[1069]

Second, the Ministerial Declaration called upon all Parties to "accelerate negotiations on the text of a legally-binding protocol or another legal instrument to be completed in due time for adoption at the third session of the Conference of the Parties." It re-affirmed that the outcome should fully encompass the remit of the Berlin Mandate, thereby countering any attempt to backslide, in particular the commitments of the Annex I Parties regarding "quantified legally-binding objectives for emission limitations and significant overall reductions within specified time-frames, such as 2005, 2010, 2020, with respect to their anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol."[1070]

Third, and perhaps most significant, the Geneva Ministerial Declaration marked the first time the Parties were willing to act in the absence of consensus.[1071]

Given their concerns over the economic impact of climate change policy, some OPEC countries, particularly Saudi Arabia, have highlighted scientific uncertainty and questioned the need for strong action. They have also wielded procedural tools to delay negotiations, including threats to veto advances on other issues if insufficient progress is

[1068] UNFCCC (1996a) Report of the Conference of the Parties on its Second Session, held at Geneva from 8 July to 19 July 1996, FCCC/CP/1996/15, 29 October 1996. Accessed on 2 March 2018 at: http://unfccc.int/resource/docs/cop2/15.htm

[1069] UNFCCC (1996b) Report of the Conference of the Parties on its Second Session, held at Geneva from 8 July to 19 July 1996, Addendum, Annex, FCCC/CP/1996/15/Add.1, 29 October 1996, pp. 71-72. Accessed on 2 March 2018 at: http://unfccc.int/resource/docs/cop2/15a01.pdf

[1070] Id., p. 73.

[1071] Daniel Bodansky (2001) supra note 907, p. 35.

made on issues of concern to them.[1072] The desire for consensus on the part of the Parties had, therefore, provided Saudi Arabia and other OPEC States with virtual veto power over the AGBM negotiations.

Because there was no agreement on the Rules of Procedure, particularly on the majority-voting rule, for UNFCCC,[1073] most Parties assumed that consensus was not merely a desirable goal but a legal requirement for action by the COP. Given the lack of authority on the part of COP to take decisions by majority vote, the Parties supporting the Ministerial Declaration did not attempt to have it formally adopted by the COP. Instead, COP-2 took note of the Declaration and appended it to the final report as an Annex, over the opposition of Saudi Arabia and other OPEC states, Russia, and Australia. The willingness of the European Union, the United States, and most of the developing states to act in the absence of consensus sent a strong signal to the AGBM that these states were prepared to go their own way if a small minority were to continue blocking progress in the negotiation process.[1074]

Fourth, other governments questioned the need for legally binding commitments either on targets and timetables, which were referred to as "quantified emission limitation and reduction objectives" (QELRO), policies or measures. During the course of the AGBM negotiation, there was a distinct possibility of backsliding with regards to the commitments of the Annex I Parties to QELRO.

Again, the Ministerial Declaration at COP-2 came to the rescue with reaffirmation of the commitments under UNFCCC. It marked a significant turning point in the negotiation process towards the adoption of the Kyoto Protocol in 1997.[1075]

3.3.3.3.3. Main Obstacles in AGBM Negotiation after COP-2

However, for much of the year following COP-2, the negotiations stalemated over two main issues, namely, first, differences in QELRO for the developed countries, and second, whether mechanisms should be established to allow the developed states to meet their targets in a flexible manner.

On the first issue of QELRO for Annex I Parties, the European Union had proposed a

[1072] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 40-41.
[1073] Id., pp. 432-434.
[1074] Daniel Bodansky (2001) supra note 907, p. 36.
[1075] Id., p. 35.

comparatively strong target of 15 percent cut in greenhouse gas emissions below 1990 levels by the year 2010. The United States and Australia proposed much weaker targets with Japan somewhere in the middle. Ultimately, this QELRO issue was resolved by specifying different emission targets for each party, ranging from an 8% decrease for the European Union to a 10% increase for Iceland from 1990 levels. The total emission reduction amounted to 5% decrease from 1990 levels by 2010.[1076] The Russian Federation and Ukraine were particularly favored, and special allowances were also given to Australia, Iceland, New Zealand and Norway.[1077]

The debate about the second issue on flexibility of mechanisms was equally divisive. The United States, supported by some industry NGOs, wanted mechanisms that would allow developed countries to achieve their emissions targets either through emissions-abatement projects in other countries or through emissions trading.[1078] The rationale was that as the geographical location of climate change abatement is irrelevant, cost-effectiveness considerations would prescribe that the cheapest mitigation options should be undertaken wherever they are located.[1079] In contrast, both the EU and developing countries argued that domestic action should be the main means of achieving emissions targets. In fact, the developing countries initially resisted any mechanism that would allow developed countries to receive credit for emissions reductions that would occur in developing countries.

In the end, the Protocol did create three innovative "flexibility mechanisms" or Kyoto Mechanisms, including emissions trading and joint implementation among industrialized countries, as well as a 'Clean Development Mechanism' (CDM) for emission reduction projects in developing countries, but provided that these should be 'supplemental' to domestic action. The Parties deferred most of the detailed issues about how the flexibility mechanisms would work to future negotiations.[1080]

3.3.3.4. The Kyoto Protocol Epoch

The Kyoto Protocol was finally adopted at COP-3 in Kyoto, Japan, on 11 December 1997.[1081] In accordance with its Article 24, the Protocol was open for signature from 16

[1076] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 24-25.

[1077] Bert Bolin (2007) supra note 921, p. 148-149.

[1078] Daniel Bodansky (2001) supra note 907, p. 36.

[1079] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 136.

[1080] Daniel Bodansky (2001) supra note 907, pp. 36-37.

[1081] UNFCCC (2019b) Kyoto Protocol – Status of Ratification, United Nations Climate Change. Accessed on 31 August 2019 at: https://unfccc.int/process/the-kyoto-protocol/status-of-ratification

March 1998 to 15 March 1999 at United Nations Headquarters, New York.[1082] By that date, the Kyoto Protocol had received 84 signatures.[1083]

Pursuant to its Article 22, the Kyoto Protocol is subject to ratification, acceptance, approval or accession by Parties to the UNFCCC. The requirement for entry into force was to be on the 90th day after the date on which not less than 55 Parties to the Convention, incorporating Parties included in Annex I of the Convention which accounted in total for at least 55 % of the total carbon dioxide emissions for 1990 of the Parties included in Annex I, had deposited their instruments of ratification, acceptance, approval or accession.[1084] The Kyoto Protocol eventually entered into force on 16 February 2005 when the Russian Federation ratified the Protocol on 18 November 2004[1085] to complete the requirement of Art 25 (1).[1086] There are currently 192 Parties to the Kyoto Protocol with the notable exceptions of the US (who has never ratified the Protocol) and Canada (who withdrew from the Protocol in 2012).[1087]

3.3.4. The International Politics Period (1998–2015)

The immediate post-Kyoto Protocol period was marked by the Asian financial crisis[1088] with the free fall in the exchange rates of Asian currencies vis-à-vis the American dollar and concomitant economic recession. The contagion also spread to Russia, and some countries in Eastern Europe and South America. This economic turbulence, mainly in the developing world, had a significant impact on the on-going negotiations of the parties to implement the Kyoto Protocol.

The neoliberal ideology had by this time spread to the rest of the world from its American epicenter, and the countries in Asia that were adhering closely to the neoliberal approach of completely opening up their financial markets were most affected by the Asian financial crisis. The international politics of national interests

[1082] United Nations (1998) supra note 17, Article 24.

[1083] UNFCCC (2019b) supra note 1081.

[1084] United Nations (1998) supra note 17, Article 22.

[1085] UN Secretary-General (2004) Entry into Force of Kyoto Protocol, Following Russia's Ratification, Historic Step Forward to Combat Global Warming, Secretary-General says in Nairobi, SG/SM/9599-ENV/DEV/797, 18 November 2019 at: https://www.un.org/press/en/2004/sgsm9599.doc.htm

[1086] United Nations (1998) supra note 17, Article 25(1).

[1087] UNFCCC (2019b) supra note 1081.

[1088] HKIEBS (2000) Asian Financial Crisis: Causes and Development, Hong Kong Institute of Economics and Business Strategy, University of Hong Kong, Hong Kong, People's Republic of China.

started to reel its ugly head and the limitations of a top-down international law approach to climate change governance soon manifested itself when it came to the implementation of the legal instrument Kyoto Protocol to curb GHG emissions.

The same three issues of (1) the fear in the loss of national sovereignty to a supranational authority, (2) the prevalence of neoliberal ideology in the US, and (3) North-South economic divide that affected the LoS Convention in the early 1980s continued to contribute significantly to the failure of the top-down international law approach when it comes down to the implementation of the legal obligations of the Kyoto Protocol by the developed nations, especially the US.

More importantly this time round the positions of the developing countries had hardened in the diplomatic negotiations in the aftermath of the Asian financial crisis and they were completely unwilling to concede to the need for the legislation of GHG emission targets and timelines for the developing countries. It led eventually to the disastrous Conference of Parties (COP-15) at Copenhagen in 2009, which marked the end of the International Law Period.

At the Copenhagen conference, the Power-States negotiated the Copenhagen Accord,[1089] which was essentially the inflection point of the complete turn to a bottom-up approach to the negotiation and adoption of an international agreement to curb GHG emissions. It did lead eventually to the universal adoption of the Paris Agreement at Paris in 2015, which marked the culmination of the International Politics Period.

3.3.4.1. The Post-Kyoto Protocol Epoch

Many of the developed countries, especially USA, were interested to launch immediate post-Kyoto negotiations to include GHG emission reduction commitments from the developing countries in the extension period of the Kyoto Protocol from 2012 onwards because the legal binding targets of the Kyoto Protocol for the developed countries is applicable only from 2008 to 2012.[1090]

3.3.4.1.1. Strengthening of the North-South Economic Divide

The provision of legally binding targets/timelines only for the developed (Annex I)

[1089] See Section 3.3.4.2.2.

[1090] UNFCCC (2019c) What is the Kyoto Protocol? United Nations Climate Change. Accessed on 31 August 2019 at: https://unfccc.int/kyoto_protocol

countries in the Kyoto Protocol clearly reflected the North-South economic divide. Most of the developing countries, who were disenchanted with the skewed gains from globalization and the negative impact of policies prescribed by the Western-controlled international organizations, e.g. IMF, to contain the financial crisis in vulnerable countries, only wanted to focus on the implementation of the agreed commitments of the Annex I Parties in the post-Kyoto Protocol period.

However, the Kyoto Protocol, based on cost/benefit analysis, was expected to impose relatively high costs for the Annex I countries, generate only modest gains in GHG emissions reduction, and fail to provide a viable solution to the climate change problem. Hence, the developed countries, especially the US, were insistent on including the developing countries in the commitments provisions for the post-Kyoto Protocol period.

3.3.4.1.2. Strengthening of Domestic Political Divide in the United States

Just before the adoption of the Kyoto Protocol, the US Senate, in its 105th Congress session in July 1997, had unanimously voted by 95-0 for the bipartisan (Senators Byrd and Hagel) Senate Resolution 98 that "declares that the United States should not be a signatory to any protocol to, or other agreement regarding, the United Nations Framework Convention on Climate Change of 1992, at negotiations in Kyoto in December 1997 or thereafter which would: (1) mandate new commitments to limit or reduce greenhouse gas emissions for the Annex 1 Parties, unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period; or (2) result in serious harm to the U.S. economy."[1091]

Because the Executive and the Legislative branches of the US Government has power of veto over the each other, the US President is not able to pledge anything that Congress will not support. Hence, from the view of the other negotiators in any UN negotiation process, the US has effectively two governments. Doubtless the US founding fathers had their reasons but it makes the US a nation apart in the UN negotiation process because it is often unable to state what its position is or to move that position, which is a nightmare for other countries' negotiators.[1092]

[1091] US Senate (1997) Senate Resolution 98, 25 July 1997, 105th Congress Session (1997-1998), USA. Accessed on 29 January 2019 at: https://www.congress.gov/bill/105th-congress/senate-resolution/98

[1092] Richard Black (2009) Why did Copenhagen fail to deliver a climate deal? BBC News, 22 December 2009. Accessed on 9 February 2019 at: http://news.bbc.co.uk/2/hi/8426835.stm

One of the major obstacles to the implementation of the Kyoto Protocol was confirmed when President George W. Bush (Rep) on 13 March 2001 announced that the US did not intend to ratify the Protocol.[1093] Hence, it took the Kyoto Protocol eight years before it entered into force due to the opposition of the US government.

When the Kyoto Protocol entered into force in 2005, the Ad Hoc Working Group on the KP (AWG-KP) was established at the first meeting of the Parties to the Kyoto Protocol (COP-11/MOP-1) in December 2005 at Montreal, Canada, to fulfil the mandate established by the Protocol to negotiate commitments beyond 2012.[1094] However, agreement on a timeline and structured negotiation on the post-2012 framework only took place with the Bali Action Plan, negotiated in Bali, Indonesia in 2007.[1095] The work of the AWG-KP did lead to the adoption of the Doha Amendment in 2012, which established new commitments for Annex I countries in the Protocol for the second commitment period from 2013 to 2020. To date, it has not entered into force.[1096]

3.3.4.1.3. Buenos Aires Plan of Action (BAPA)

The Parties of the Convention at COP-4 in Buenos Aires, Argentina, sought to resolve issues of financial mechanism,[1097] technology transfer,[1098] adverse effects of climate change/impact of response measures[1099] for the implementation of the Protocol, and to establish rules for the activities implemented jointly, [1100] the three flexible mechanisms[1101] for least-cost solutions to the climate change problem,[1102] and the

[1093] US President Bush (2001) Text Of A Letter From The President To Senators Hagel, Helms, Craig, and Roberts, The White House, Office of the Press Secretary, 13 March, 2001.

[1094] UNFCCC (2005) Decision 1/CMP.1: Consideration of commitments for subsequent periods for Parties included in Annex I to the Convention under Article 3, paragraph 9, of the Kyoto Protocol, FCCC/KP/CMP/2005/8/Add.1, 9-10 December 2005, p. 3.

[1095] UNFCCC (2008) Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007, Addendum, Part Two: Action taken by the Conference of the Parties at its thirteenth session. Accessed on 8 February 2019 at: https://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf

[1096] UNFCCC (2018a) Doha Amendment, Process and Meetings, Kyoto Protocol, United Nations Framework Convention on Climate Change (UNFCCC). Accessed on 4 October 2018 at: https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment

[1097] UNFCCC (1995c) Decisions 2/CP.4 and 3/CP.4.

[1098] UNFCCC (1995d) Decision 4/CP.4.

[1099] UNFCCC (1995e) Decision 5/CP.4.

[1100] UNFCCC (1995f) Decision 6/CP.4.

[1101] UNFCCC (1995g) Decision 7/CP.4.

[1102] Sheila M. Olmstead and Robert N. Stavins (2006) An International Architecture for the Post-Kyoto Era, RWP06-009, March 2006, John Kennedy School of Government, Harvard University, Cambridge, MA, USA, p. 1.

preparations of COP/MOP[1103] under the Buenos Aires Plan of Action (BAPA).[1104] The possibility of a post-Kyoto Protocol negotiating round to cover the developing countries was mothballed till 2005.[1105]

3.3.4.1.4. Re-Emergence of the US-Europe Political Divide

The deadline for completion of action on these respective issues was COP-6. However, the ambitious BAPA proved to be too taxing for the negotiators within the short time allotted for the increasingly complex negotiation. It was exacerbated by the lack of gap closure between the developing countries, who were frustrated by the lack of leadership on the part of the developed countries to curb GHG emissions, and the developed countries, especially US, who were upset by the refusal of the developing countries to consider commitments for the post-Kyoto period. However, the collapse of COP-6 at Hague in 2000 was due primarily to the US wanting carbon sinks as part of the agreement (as well as other provisions like nuclear energy) while the Europeans were firmed on their stance that the US should not be given exceptions and allowed to meet its greenhouse gas reduction targets without actually cutting emissions, which is the re-emergence of the US-Europe political divide on emission reduction measures.[1106]

3.3.4.1.5. Withdrawal of the United States from Kyoto Protocol

Eventually, President George W. Bush (Rep) on 13 March 2001 announced that the US government did not intend to ratify the Protocol. Although the US was a signatory to the Protocol, it ended up not as a full party to the instrument. The reason given by President Bush was that there was no target and timeline set for reducing GHG emissions by the developing countries.[1107] It marked the end of the second epoch of international climate change governance. Similar to the end of the first epoch, it was the US Republic government that was the critical actor in ending the second epoch although it was clear from the unanimous approval of US Senate Resolution 98 in 1997 that it had the support of both political parties. Within the United States itself, there is first the political tension of the two-party system – Democrats and Republicans, and the second the political

[1103] UNFCCC (1995h) Decision 8/CP.4.

[1104] UNFCCC (1995i) Decision 1/CP.4

[1105] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 26.

[1106] Anup Shah (2001) COP6 – The Hague Climate Conference, Global Issues, 4 September 2001. Accessed on 29 January 2019 at: http://www.globalissues.org/article/181/cop6-the-hague-climate-conference

[1107] US President Bush (2001) supra note 1093.

tension between the Executive and the Legislature arms of the government.

Without the involvement of the United States, which was then still the biggest contributor to total anthropogenic GHG emissions and the largest economy in the world, it was assumed that it would lead to the inevitable demise of the Kyoto Protocol. One of the requirements for entry in force of the Protocol was ratification by nation-States, which should represent 55% of the 1990 global emissions of carbon dioxide. Of that amount, the US alone represented 35%, meaning that a shortfall in ratifications from nation-States representing only another 10% of the total global emissions would prevent the entry into force of the Protocol.[1108] However, with the Russian ratification in 2005, the Kyoto Protocol did eventually come into force 4 years later after much uncertainty.

Hence, the third epoch began in 2001 with the other member-States scrambling to salvage the Kyoto Protocol from dying a natural death. The shock therapy of US withdrawal galvanizes the EU and the G-77 plus China into more intense and concerted action. COP-6 was re-convened in Bonn in July 2001, and, without the US, the remaining nation-States were able to strike a political deal known as the Bonn Agreements.[1109] COP-6 in Bonn in July 2001 was followed quickly by COP-7 in Marrakesh in November of the same year.

3.3.4.1.6. The Marrakesh Accords

Progress ensued immediately with the Marrakesh Accords at COP-7 during the same year of US withdrawal, in which the remaining Parties agreed upon the rules and procedures by which the flexible mechanisms were supposed to work. Hence, before the end of 2001, the infrastructure for the implementation of the Kyoto Protocol with the adoption of the Marrakesh Accords, which is the 'rule book' for governing the important aspects of the operation of the protocol such as accounting for greenhouse gas emissions and reductions. The Accords, which comprised of 23 decisions, incorporated and built on the Bonn Agreements, and thereby completed the post-Kyoto policy-making launched by BAPA.[1110] Some outstanding issues remained but the technical issues relating to reporting and reviewed were resolved at COP-8 and COP-9, and the rules for sink projects under the CDM were cleared up by COP-9. With each subsequent

[1108] David A. Wirth (2017) supra note 854, p. 193.

[1109] United Nations (2001) Governments Adopt Bonn Agreement on Kyoto Protocol Rules, Press Release ENV/DEV/594, 23 July 2001. Accessed on 7 February 2019 at https://www.un.org/press/en/2001/envdev594.doc.htm

[1110] UNFCCC (2001) Decisions 2-24/CP.7.

meeting of the COP, there was further progress made in finalizing the rules and operational details of the provisions in the Kyoto Protocol.[1111]

3.3.4.1.7. Bali Action Plan

The Kyoto Protocol had specified that negotiations on a second and subsequent commitment periods should commence "at least seven years before the end of the first commitment period,' which meant 2005.[1112] However, the timeline and structured negotiation for a second commitment period was only established at the concurrent COP-13 of the UNFCCC and CMP-3 of the Kyoto Protocol in Bali, Indonesia, in 2007, with the Bali Action Plan.[1113] The Plan set the path for negotiating a new global climate change agreement at COP-15 in Copenhagen to replace the Kyoto Protocol.

The negotiation process of the Bali Action Plan was essentially divided into two tracks. The first track under the auspices of the Kyoto Protocol was facilitated by the AWG-KP focusing on the adoption of new legally binding emission reduction targets/timelines for the developed (Annex I) countries[1114] while the second track under the auspices of the UNFCCC was facilitated by the Ad Hoc Working Group on Long-term Cooperative Action,[1115] which involved all parties to the Convention, including the US.

3.3.4.1.8. Ad Hoc Working Group on Long-term Cooperative Action

First, the Convention with its universal participation, served, and continues to serve, as the principal forum for coordinating global climate policy among its 197 parties. For instance, with the change of US government in 2009, the new Democratic administration under President Barack Obama followed up on its promise to prioritize domestic efforts to address climate change by modifying its domestic climate change law. The US government also began to re-engage the UN-sponsored climate negotiations under the Convention instead of the Protocol because the US was no longer a full party to the Kyoto Protocol. As COP-15 drew nearer, the US, China, India, and

[1111] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 28-29.

[1112] Sheila M. Olmstead and Robert N. Stavins (2007) A Meaningful Second Commitment Period for the Kyoto Protocol. In The Economists' Voice: Top Economists Take on Today's Problems [J. Stiglitz, A. Edlin, B. Delong (Eds.)], Columbia University Press, New York, USA, pp. 28-36.

[1113] UNFCCC (2008) supra note 1095.

[1114] UNFCCC (2005) supra note 1094.

[1115] UNFCCC (2008) supra note 1095, p. 5.

Brazil had indicated that they were willing to come to the negotiating table.[1116]

Second, the Convention is the forum for addressing the mitigation commitments for the non-Annex I countries in order to go beyond the limitations of the Kyoto Protocol as the legal procedural constraints of the Protocol made it difficult for amendments to be made to the Protocol, as evident from the non-ratification of the Doha Amendment.[1117] Hence, there was a fundamental shift in post-Bali negotiations from the failures of developed countries to commit to Kyoto Protocol obligations to the relative roles and responsibilities of developed and developing countries. By this time, the GHG emissions of the rapidly developing countries had grown exponentially, particularly China, which had surpassed the United States as the largest net emitter of GHG emissions by 2006. It was obvious to the international community that achieving any meaningful GHG emission reductions could not now be accomplished without the full engagement of the developing countries. Hence, substantive progress was made in developing negotiating texts for the all-important COP-15 in Copenhagen at the end of 2009.[1118]

Third, the Convention is also the forum for crafting global policies pertaining to adaptation to climate change as well as the gateway for financial assistance to be provided to the developing countries as the primary focus of the Kyoto Protocol was on climate change mitigation. It is inevitable, as the GHG emissions already released into the atmosphere had already accumulated to significant levels, that serious climate change would be effected, even if further global GHG emissions could be reduced.[1119]

3.3.4.2. The Copenhagen Conference Epoch

The Copenhagen Climate Change Conference (COP-15/MOP-5) was supposed to be an important consolidation point in the evolution of international climate change governance following multiple years of exhausting negotiations since the adoption of the Kyoto Protocol in 1997. Their frustrations were mainly directed at the major GHG emitters, namely the United States and the rapidly developing countries, e.g. China and India, for their intransigence. The international community was reasonably expecting

[1116] Cinnamon P. Carlarne, Kevin R. Gray and Richard G. Tarasofsky (2016) International Climate Change Law: Mapping the Field. In The Oxford Handbook of International Climate Change Law [Cinnamon P. Carlarne, Kevin R. Gray and Richard G. Tarasofsky (Eds.)], Oxford University Press, Oxford, UK, p. 9.

[1117] UNFCCC (2012) supra note 837.

[1118] Cinnamon P. Carlarne, Kevin R. Gray and Richard G. Tarasofsky (2016) supra note 1116, pp. 8-9.

[1119] David A. Wirth (2017) supra note 854, pp. 193 -194.

that all these major GHG emitters would engage in serious negotiations with a view to raising collective ambition in reducing GHG emissions at the Conference.[1120]

3.3.4.2.1. Failure of the Copenhagen Climate Change Conference

Unfortunately, the Parties at COP-15 in Copenhagen failed to agree to a new legally binding agreement despite high expectations of such a deal. The actual Conference itself turned out to be a tumultuous event of high tempers and emotions, of the presence of Heads of State overshadowing the efforts of the negotiators,[1121] of the UN negotiation process being in disarray,[1122] of the Danish presidency of the Conference being accused of mismanagement[1123] to downright incompetence,[1124] of the poor choice of conference venue with its bad weather, bad food and bad internet connections.[1125]

3.3.4.2.2. Copenhagen Accord

The conference did not even produce a non-binding accord in the form of a COP decision as objections by a few small developing nation-States such as Venezuela, Sudan, Bolivia and Nicaragua resulted in the COP merely taking note of the Copenhagen Accord. The fact that international consensus could be thwarted by a small number of negotiating member-States fundamentally drew attention to the inadequacy of the negotiation process of international climate change governance. The Accord consequently has no formal status in international climate change law.[1126]

Implicit in the UN negotiating process is the notion that the negotiators listen to each

[1120] Cinnamon P. Carlarne, Kevin R. Gray and Richard G. Tarasofsky (2016) supra note 1116, p. 9.

[1121] Id., pp. 9-10.

[1122] John Vidal (2009a) Copenhagen climate summit in disarray after 'Danish text' leak, The Guardian, 8 Dcecember 2009. Accessed on 9 February 2019 at: https://www.theguardian.com/environment/2009/dec/08/copenhagen-climate-summit-disarray-danish-text

[1123] Jonathan Watts (2010) Copenhagen destroyed by Danish draft leak, says India's environment minister, The Guardian, 12 April 2010. Accesssed on 9 February 2019 at: https://www.theguardian.com/environment/2010/apr/12/copenhagen-destroyed-danish-draft-leak

[1124] Richard Black (2009) supra note 1092.

[1125] Jean Chemnick (2015) How Paris may succeed where Copenhagen failed, Paris Climate Talk, 11 December 2015. Accessed on 9 February 2019 at: https://www.eenews.net/special_reports/paris_climate_talks/stories/1060029405

[1126] UNFCCC (2010a) Report of the Conference of the Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009, Addendum, Part Two: Action taken by the Conference of the Parties at its fifteenth session, Decision 2/CP.15, FCCC/CP/2009/11/Add.1, 30 March 2010, pp. 4-9 (hereinafter Copenhagen Accord). Accessed on 8 February 2019 at: https://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf

other and negotiate for convergence of the different starting positions so as to come to an agreement. It happened in Kyoto and the Kyoto Protocol was forged. In Copenhagen, everybody talked but nobody listened. Even before the Conference began, the office of the Prime Minister Lars Lokke Rasmussen, with individuals from "the circle of commitment" had put forward a secret draft political agreement and it was shown to a handful of countries at the beginning of the Conference. It was meant for consultation at the end of the Conference as gridlock in the negotiation process was expected. This back door negotiation process, however, collapsed when the 'Danish secret text' was leaked to The Guardian[1127] before consensus had been reached.

The developing countries were furious that the 'Danish secret text' was being promoted by rich countries without their knowledge and without discussion in the Conference negotiations, especially nation-States that felt threatened by climate change impacts.[1128] It undermined the authority of the Danish conference presidency, and the wide-ranging 30-page political draft was scrapped, leaving world leaders present at the Conference scrambling for a replacement.[1129]

The end of the meeting saw leaders of the US and the BASIC group of countries (Brazil, South Africa, India and China) hammering out a last-minute deal in a back room as though the nine months of talks leading up to this summit, and the Bali Action Plan to which they had all committed two years previously, did not exist. Most of the negotiation was carried out by the Heads of State, led by President Obama, and through a series of meetings among the Chinese Premier Wen Jiabao, Indian Prime Minister Manmohan Singh, Brazilian President Luiz Inácio Lula da Silva, and South African President Jacob Zuma, an unprecedented political agreement was forged, comprising of a three-page document with two appendices, each consisting of one blank table.[1130]

In the weeks leading up to the actual Copenhagen conference, hopes had already faded that negotiations would result in a legally binding treaty. In fact, President Obama and other world leaders, including Lars Lokke Rasmussen, the prime minister of Denmark, had, at the APAC Summit Meeting held in Singapore just a month before Copenhagen Conference, announced that the world leaders had put off the difficult task of reaching

[1127] John Vidal (2009a) supra note 1122.

[1128] Richard Black (2009) supra note 1092.

[1129] Jonathan Watts (2010) supra note 1123.

[1130] Robert N. Stavins and Robert C. Stowe (2010) What Had Copenhagen Wrought? A Preliminary Assessment, Environment: Science and Policy for Sustainable Development, Volume 52, Number 3, pp. 8-14.

a fully legal binding agreement at the conference and had agreed instead to reach a less specific "politically binding" agreement that would punt the most difficult issues into the future as the mission for the Copenhagen conference.[1131]

3.3.4.2.3. Achievements of the Copenhagen Climate Change Conference

There was near unanimous agreement in the international community that the Copenhagen Conference did little to prevent dangerous climate change, which was the core objective of the UNFCCC. However, some clear directions for the way forward with climate change governance did come out of the debacle.

For instance, some of the proposals of the Copenhagen Accord[1132] were in consonance with the Bali Action Plan. For the first time, there was an agreement on holding to a 2°C increase in global average temperature as a long-term guardrail rather than just an aspiration.[1133] The Accord did go some way towards bridging the North-South economic divide between developed and developing countries with reciprocal burden-sharing of GHG emission reductions, which has dogged climate negotiations since UNFCCC.[1134] It also put in place a commitment to significant funding via a 'Green Climate Fund' for developing nations to adapt to climate change, and included aspirational targets from all of the major emitters, including developing countries.[1135]

In terms of policies and measures, the Accord proposed pursuing "various approaches, including opportunities to use markets, to enhance the cost-effectiveness of, and to promote mitigation actions" and recognized that "developing countries, especially those with low emitting economies should be provided incentives to continue to develop on a low emission pathway."[1136] It also recognized that "the crucial role of reducing emission from deforestation and forest degradation and the need to enhance removals of greenhouse gas emission by forests and agree on the need to provide positive incentives to such actions through the immediate establishment of a mechanism including REDD-plus, to enable the mobilization of financial resources from developed countries."[1137]

[1131] Helene Cooper (2009) Leaders Will Delay Deal on Climate Change, The New York Times, 14 November 2009. Accessed on 7 Febraury 2019 at: https://www.nytimes.com/2009/11/15/world/asia/15prexy.html?_r=1

[1132] UNFCCC (2010a) Copenhagen Accord, supra note 1126.

[1133] Id., Paragraph 2.

[1134] Id., Paragraphs 4 & 5.

[1135] Id., Paragraphs 3 & 10.

[1136] Id., Paragraph 7.

[1137] Id., Paragraph 6.

In terms of science and technology, the Accord called for the "consideration of strengthening the long-term goal referencing various matters presented by the science, including in relation to temperature rises of 1.5 degrees Celsius"[1138] and to "establish a Technology Mechanism to accelerate technology development and transfer in support of action on adaptation and mitigation that will be guided by a country-driven approach and be based on national circumstances and priorities."[1139]

Finally, the Accord called for an assessment of the implementation of the proposals to be completed by 2015 in light of the UNFCCC's ultimate objective.[1140]

3.3.4.2.4. From 'Top-Down' Approach to 'Bottom-Up' Approach

More importantly, out of the ashes of the disastrous 'top-down' approach arose the phoenix of a 'bottom-up' approach to international climate change negotiations. The essence of the Copenhagen Accord was an invitation for the developed countries (Annex I) that wished to participate in the Accord were to submit economy-wide, quantified emissions-reduction targets for inclusion in Appendix I while the developing countries (non-Annex I) were invited to submit their "nationally appropriate mitigation actions" for inclusion in Appendix II.[1141]

By early March 2010, a total of 109 parties (counting the EU countries separately) had formally expressed support for the Accord (out of 197 parties to the Convention). These included the top 12 GHG emitters in 2005, which would already accounted for more than 70% of GHG emissions.[1142]

3.3.4.3. Post Copenhagen Conference Epoch

The Post Copenhagen Conference epoch started with COP-16, which was held in Cancun, Mexico from 29 November to 10 December 2010. The Parties at COP-16 concluded the Cancun Agreements,[1143] in which the key components of the Copenhagen

[1138] Id., Paragraph 12.

[1139] Id., Paragraph 11.

[1140] Id., Paragraph 12.

[1141] Id., Appendices I & II.

[1142] Robert N. Stavins and Robert C. Stowe (2010) supra note 1130, p. 9.

[1143] UNFCCC (2010b) Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 201, Addendum, Part Two: Action taken by the Conference of the Parties at its sixteenth session, Decision 1/CP.16, FCCC/CP/2010/7/Add.1, 15 March 2011 (hereinafter

Accord were formalized and expanded upon. It was then followed by COP-17, which was held in Durban, South Africa, from 28 November to 9 December 2011.[1144] The conference provided the Parties with the opportunity to reflect critically on the first 20 years of experience under the UNFCCC. The Parties adopted the Durban Platform for Enhanced Action to initiate a new round of negotiations aimed at an agreed outcome with legal force to be completed by 2015 for implementation from 2020 onwards.[1145]

3.3.4.3.1. Cancun Agreements

The negotiation dynamics at COP-16 at Cancun was different from those at COP-15 in Copenhagen. First, another failure at Cancun would very likely sideline the UNFCCC negotiation process, which most nation-States wanted to avoid. This dynamic essentially increased their willingness to find solutions and make compromises. The Mexican presidency at the conference allowed room for divergent views but did not allow any nation-State to block the rest from moving forward. Second, the Parties viewed the negotiation process conducted by the Mexican presidency as transparent. They were not worried about a secret text appearing at the last minute to trump their work. Third, both China and the United States were in a much more cooperative mode. They were avoiding blame games in the media and focusing on getting the job done. Fourth, India was also constructive with its proposals and played a leadership role in the lead-up to and during the conference. Fifth, a new coalition comprising of a number of developing and developed countries, known as the Cartagena Dialogue, was formed since Copenhagen to find solutions in the UNFCCC negotiation process. Having already negotiated compromises in this forum, they were well placed to help the other nation-States find solutions during the negotiations. Such South-North dialogue is essential to move the UNFCCC negotiation process forward.[1146] The Cancun

'Cancun Agreements'). Accessed on 9 February 2019 at: https://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf

[1144] UNFCCC (2011a) Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November to 11 December 2011, Addendum, Part Two: Action taken by the Conference of the Parties at its seventeenth session, FCCC/CP/2011/9/Add.1, 15 March 2012 (hereinafter Durban Platform for Enhanced Action). Accessed on 12 February 2019 at: https://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf

[1145] Id., Decision 1/CP.17, Paragraph 4.

[1146] A group of about 40 countries working towards an ambitious legally binding agreement under the UNFCCC, and who are committed to becoming or remaining low carbon countries. The group was founded in Cartagena, Colombia, in 2010, after COP12 in Copenhagen in 2009. The group provides a small, inclusive, informal and flexible space that is open to countries exploring positions and outcomes beyond their own to reach a middle ground for climate change negotiations. To achieve this goal, meetings are closed to media and observers. The group does not publish details of group discussions

Agreements were concluded with consensus of 193 Parties, concretizing the core text of the Copenhagen Accord and the building blocks of the Bali Action Plan.[1147]

Goal of Holding Global Average Temperature to below 2°C

For instance, the Parties to the Cancun Agreements affirmed that "climate change is one of the greatest challenges of our time and that all Parties share a vision for long-term cooperative action in order to achieve the objective of the Convention ... on the basis of equity and in accordance with common but differentiated responsibilities and respective capabilities"[1148] and that "deep cuts in global greenhouse gas emissions are required according to science ... with a view to reducing global greenhouse gas emissions so as to hold the increase in global average temperature below 2°C above preindustrial levels" as well as "the need to consider, in the context of the first review ... strengthening the long-term global goal on the basis of the best available scientific knowledge, including in relation to a global average temperature rise of 1.5 °C."[1149]

Fair Burden-Sharing by All

In calling for enhanced action on mitigation by all Parties, the Agreements urged the "developed country Parties to increase the ambition of their economy-wide emission reduction targets"[1150] and agreed that the "developing country Parties will take nationally appropriate mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity-building, aimed at achieving a deviation in emissions relative to 'business as usual' emissions in 2020."[1151]

Green Climate Fund

In terms of finance, the Agreements established the Green Climate Fund[1152] and

beyond a brief media statement that is usually provided by the host nation. Extracted from CICEP (2019) Cartagena Dialogue, Understanding the Negotiations: The CICEP guide to terms and abbreviations at the negotiations, CICEP, Oslo, Norway. Accessed on 31 August 2019 at: http://www.cicep.no/copguide/2015/10/25/cartagena-dialogue

[1147] UNFCCC (2010b) supra note 1143, Decision 1/CP.16.

[1148] Id., Paragraph 1.

[1149] Id., Paragraph 4.

[1150] Id., Paragraph 37.

[1151] Id., Paragraph 48.

[1152] Id., Paragraph 102.

prescribed the principles for its development.[1153]

Low Carbon Economy

The Parties realized that addressing climate change requires a paradigm shift towards fostering a low-carbon global economy based on sustainability principles, innovative technologies, and transformational changes in production and consumption patterns, while ensuring a just transition of the workforce.[1154]

Polycentric Governance of Global Climate Change Action

In terms of policies and measures, the Agreements recognized the need to move to a form of polycentric governance by engaging "a broad range of stakeholders at the global, regional, national and local levels, be they government, including sub-national and local government, private business or civil society, including youth and persons with disability, and that gender equality and the effective participation of women and indigenous peoples are important for effective action on all aspects of climate change."[1155] The Agreements also decided to consider the establishment, at COP-17, of one or more market-based and non-market-based mechanisms to enhance the cost-effectiveness of, and to promote, mitigation actions,[1156] but keeping in view the need to maintain and build upon existing mechanisms, including those established under the Kyoto Protocol.[1157]

Importance of Carbon Sinks

In the case of reducing emissions from deforestation and forest degradation, the conservation and enhancement of forest carbon stocks, and the sustainable management of forests,[1158] the Agreement decided that these activities "should be implemented in phases, beginning with the development of national strategies or action plans, policies and measures, and capacity-building, followed by the implementation of national policies and measures and national strategies or action plans that could involve further capacity-building, technology development and transfer and results-based

[1153] Id., Paragraphs 103-106, 107-109.
[1154] Id., Paragraph 10.
[1155] Id., Paragraph 7.
[1156] Id., Paragraphs 80 & 84.
[1157] Id., Paragraph 83.
[1158] Id., Paragraph 70.

demonstration activities, and evolving into results-based actions that should be fully measured, reported and verified."[1159]

Technology Development and Transfer

In enhancing action on technology development and transfer to support both mitigation and adaptation in order to achieve full implementation of the Convention,[1160] the "technology needs must be nationally determined, based on national circumstances and priorities."[1161] The Parties decided to establish a Technology Mechanism to facilitate the implementation, which will consist of a Technology Executive Committee and a Climate Technology Centre and Network with complementary functions.[1162]

Enhanced Role of Adaptation

The Parties recognized that "adaptation must be addressed with the same priority as mitigation and requires appropriate institutional arrangements to enhance adaptation action and support."[1163] Hence, the role of adaptation in facilitating full implementation of the Convention objective was greatly expanded by the establishment of the Cancun Adaptation Framework[1164] and a new Adaptation Committee[1165] in the Agreements.

3.3.4.3.2. Durban Platform for Enhanced Action

The new UN negotiation process, taking over from the Bali Action Plan, was known as the Durban Platform for Enhanced Action. This Platform called for "strengthening the multilateral, rules-based regime under the Convention",[1166] initiated a new round of negotiations aimed at an agreed outcome with legal force to be completed by 2015 for implementation from 2020 onwards. The Durban Platform created a new 3-year roadmap for implementing the 2010 Cancun Agreements, especially on the Green Climate Fund,[1167] modalities and procedures for the Technical Executive Committee[1168]

[1159] Id., Paragraph 73.
[1160] Id., Paragraph 113.
[1161] Id., Paragraph 114.
[1162] Id., Paragraphs 117-119.
[1163] Id., Paragraph 2(b).
[1164] Id., Paragraph 13.
[1165] Id., Paragraph 20.
[1166] UNFCCC (2011a) supra note 1144, Decision 1/CP.17, Preamble, Paragraph 3.
[1167] Id., Decision 3/CP.17.
[1168] Id., Decision 4/CP.17.

and the Cancun Adaptation Framework,[1169] extending the beleaguered Kyoto Protocol for a second commitment period, which was of legal significance as the Kyoto Protocol mechanisms will continue,[1170]and driving the evolution of the international climate change law towards the 2015 Paris Agreement.

Competing Models of Climate Change Governance

Since negotiations started on an international climate change agreement, negotiators have struggled to choose between two competing model: a top-down model with binding targets and timetables and a bottom-up model favoring voluntary national actions defined unilaterally. In fact, the Convention has, in the course of its evolution, experimented with both these models: the legally binding top-down 1997 Kyoto Protocol and the voluntary bottom-up 2009 Copenhagen Accord, which was adopted formally in Cancun. In practice, each model has its own strengths and weaknesses. However, when measured against the complexity and scale of the global climate change problem and the extreme urgency to abate catastrophic climate change impact, both models have proven inadequate.[1171] The Durban meeting presented the Parties with the opportunity to forge an alternative model, which could draw on the best of both model, and thereby set a new direction for international climate change governance.

Balanced Political Compromise

After the debacle with the 2009 Copenhagen Climate Change Conference, the negotiators had become more pragmatic in their efforts to achieving a consensus. Although many nation-States, especially the EU,[1172] still continue to press for a comprehensive, legally binding international agreement, the principal negotiating groups understood that they needed to forge a finely balanced political compromise to be able to move international climate change governance forward.

[1169] Id., Decision 5/CP.17.

[1170] Cinnamon P. Carlarne, Kevin R. Gray and Richard G. Tarasofsky (2016) supra note 1116, p. 12.

[1171] Daniel Bodansky (2012a) The Durban Platform: Issues and Options for a 2015 Agreement, Center for Climate and Energy Solutions, Arlington, VA, USA, p. 1. Accessed on 10 February 2019 at: http://ssrn.com/abstract=2270336

[1172] Council of the European Union (2011) Council Conclusion 15353/11, 10 October 2011, declares that the "EU remains of the view that a single legally-binding instrument would be the best framework for the period after 2012, but the Council agreed in confirming the EU's openness to a second commitment period, on the condition that it should be the last one before convergence between the Kyoto Protocol and Convention outcomes, and that in any case it should last no longer than 2020." Accessed on 10 February 2019 at: http://europa.eu/rapid/press-release_PRES-11-359_en.htm?locale=en

For instance, the EU, supported by small-island and least-developed countries, sought a fast mandate for the negotiation of a new legally binding instrument. The Parties addressed this demand by establishing a process to negotiate "a treaty, another legal instrument or an agreed outcome with legal force",[1173] by starting its work, as a matter of urgency, in the first half of 2012, and completing its work as early as possible but no later than 2015.[1174] In exchange, the EU agreed to a second commitment period under the Kyoto Protocol. The meeting decided that, "the second commitment period under the Kyoto Protocol shall begin on 1 January 2013 and end either on 31 December 2017 or 31 December 2020."[1175] As a result, the Parties decided to extend the Ad Hoc Working Group on Long-term Cooperative Action under the Convention for just one more year.[1176] In accordance with the rules of the Convention and the Kyoto Protocol, the second commitment period, which will extend till 2020, known as the Doha Amendment, was formalized in 2012 at Doha, Qatar.[1177] The Ad Hoc Working Group on Long-Term Cooperative Action was then terminated.

Meanwhile, the US insisted that it would accept the mandate to negotiate such a new legal 'outcome' only if the mandate was applicable to both developed and developing countries. The Parties addressed this concern by calling for "the widest possible cooperation by all countries and their participation in an effective and appropriate international response" and by providing that the outcome of the Durban Platform negotiations will be "applicable to all parties."[1178] These negotiation provisions of the Durban mandate was a dramatic departure from the Kyoto Protocol negotiating mandate, which had categorically excluded any new commitments for the developing countries. The BASIC group (Brazil, South Africa, China, India) achieved their main demand of the acceptance by the developed countries in the EU of a second commitment period under the Kyoto Protocol (as the US was no longer a Party to the Kyoto Protocol since 2001). In exchange, China agreed to accept legal commitments but only after 2020, while India continued to resist the EU's call for a new legally

[1173] UNFCCC (2011a) supra note 1144, Decision 1/CP.17, Paragraph 2.

[1174] Id., Paragraphs 3 & 4.

[1175] UNFCCC (2011b) Decision 1/CMP 7, Paragraph 1, Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its seventh session, held in Durban from 28 November to 11 December 2011, Addendum, Part Two: Action taken by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol at its seventh session, FCCC/KP/CMP/2011/10/Add.1, 15 March 2012. Accessed on 12 February 2019 at: https://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf

[1176] UNFCCC (2011a) supra note 1144, Decision 1/CP.17, Paragraph 1.

[1177] UNFCCC (2012) supra note 837.

[1178] UNFCCC (2011a) supra note 1144, Decision 1/CP.17, Preamble, Paragraph 1.

binding instrument.[1179] The final result of this finely balanced political compromise could, therefore, take the form of an agreed 'outcome with legal force', whose meaning is presumably different from a 'treaty' or 'another legal instrument' since it was listed as a third alternative.[1180]

Road Leading to Paris

The 2011 Durban Platform was implemented at successive COP meetings on the road leading to Paris. One of the key decisions made was in COP-19 in Warsaw, Poland in 2013, in which the Parties called for the early identification of the "intended national determined contributions" (INDC) by first quarter of 2015, "by those Parties ready to do so," eight months before the Paris Climate Change Conference started.[1181] By 18 April 2016, a total of 190 Parties had communicated an INDC (97% of all Parties to the UNFCCC) with a total GHG emissions coverage of 94.6%.[1182]

3.3.4.4. The Paris Agreement Epoch

For the first time in the evolution of international climate change governance, an international agreement has brought together all nations into a common cause to forge ambitious plans to mitigate climate change and adapt to its effects.[1183] The 2015 Paris Agreement[1184] was the agreed outcome of the Durban Platform for Enhanced Action. It was achieved at COP-21 held in Paris from 30 November to 12 December 2015.

It brought the work of the Ad Hoc Working Group for the Durban Platform for Enhanced Action (ADP) to a successful end, and the Parties appointed a new Ad Hoc Working Group for the Paris Agreement.

[1179] Daniel Bodansky (2012a) supra note 1171, p. 2.

[1180] UNFCCC (2011a) supra note 1144, Decision 1/CP.17, Paragraph 4.

[1181] UNFCCC (2014c) Report of the Conference of the Parties on its nineteenth session, held in Warsaw from 11 to 23 November 2013, Addendum, Part two: Action taken by the Conference of the Parties at its nineteenth session, Decision 1/CP.19 2(b), FCCC/CP/2013/10/Add.1, 31 January 2014. Accessed on 13 February 2019 at: file:///Users/checkwoomacair2/Downloads/10a01.pdf

[1182] UNFCCC (2019d) Nationally Determined Contributions (NDCs): Intended Nationally Determined Contributiions (INDCs), United Nations Framework Convention on Climate Change. Accessed on 13 February 2019 at: https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs#eq-4

[1183] UNFCCC (2019e) What is the Paris Agreement? United Nations Framework Convention on Climate Change. Accessed on 13 February 2019 at: https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement

[1184] United Nations (2015a) supra note 18.

3.3.4.4.1. Proceedings of the Paris Climate Change Conference

During the first week of COP-21, the ADP struggled to advance its mandate. The technical negotiations were very much hampered by the palpable sense of distrust amongst the participants. Without the political mandate to bridge differences between the Parties, the negotiators at the technical session simply run out of steam. As a result, only high-level political engagement could salvage the negotiation process from a stalemate. So when the ADP formally closed the technical session at the end of the first week, it handed over to the COP a 48-page document, which comprised of a draft treaty text and a COP decision, which included more than 900 square brackets [section of text without consensus].[1185]

In the second week of COP-21, there was a remarkable, almost miraculous, change of pace. The French presidency of the Conference expertly managed the negotiating efforts of the numerous ministers representing the 196 Parties to the UNFCCC. The negotiation efforts were now supported by renewed political will, which became apparent with an unprecedented coalition of 100 developed and developing States, including the US, as well as small island developing States and the European Union. These political allegiances, however, were really the result of a long string of multilateral and bilateral consensus building consultations prior to the conference rather than that of phenomenal last-minute progress at COP-21. However, the French presidency was instrumental in bringing it to a successful conclusion during the ministerial session.[1186]

Thus, as the Paris Conference came to a close in a jubilant atmosphere with the formal adoption of the Paris Agreement as a treaty, many delegates deservedly praised the French presidency for its sapient steering of the process at this critical junction, which was a sharp contrast from the Danish presidency at the Copenhagen Conference.[1187]

3.3.4.4.2. Objectives of the Paris Agreement

The central aim of the Paris Agreement is to strengthen the global climate change abatement ambition to keep the rise in the mean global surface temperature within this century to well below the 2°C above pre-industrial levels and to pursue greater ambition

[1185] Annalisa Saravesi (2016) The Paris Agreement: A New Beginning? Research Paper 2016/03, Edinburgh School of Law, University of Edinburgh, Edinburgh, UK, p. 3.

[1186] Id., p. 4.

[1187] Jonathan Watts (2010) supra note 1123.

to limit the temperature rise to less than 1.5°C.

The Paris Agreement also aims to strengthen the ability of countries to deal with the impacts of climate change through the establishment of an appropriate financial flow, a new technology framework, and an enhanced capacity building framework, especially for the developing countries and the most vulnerable countries, in line with their own national objectives. The Agreement will provide a more robust transparency framework to enhance transparency of action and support. It will also enhance support to assist the developing countries to undertake GHG emissions reduction. Hence, it charts a new course in the global climate change abatement effort.[1188]

3.3.4.4.3. Nationally Determined Contributions (NDCs) of the Paris Agreement

The Paris Agreement requires all Parties to put forward their best efforts to curb GHG emissions through nationally determined contributions (NDCs) and to strengthen these GHG emissions reduction efforts in the years ahead. The Agreement also requires that all Parties report regularly on their GHG emissions and on their implementation efforts. There will be a global stocktake every five years to assess progress of the collective efforts towards achieving the purpose of the Agreement and to inform further individual actions by all the Parties.[1189]

This third Paris Agreement Epoch, however, ended with the transition of the Obama administration to the Trump administration and the decision by President Donald Trump (Rep) to withdraw the US from the Paris Agreement on 1 June 2017 in order to fulfill his presidential campaign pledge to help American business and workers.[1190]

3.3.5. Post-International Politics Period (2016 Onwards)

The first epoch of the fourth Post-International Politics Period, the Post-Paris Agreement epoch, will have to path the way for the international community to gather the required political will by 2020, despite the threat of US withdrawal, and come up

[1188] UNFCCC (2018) The Paris Agreement: essential elements, Process and Meetings: The Paris Agreement, United Nations Framework Convention on Climate Change (UNFCCC). Accessed on 4 October 2018 at: https://unfccc.int/process/the-paris-agreement/what-is-the-paris-agreement

[1189] UNFCCC (2019e) supra note 1183.

[1190] Timothy Cama and Devin Henry (2017) Trump: We are getting out of Paris cliamte deal, The Hill, 1 June 2017. Accessed on 8 Oct 2018 at: https://thehill.com/policy/energy-environment/335955-trump-pulls-us-out-of-paris-climate-deal

with concrete and realistic plans to cut GHG emissions so that GHG emissions will be reduced by 55% in 2030 from 2017 level in order to keep the rise in GMST of the Earth to below 1.5°C above the pre-industrial level by 2100.[1191]

According to Article 28 (1) & (2), the earliest effective date of withdrawal for the US is four years from the date on which this Agreement has entered into force, which was 4 November 2016. Hence, it could end on 5 November 2020, which is shortly before the end of President Trump's current term.[1192] However, US negotiators have continued to participate as mandated in U.N. climate negotiations to solidify details of the Agreement. It is crucial for US negotiators to continue participating without taking the lead in the negotiations because if the US decided later to stay in or re-enter the Agreement it would want to ensure meanwhile that the negotiations are moving in a direction it can live with later.[1193]

3.3.5.1. The Post Paris Agreement Epoch

After COP-21 in Paris, COP-22 was held in Marrakech, Morocco from 7-18 November 2016 while COP-23 took place in Bonn, Germany, hosted by the UNFCCC Secretariat and presided over by Fiji from 6-17 November 2017.[1194]

3.3.5.1.1. Katowice Climate Change Conference (COP-24)

At the heart of the COP-24 negotiation in Katowice, Poland from 2-14 December 2018 was the Paris 'rulebook', which was mandated at COP-21 in Paris to be finalized by the end of COP-24. This is the detailed 'operating manual' for the 2015 Paris Agreement to enter into force in 2020.[1195] Hence, the negotiations on the 'rulebook' proved in some ways more challenging than those leading to the Paris Agreement as the delegates had to face a mix of technical and political challenges and, in some respects, higher stakes in seeking to elaborate the Agreement's broad provisions into detailed rules.[1196]

[1191] UNEP (2018a) supra note 50, p. 6.

[1192] United Nations (2015a) supra note 18, Articles 28.1 & 28.2, p. 35.

[1193] C2ES (2019) Paris Agreement: Q&A, Center for Climate and Energy Solutions, Arlington, VA, USA. Accessed on 31 August 2019 at: https://www.c2es.org/content/paris-climate-agreement-qa/

[1194] UNFCCC (2019f) Process and Meetings: Conference, United Nations Climate Change. Accessed on 31 August 2019 at: https://unfccc.int/process-and-meetings#:606038e4-000c-47ee-8c49-4f590df37224

[1195] Carbon Brief (2018) COP24: Key outcomes agreed at the UN climate talks in Katowice, Carbon Brief, 16 December 2018. Accessed on 31 August 2019 at: https://www.carbonbrief.org/cop24-key-outcomes-agreed-at-the-un-climate-talks-in-katowice

[1196] C2ES (2019) supra note 1193.

Starting with nearly 3,000 brackets in the negotiating text of the rulebook before the talks began, the delegates had the uphill task of moving it towards a 'clean' text, with zero brackets or options, on which all could agree. Some of the rulebook sections that proved most difficult to resolve during the negotiations included the provisions for voluntary market mechanisms under Article 6, standards for climate finance reporting under Article 9, and the rules on transparency under Article 13, which cover reporting of greenhouse gas emissions and progress in tackling them.[1197] At the end of the tension-filled two weeks, delegates did finally adopt rules and procedures on mitigation, transparency, adaptation, finance, periodic stocktakes, and other Paris provisions[1198] but were unable to agree on rules for Article 6, which provides for voluntary cooperation among parties in implementing their NDCs, including through the use of market-based approaches. The parties decided to defer those decisions to COP-25, which will be held in Santiago, Chile from 2– 13 December 2019.[1199]

Even the IPCC Special Report on Global Warming of 1.5°C, which had been formally requested at the 2015 Paris Climate Change Conference, became a major source of tension at the talks. The US, Saudi Arabia, Russia and Kuwait refused to "welcome" the report. They only wanted to "note" it. Hence, in the final COP decision text it did not "welcome" the report, but instead "welcome" its "timely completion" and "invited" countries to make use of the report in subsequent discussions at the UNFCCC.[1200]

3.3.5.1.2. UN Climate Action Summit 2019

UN Secretary-General António Guterres has called on all leaders to come to New York on September 23rd for the UN Climate Action Summit 2019[1201] with concrete, realistic plans to enhance their nationally determined contributions (NDCs) by 2020, in line with reducing GHG emissions by 45% by 2030, and to net zero emissions by 2050.

One track of the summit calls on government leaders to ensure that their national plans do not address mitigation alone; that they must show the way toward a full

[1197] Carbon Brief (2018) supra note 1195.

[1198] UNFCCC (2019g) Decisions adopted at the Climate Change Conference in Katowice, Poland, 2-14 December 2018, United Nations Climate Change. Accessed on 31 August 2019 at: https://unfccc.int/decisions_katowice

[1199] UNFCCC (2019f) supra note 1194.

[1200] Carbon Brief (2018) supra note 1195.

[1201] United Nations (2019) supra note 86.

transformation of national economies in line with sustainable development goals. The plans should not create winners and losers or add to economic inequality; they must be fair and create new opportunities and protections for those negatively impacted, in the context of a just transition; they should include women as key decision-makers as only gender-diverse decision-making has the capacity to tackle the different needs that will emerge in this critical transformational period.

The other track of the summit brings together leaders of governments, private sector, civil society, local authorities and other international organizations to develop ambitious solutions in six related areas:

(1) Finance: mobilize public and private sources of finance to drive decarbonization in all priority sectors
(2) Energy Transition: accelerate shift from fossil fuels towards renewable energy, as well as make significant gains in energy efficiency
(3) Industry Transition: transform the carbon-intensive industries such as oil and gas, steel, cement, chemicals and information technology
(4) Nature-Based Solutions: reduce emissions, increase sink capacity, and enhance resilience within and across forestry, agriculture, oceans and food systems
(5) Cities and Local Action: advance mitigation and resilience at urban and local levels, focusing on new commitments on low-emission buildings, mass transport and urban infrastructure as well as resilience for the urban poor
(6) Resilience and Adaptation: advance global efforts to address and manage the impacts and risks of climate change, particularly in the most venerable communities and nation-States

In addition, the Secretary-General is also calling for youth engagement in order to mobilize young people worldwide to take action on climate change and to ensure that young people are integrated and represented across all aspects of the summit, including the six transformational areas, as well as to advance commitments in areas that affect people's well-being, such as reducing air pollution, generating decent jobs, and strengthening climate adaptation strategies and protect workers and vulnerable groups.

CHAPTER 4: ANALYSES OF CLIMATE CHANGE GOVERNANCE

"When order is achieved among human beings by allowing them to interact with each other on their own initiative — subject only to the laws which uniformly apply to all of them — we have a system of spontaneous order in society."

Michael Polanyi[1202]

"Climate change is one of the great challenges of our generation. The politics of the issue have been divisive for decades and a new approach is needed to address this urgent problem."

Trent Lott and John Breaux[1203]

The normative intent of the thesis is, first, to recommend an alternative institutional arrangement in the short-term to reduce the risks of catastrophic climate disruptions (Chapter 4, Section 3) and, second, to propose an alternative world order for the long-term attainment of social goals for the common good of humankind: the stabilization of "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"[1204] and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations (Chapter 5, Section 3).[1205]

To make a recommendation for a short-term solution to reduce the risks of catastrophic climate disruptions will require the international law research students to identify gaps in the current approach [problem-solving approach] to solving the climate change problem while to proffer a proposal for an alternative world order for the long-term continuous development towards the optimum world public order will require him to

[1202] Michael Polanyi (1951) The Logic of Liberty: Reflections and Rejoinders [First Edition (US) First Printing Edition (May 1, 1998), Routledge, Abingdon, UK], Liberty Fund, Inc., Indianapolis, IN, USA.

[1203] Trent Lott and John Breaux (2018) Here's How to Break the Climate Impasse, Opinion, The York Times, 20 June 2018. Accessed on 3 October 2018 at: https://www.nytimes.com/2018/06/20/opinion/climate-change-fee-carbon-dioxide.html

[1204] United Nations (1992a) supra note 16, Article 2.

[1205] UNEP (1992a) supra note 75.

understand the critical shortcomings of the current world order [current theory].[1206] In both cases, it will require the international law research student to review and critique past and current approaches to understand the success factors and limitations of the international climate change regime and gain insights as to the necessary and sufficient conditions to solve the climate change problem, which is the intent of this chapter.

4.1. COMPARATIVE ANALYSIS OF REGIMES

Transboundary air pollution and substances that deplete the stratospheric ozone layer, like climate change, are atmosphere global commons. The international regime approach has been recognized as an effective approach for the governance of both the transboundary air pollution and depletion of the ozone layer. These two international regimes are closely related to the international climate change regime because they were established prior to the climate change regime and some of their 'design principles' were adopted for the climate change regime. It is therefore useful for the international law research student to identify and understand the design principles or critical success factors of regime design in these two earlier regimes and to evaluate if these factors were adequately reflected in the 'design' of the international climate change regime.

It is true that high correlations between the identified critical success factors and the successful negotiation, adoption and implementation of the two earlier regimes do not imply cause-and-effect. The same truth holds if there were similar high correlations between the identified critical success factors and the climate change regime. However, the absence of any of these critical success factors in the design of the international climate change regime might well contribute significantly to its failure.

The four critical success factors of regime design, gleaned from the two international regimes for the atmosphere global commons and compared with its manifestation in the climate change regime, were identified as follows:

(1) Science of Cause-and-Effect is Understood and Updated (Precautionary Principle)
(2) Iterative Approach to Policymaking and Legislation (Precautionary Principle)
(3) Fair Burden Sharing by All (CBDR-RC)
(4) Effective and Efficient International Organization (Principle of Systemic Integration)

[1206] Robert W. Cox (1981) supra note 28.

These four critical success factors were used as reference standards in the comparative analysis of the atmosphere global commons in this section. A brief explanation of their relationships to the fundamental elements of systems, namely process, structure and agent and to the academic spheres of science, economics, international law, international politics and ethics, is provided in the beginning of the respective sections of the critical success factors.

The first three critical success factors are generally considered as non-legal factors and the status of the fourth factor is debatable. Although some international organizations have legislative, executive and/or adjudicative functions beyond administrative and coordinating functions, the primary functions of the international organizations or international institutional arrangements associated with the atmosphere global commons are either a coordinating and/or administrative function rather than a legislative and/or adjudicative function. However, all four critical success factors are derived from the general principles of international law respectively.

The legal core of the international climate change regime is built around the three MEAs of the United Nations Framework Convention for Climate Change (UNFCCC),[1207] Kyoto Protocol,[1208] and Paris Agreement.[1209] The evolution of the legal structures of these three MEAs is analyzed in Section 4.2.

4.1.1. Science of Cause and Effect is Understood and Updated

Because of the deep interconnections of the components of the complex biophysical climate system, and because these linkages of cause-and-effect in a complex system can be separated far from a space-time perspective, and the intensity of outcomes can be attenuated by feedback mechanisms, the science of cause-and-effect can be uncertain and ambiguous, the international community is firm on the view that climate change regulations should only be adopted where there is compelling scientific evidences that action is required to prevent environmental damage.[1210] Policymakers are therefore caught in a social dilemma because taking precautionary measures is required if humankind were to avert the worst effects of climate change.

[1207] United Nations (1992a) supra note 16.
[1208] United Nations (1998) supra note 17.
[1209] United Nations (2015a) supra note 18.
[1210] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth Mackenzie (2018) supra note 354, p. 6.

Hence, the first critical success factor is that the science of cause-and-effect underlying global environmental problems, especially climate change, must be understood and updated regularly so that the provisions of the MEAs and their protocols, which constitute the core elements of the global environmental governances, can be reviewed, supplemented and amended as necessary to accord with the new scientific evidences.

The corollary, therefore, is that the preferred process of lawmaking in the case of international environmental governance, including climate change, is the adoption of flexible multilateral agreements, which can be extended through protocols. Such a flexible law-making arrangement with provisions for periodic review is typical of a process approach to problem solving.

Meanwhile, the creation of the IPCC as an independent body to provide the latest scientific and technological information on climate change for the policymakers and diplomatic negotiators to make evidence-based decisions as an integral part of the law-making process in the evolution of international climate change governance is also typical of the process approach to problem solving.

4.1.1.1. Transboundary Air Pollution Regime

Although the regime based on the Convention on Long-Range Transboundary Air Pollution (CLRTAP) is more regional than global, it was the first atmospheric commons regime to highlight the importance of all four critical success factors. The international political negotiation process used was not only significant within the air pollution regime itself; it also significantly influenced the international political negotiation process of the ozone layer regime as well as that of the climate change regime.

In fact, it was the pressing issue of transboundary air pollution at the time of the 1972 Stockholm Conference that prompted conference participants to take up the challenge of fostering international cooperation to combat acid rain.[1211] Findings of several scientific studies carried out thereafter, between 1972 and 1977, confirmed that the long-range transport of air pollutants took place over several thousand kilometers before deposition and that these air pollutants were responsible for the acidification of the Scandinavian lakes and one of the sources was as far as England in the UK.[1212]

[1211] UNECE (2004) supra note 885, p. 1.

[1212] Brynjulf Ottar (1976) Organiaation of long range transport of air pollution monitoring in Europe, Water, Air and Soil Pollution, Volume 6, Issues 2-4 (June 1972), pp. 219-229.

It was the clear evidences from these scientific findings that compelled the member-States of the CLRTAP to go, beyond mere cooperation in scientific research, into concerted collective action to reduce emissions of these air pollutants.[1213]

4.1.1.2. Ozone Layer Regime

Another excellent example of the significant effect of science on policy and law was from the ozone layer regime. The timely publication of the discovery of the Antarctic ozone hole, in a reputable scientific journal, two months after the adoption of the Vienna Convention,[1214] confirming the prediction of the deleterious impact of CFCs on the stratospheric ozone layer spurred immediate action by the international community to ratify the Montreal Protocol in double quick time.[1215]

4.1.1.3. Climate Change Regime

Similarly, the rapid progress in climate science research on global warming and climate change in recent decades, predicated on the advancement in scientific methodology and tools, including the use of mathematical models and the observations of past climates, has been instrumental in helping facilitate the adoption of the core MEAs of the climate change regime, namely the UNFCCC, the Kyoto Protocol, and the Paris Agreement.[1216] Meanwhile, the confidence of policymakers, diplomatic negotiators and the general public in the work of the IPCC on climate change has also been enhanced because these IPCC reports have been broad-based and regularly updated.

Perhaps, more important, from a scientific perspective, is that climate science today is inherently self-correcting for results from incorrect or incomplete scientific theories ultimately do not survive the repeated testing against the observations of nature by the wide ranging group of scientists from diverse scientific disciplines, and the unbiased reporting and reviewing by an independent team of experts and policymakers from different socio-economic and political backgrounds.[1217]

[1213] UNECE (2016) supra note 882.

[1214] J. C. Farman, B. G. Gardiner and J. D. Shanklin (1985) supra note 894.

[1215] Edith Brown Weiss (2009) supra note 892.

[1216] Bert Bolin (2007) supra note 921, pp. 77-78.

[1217] Le Treut, H., R. Somerville, U. Cubasch, Y. Ding, C. Mauritzen, A. Mokssit, T. Peterson and M. Prather (2007) supra note 1006, p. 95.

4.1.1.4. Lessons Learned from the First Critical Success Factor

The science of cause-and-effect underlying the climate change phenomena is clear and updated regularly. In fact, the work of the IPCC is unprecedented in its size, scope, and complexity as an international interdisciplinary scientific advisory body,[1218] as compared to the work of the EMEP and TEAP of the transboundary air pollution and ozone layer regimes respectively.

In fact, because of the complexity of systemic biophysical climate change and the wide-ranging and deep interconnections with the human social system, the work of the IPCC is vital to the evolution of climate change governance towards its social goals, and its effectiveness in terms of the right internal legal architecture, transfer of authority, change of behavior, or problem-solving.

However, despite the clear statements of fact in the IPCC reports, which are accompanied with reliable estimates of probability within defined limits so that risks can be assessed and appropriate actions taken, the provisions in the Kyoto Protocol, which is the legal binding instrument of the climate change regime, has not been regularly reviewed, supplemented and amended as necessary. In fact, international diplomatic efforts just to extend the commitment period of the Kyoto Protocol from 2012 to 2020 had not entered into force due to the lack of support from the international community of sovereign nation-States. The failure of the Doha Amendment[1219] was not because the science of cause-and-effect was not updated regularly or not clearly expressed by the IPCC; it was due to the developed nation-States, especially the US, first, insisting that fast developing nation-States contribute with GHG emissions reduction targets [fair burden sharing by all], and second, refusing to concede national sovereignty and power to a supranational authority [transfer of authority].[1220]

These two reasons also contributed significantly to the failure of the 2009 Copenhagen Climate Change Conference. To go around these two key obstacles of fair burden sharing by all and strict national sovereignty, the international community, after the Copenhagen debacle, agreed to take the decisive turn from a top-down Kyoto Protocol with legal binding rules for selected nation-States to a bottom-up Paris Agreement with voluntary NDCs to curb GHG emissions from all nation-States.[1221]

[1218] Spencer Weart (2013) supra note 90, p. 3663.
[1219] UNFCCC (2012) supra note 837.
[1220] US President Bush (2001) supra note 1093.
[1221] United Nations (2015a) supra note 18.

4.1.2. Iterative Approach to Policymaking and Legislation

The development of the principles, structures and processes, and rules, of international environmental and climate change law through the creation of treaties, the performance of international acts such as resolutions of the United Nations General Assembly and other international organizations, and the application of international customary law, has generally been urgent reaction (lagging approach) to events or incidents of environmental concerns, or catalyzed by the availability of scientific evidences, rather than due to the early anticipation of general or specific environmental threats (leading approach). It is exacerbated by the complexity of most global environmental issues, including climate change. Our understanding of these global environmental issues are usually fraught with uncertainty and the direction for action are often ambiguous. For instance, it is difficult enough for climate scientists to project the future course of climate change. One can therefore imagine the immense difficulty the policymakers and diplomatic negotiators will have face when anticipating and deciding on the nature and scope of policies and law needed to abate the adverse effects of climate change.

Hence, the second critical success factor, which is a corollary from the first factor, is an iterative approach, informed by Bayesian reasoning,[1222] to policymaking and legislation in the arena of global environmental problems. It is also a well-known feature of the process approach. The iterative approach essentially involves the use of the well-known Plan, Do, Study and Act (PDSA) continuous improvement cycle for process, which has evolved over hundred of years from the scientific method and pragmatic philosophy.[1223]

When the policymaker uses such an iterative approach, the policymaker is collating further evidences of cause-and-effect and learning about the evolving risks of adverse impacts. By taking appropriate actions via iterative approximations, the policymaker is able to move in a helical process closer and closer to the optimal solution.

It is implicit that when negotiators adopt the framework convention plus protocol model that the iterative approach to policymaking and legislation is being used. The nature of a framework convention essentially reflects the decision of the parties of the convention to establish general obligations, create basic institutional arrangements, and provide

[1222] See Nate Silver (2012) The Signal and the Noise: Why so Many Predictions Fail – But Some Don't, The Penguin Press, New York, p. 370 - 411, for a simple explanation of Bayesian reasoning.

[1223] W. Edwards Deming (1993) The New Economics, MIT Press, Cambridge, MA, USA, p. 135.

procedures for the adoption of stricter obligations or standards in subsequent protocols and/or to leave room for the adoption of the said provisions in national legislation.

A framework convention helps to elevate political intent for action in the initial stages and yet still leave room for consensus when it comes to details of the action plan at the later stages. Its advantage is that agreement is easier to achieve by the parties in the initial stages because these early decisions on general principles and basic procedures that could guide the negotiation of detailed and targeted protocols are not costly. Once there is joint buy-in of the framework convention, there is joint ownership of the treaty negotiation, which impels the negotiators to do their best, in the midst of peer pressure as well, to build consensus on the provisions of the treaty. Often because the issues in question are addressed through the development of national policies, a framework convention is flexible, thereby allowing for discretion of national governments to decide how to achieve the agreed objectives based on their countries' capabilities.

4.1.2.1. Air Pollution Regime

The CLRTAP and its extension protocols were probably the first multilateral environmental agreements in which such an iterative approach was used to control and reduce the damage to the environment by air pollutants. More importantly from a political perspective is that its signatories even acknowledged that the CLRTAP approach was, "an outstanding example of intergovernmental cooperation".[1224]

4.1.2.1.1. Lowest Common Denominator Agreement

The CLRTAP when first established was a lowest common denominator agreement[1225] or as Underdal would say the agreement was predicated on the 'law of the least ambitious program'.[1226] Hence, the CLRTAP started off as a very weak institution.

It acted mainly as a platform for building trust between the European East-West political blocs in the non-contentious field of scientific research to advance knowledge on the extent of acid rain damage as well as the nature of transboundary flows within

[1224] UNECE (1999) Gothenburg Ministerial Declaration. In the Report of the Seventeen Session of the Executive Body, Annex II, ECE/EB.AIR/68, 27 December 1999, p. 25.

[1225] Loren R. Cass (2015) Air pollution and acid rain. In Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, p. 393.

[1226] Arild Underdal (1980) The Politics of International Fisheries Management: The Case of the Northeast Atlantic, Olso University Press, Oslo, Norway.

the European continent. The important political outcome of this weak institutional approach in the initial phase of the CLRTAP was that member-States in which the air pollution had originated (perpetrator) and the member-States that were mainly receivers (victims) of the transboundary air pollution were able to co-operate without "finger-pointing" in the process of evaluating the extent of acid rain and monitoring transboundary flow.[1227]

4.1.2.1.2. European Monitoring and Evaluation Programme (EMEP)

The most important scientific research work was conducted under the auspices of the EMEP and the Working Group on Effects. They oversaw collaborative research on many fronts, including forests, materials, freshwater ecosystems, crops, and integrated monitoring. The research findings helped solidify consensus among the member-States on the importance of the acid rain problem and led some countries to discover domestic acid rain damage that they had not expected to find.[1228]

The EMEP also worked on highly sophisticated monitoring and modelling of pollution flows. In time, EMEP was able to pinpoint with increasing precision the origin and end deposition of sulphur dioxide and nitrogen oxides on a continental scale. These findings clearly established who the 'upstream' polluters and the 'downstream' victims were. It also demonstrated a verification capability, which made it almost impossible to cheat on emissions reduction without getting caught.[1229]

4.1.2.1.3. Step-Up to Strong Rule-Making

When a sound scientific knowledge base had been put in place, the CLRTAP shifted its focus to the development and negotiation of gradually more specific but comprehensive provisions, which involves strong rule-making, while at the same time ensuring that the scientific knowledge base was kept up to date. These negotiations to enact more concrete measures to control the air pollutants were conducted via specific agreements

[1227] Reuters (1983) supra note 884.

[1228] Toni Schneider and Jurgen Schneider (2004) Chapter 3: EMEP – Backbone of the Convention. In Clearing the Air: 25 Years of the Convention on the Long-range Transboundary Air Pollution [Johan Sliggers and Willem Kakebeeke (eds.)], United Nations Publications, New York, pp. 31-44.

[1229] Marc A. Levy (1995) International Cooperation to Combat Acid Rain. In Green Globe Yearbook of International Cooperation on Environment and Development [Helge Ole Bergesen, Georg Parmann, and Øystein B. Thommessen (eds.)], Oxford University Press, Oxford, p. 60.

called Protocols.[1230] The current phase of the CLRTAP focuses on the implementation and compliance of the provisions of the Convention as well as the examination and review of the Protocols to ensure the adequacy of these provisions.[1231]

4.1.2.1.4. Integrating Consensus-Building and Rule-Making

CLRTAP was able to achieve its objectives by integrating the functions of consensus building and rule-making in an iterative manner. One would not understand the positive outcomes of the Convention if one examine these two activities separately.[1232]

The weak institutional approach in the initial phase allowed for strong consensus building at the outset whereas the enactment of strong rules right from the start would have generated hostility immediately on the part of the member-States. Although the European governments were willing to make symbolic pledges for the environment, they were (with only two exceptions) unwilling, at the beginning, to take concrete action to prevent acid rain. Hence, these skeptical European governments were not threatened by CLRTAP in the beginning and were willing to cooperate in scientific research into the cause-and-effect of acid rain. Gradually, the scientific working groups were able to resolve the uncertainties in the cause-and-effect of acid rain, and then recommend concrete action. For instance, they were able to identify who were the 'upstream' polluters and the 'downstream' victims in order to shame recalcitrant member-States, keep consensus-building high on the governments' agenda, and facilitate action of sub-national environmental groups to pressure their national governments to take remedial action. In the process, the working groups also developed a verification capability, which made it almost impossible for the member-States to cheat on emissions reduction without getting caught.[1233]

4.1.2.1.5. Non-Use of Dispute Settlement Mechanism

Although later Protocols to the CLRTAP contained a formal dispute resolution mechanism with the options of the International Court of Justice (ICJ), arbitration or

[1230] UNECE (2004) supra note 885, p. 1.

[1231] Harald Dovland, Richard Ballaman and Jan Thompson (2004) Introduction. In: Clearing the Air: 25 years of the Convention on Long-range Transboundary Air Pollution [Johan Sliggers and Willem Kakebeeke (eds.)], United Nations Economic Commission on Europe, New York and Geneva, 2004, p. 3.

[1232] Marc A. Levy (1993) European Acid Rain: Tote-Board Diplomacy. In Institutions for the Earth: Sources of Effective International Environmental Protection [Peter M. Haas, Robert O. Keohane and Marc A. Levy (eds.)], MIT Press, Cambridge, MA, USA, pp. 76-77.

[1233] Marc A. Levy (1995) supra note 1229, p. 60.

conciliation, these options have not been invoked to date. Operationally, the compliance procedure within the CLRTAP regime is without prejudice to the dispute settlement provisions in the Protocols.[1234]

The measures recommended by the Implementation Committee (IC) of CLRTAP to bring about compliance are not discriminatory, i.e. trade-based. Hence, the emphasis was clearly to encourage compliance rather than punish non-compliance. One of the core obligations under CLRTAP is the provision of information on national emissions of these pollutants. In both the cases of failure to provide correct reporting and failure to meet reduction commitments, non-compliant member-States were merely instructed by the IC to report on their progress in rectifying their non-compliance based on their own proposed timelines. If progress were still not achieved, the Executive Body of the CLRTAP would only express their disappointment and further urged the non-compliant member-States towards compliance.[1235]

4.1.2.1.6. Tote-Board Diplomacy

The Protocols to the Convention were not designed to enact binding rules based on the principle of mutual adjustment towards a pareto-optimum. If so, one would need strong rules in the Protocols that had to be complied with. In tote-board diplomacy,[1236] weak rules can also work quite well, and the initial non-compliance does not affect the overall long-term strategy of the Protocols.

First, the Protocols essentially served as normative registers to show that the registered member-States had accepted the Protocols as standards to guide the establishment of their respective national policies. Hence, those member-States that were not on the normative register would be subjected to both international and domestic pressure to register. Second, it acts as a tote board to show which member-State was compliant and which member-State was not. The non-compliant member-States would then also be subjected to both international and domestic pressures. Such pressures would prompt the non-compliant member-State to investigate further into the specific cases of damages due to acid rain as well as facilitate strategic linkages with relevant actors to move towards compliance. Such tote-board diplomacy has proven to be an effective instrument in the case of CLRTAP in Europe. Only the poor countries of eastern and

[1234] Alexander Gillespie (2006) Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries with Policy and Science Considerations, Martinus Nijhoff Publishers, Leiden, pp. 226-227.

[1235] Id., pp. 227-230.

[1236] Marc A. Levy (1993) supra note 1232, pp. 76-78.

southern Europe, along with Ireland, were able to escape its effects.[1237]

As a rough gauge of the effectiveness of the iterative approach in the air pollution regime, the CLRTAP has been extended by eight Protocols. One of the Protocols has been amended twice, and two of the Protocols have been amended once.[1238]

4.1.2.2. Ozone Layer Regime

Although the Parties to the Vienna Convention, based on the scientific information available then, acknowledged the potentially harmful impact on human health posed by the stratospheric ozone layer depletion, yet similar to the CLRTAP, the Parties to the Convention decided instead to focus not on remedial action but on further research first with the collation and exchange of scientific data. In order to avoid immediate disagreement due to the scientific uncertainty among the Parties, the Vienna Convention did not even specify any estimates of the substances that would contribute to the depletion of the stratospheric ozone layer. Instead the Convention called upon the Parties to "take appropriate measures" to protect against the "adverse effects resulting or likely to result" from damage to the ozone layer.[1239]

4.1.2.2.1. The Same Iterative Approach

Similar to the air pollution regime, the ozone layer regime also provided via an iterative approach the necessary framework with the Vienna Convention for future extension protocols to be negotiated and amended.[1240] Hence, the same strong consensus-building stance based on the initial weak institutional approach, as seen in the CLRTAP, was also visible throughout the whole negotiation process, albeit with the additional novel feature of financial incentives for the developing countries,[1241] to move towards the adoption of the Montreal Protocol.

4.1.2.2.2. Step-Up to Strong Rule-Making

[1237] Id., p. 77.

[1238] UNECE (2018) The Air Convention and its Protocols: Protocols, United Nations Economic Commission for Europe. Accessed on 29 June 2016 at: https://www.unece.org/env/lrtap/status/lrtap_s.html

[1239] UNEP (1985) supra note 850, Articles 3 & 4.

[1240] Id., Articles 8 & 9.

[1241] Elizabeth R. Desombre & Joanne Kauffman (1996) The Montreal Protocol Multilateral Fund: Partial Success Story. In Institutions for Environmental Aid: Pitfall and Promises [Robert O. Keohane and Marc A. Levy (eds.)], MIT Press, Cambridge, USA, pp. 94-96.

However, unlike the CLRTAP, the Montreal Protocol went beyond the tote-board diplomatic approach and adopted much stronger rules. For instance, following the decision at the second IC meeting to develop a list of possible actions that could be taken when non-compliance was recognized, three options were made available in the 4th Meeting of the Parties (MOP) in November 1992,[1242] namely:

(1) Appropriate assistance, including assistance for the collection and reporting of data, technical assistance, technology transfer and financial assistance, information transfer and training.
(2) Issuing cautions.
(3) Suspension, in accordance with the applicable rules of international law concerning the suspension of the operation of a treaty, of specific rights and privileges under the Protocol, whether or not subject to time limits, including those concerned with industrial rationalization, production, consumption, trade, transfer of technology, financial mechanism and institutional arrangements.

The threat to withhold financial assistance and/or impose discriminatory measures, e.g. trade restrictions of ozone-depleting substances (ODS), as part of the suspension of specific rights and privileges under the Protocol is the most powerful option that the IC possesses.[1243] For instance, a penalty of limited trade of ODS only with other members of the Commonwealth of Independent States was imposed on the Russian Federation[1244] and a penalty of total trade restriction of ODS was imposed on Belarus[1245] and Ukraine[1246] at the Seventh MOP in December 1995.

[1242] UNEP (1992b) Annex V: Indicative list of measures that might be taken by a Meeting of the Parties in respect of Non-Compliance with the Protocol. In Report of the Fourth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.4/15, 25 November 1992, p. 55.

[1243] Sebastian Oberthur (1997) Montreal Protocol: 10 Years After, Environmental Policy and Law, Volume 27, Issue 6, pp. 432-440.

[1244] UNEP (1995a) Decision VII/18. In Report of the Seventh Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.7/12, 27 December 1995, pp. 33-35.

[1245] UNEP (1995b) Decision VII/17. In Report of the Seventh Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.7/12, 27 December 1995, pp. 32-33.

[1246] UNEP (1995c) Decision VII/19. In Report of the Seventh Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.7/12, 27 December 1995, pp. 35-37.

4.1.2.2.3. Complementary Financial Incentives

Financial incentives provided by the Multilateral Fund (MLF) have proven useful in encouraging developing countries to address the ozone-layer problem. For instance, having access to the Multilateral Fund was a major impetus for the Chinese government's ratification and substantive procedural compliance with the Montreal Protocol. It contributed significantly to China's success in meeting its targets of freezing consumption and production of ODS.[1247]

A sector-based approach to funding was much more effective than the project-by-project approach in changing both government and industry behavior in a large country like China, where each sector comprises of an enormous number of enterprises. A project-by-project approach on such a large scale would quickly become inefficient and unmanageable. Hence, the sector approach took advantage of the government's interests to reduce ODS and its capability to monitor and manage the sector. This lesson may have relevance to the use of the General Environment Facility (GEF) to provide financial assistance to the developing countries to address climate change.[1248]

4.1.2.2.4. 'Amicable' Dispute Settlement Mechanism

The Vienna Convention also provides for formal resolution, if negotiation of inter-state dispute related to the Convention were to fail, through the good office of, or mediation by, a third Party.[1249] However, to date, no resolution of disputes have been taken under the formal procedure of the Convention, and Parties clearly prefer the model of 'amicable resolutions' of non-compliance, as specified by the Implementation Committee of the Montreal Protocol.[1250]

As a rough gauge of the effectiveness of the iterative approach in the ozone-layer regime, we note that the Vienna Convention has only been extended once with the Montreal Protocol while the Montreal Protocol has to date been amended five times.[1251]

[1247] Zhao Jimin (2002) The Multilateral Fund and China's Compliance with the Montreal Protocol, Journal of Environment and Development, Volume 11, Number 4, December 2002, pp. 331-354.

[1248] Id., pp. 352-353.

[1249] UNEP (1985) supra note 850, Article 11.

[1250] Alexander Gillespie (2006) supra note 1234, p. 216.

[1251] Ozone Secretariat (2018a) Treaties and Decisions: Status of Ratification, United Nations Environmental Programme (UNEP). Accessed on 29 June 2018 at: http://ozone.unep.org/sites/ozone/modules/unep/ozone_treaties/inc/datasheet.php

4.1.2.3. Climate Change Regime

For the policymakers involved in the negotiation of the UNFCCC, there were two political negotiation approaches to emulate as exemplified by the two extant international treaties respectively – the 1982 UN Convention on the Law of the Sea Convention (UNCLOS)[1252] and the 1985 Vienna Ozone Convention for the Protection of the Ozone Layer (Vienna Convention).[1253]

The negotiators for UNCLOS acknowledged the concept that all problems of the atmosphere are closely interrelated and therefore need to be addressed in a comprehensive manner in *toto* as a 'package deal'.[1254] The tedious and complex negotiations over substantive issues for UNCLOS took more than 14 years to complete and another 12 years for entry into force.[1255] The negotiators of the Vienna Convention focused initially on a specific framework agreement with objectives, general principles and rules on largely procedural matters and put in place provisions for future protocols to deal with the substantive issues of global climate change regulations. The Vienna Convention took only 4 years to complete and 3 years for entry into force.[1256] The intense pressure on the INC/FCC negotiators to get an agreement ready for signing at the Earth Summit in the relatively short time of 15 months[1257] was one of the main reasons why they decided to follow the Vienna Convention model.

4.1.2.3.1. The Same Iterative Approach

Similar to the earlier two regimes, the climate change regime also provided via an iterative approach the necessary framework with the UNFCCC for future extension protocols to be negotiated and amended. However, compared to both CLRTAP and the Vienna Convention, the UNFCCC was already much more prescriptive in the offset.

First, the UNFCCC did specify at a deeper level, with the notions of a 'safe' level of GHG emissions and a 'safe' time period, the ultimate objective of the Convention as the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would

[1252] United Nations (1982) supra note 785.

[1253] UNEP (1985) supra note 850.

[1254] S.N. Nandan (1986) supra note 787.

[1255] United Nations (2012) United Nations Convention on the Law of the Sea: A Historical Perspective, Division for Ocean Affairs and Law of the Sea, Office of Legal Affairs, United Nations. Accessed on 9 June 2018 at: http://www.un.org/depts/los/convention_agreements/convention_historical_perspective.htm

[1256] Edith Brown Weiss (2009) supra note 892, p. 1.

[1257] UNGA (1990) supra note 118.

prevent dangerous anthropogenic (human induced) interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."[1258] Hence, future UNFCCC negotiations would have to spell out what is a 'safe' level of GHG emissions in terms of both concentration and rate of change, and within what time frames.[1259]

Second, it incorporated several general principles of international environmental law, including the common concern of humankind, intergeneration equity, common but differentiated responsibilities and respective capabilities (CBDR-RC), precautionary principle, and sustainable development in its Preamble as well as in Article 3.[1260]

Third, based on these general principles, especially the CBDR-RC, the UNFCCC outlines a set of general commitments applicable to all parties, while specific commitments apply only to developed countries listed in Annexes I & II.[1261]

Fourth, the policies and measures to combat climate change should be "cost-effective, ensuring global benefits at the lowest possible cost", and comprehensive, taking into account different socio-economic contexts, covering all relevant sources, sinks and reservoirs of greenhouse gases, and comprising all economic sectors".[1262]

Last but not least, UNFCCC acknowledges the right of the Parties to promote sustainable development and calls upon Parties to cooperate in promoting a supportive and open international economic system, so that measures taken, unilateral or otherwise, "should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade".[1263]

4.1.2.3.2. Step-Up to Strong Rule-Making

Based on the iterative approach, and similar to the two earlier regimes, the provisions of the UNFCCC did not specify targets and timetables for the reduction of GHG emissions. It was therefore not surprising that the first decision taken at the first session of the

[1258] United Nations (1992a) supra note 16, Article 2.

[1259] Richard H. Moss (1995) Avoiding 'Dangerous' Interference with the Climate System: The Roles of Values, Science, and Policy, Global Environmental Change, Volume 5, Number 1, pp. 3-6.

[1260] United Nations (1992a) supra note 16, Preamble and Article 3, pp. 2-10.

[1261] Id., Annexes I & II.

[1262] Id., Article 3.3, p. 9.

[1263] Id., Articles 3.4 & 3.5, p. 10.

Conference of the Parties (COP-1), also known as the Berlin Mandate, was to develop stronger commitments to reduce GHG emissions,[1264] which led eventually to the establishment of the Kyoto Protocol committing its Parties to legally binding greenhouse gas emission reduction targets was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005.[1265]

The UNFCCC has only been extended once with the Kyoto Protocol. There have been two attempts to amend the Kyoto Protocol. The first attempt was the Amendment to Annex B by Decision 10/CMP.2 in accordance with Articles 20 and 21 of the Kyoto Protocol, at the 2nd Session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, which was held in Nairobi, Kenya, in November 2006.[1266] The second attempt was the Doha Amendment by Decision 1/CMP.8 at the 8th Session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP), which was held in Doha, Qatar, on 8 December 2012.[1267]

In accordance with paragraph 4 of Article 20,[1268] an amendment will enter into force with at least 144 instruments of acceptance, which is from three fourths of the Parties to the Kyoto Protocol. To date, both amendments do not have enough instruments of acceptance from the Parties to enter into force.

4.1.2.3.3. 'Amicable' Dispute Settlement Mechanism

Two complementary mechanisms were established in the UNFCCC for the resolution of questions regarding implementation[1269] and dispute settlement[1270] respectively. The first mechanism – multilateral consultative process – was novel. It was provided to assist the Parties to overcome difficulties encountered when implementing the Convention. It aims at promoting the understanding of the Convention as well as at preventing disputes from arising. The decisions on the functioning of the multilateral consultative process and the establishment of a standing Multilateral Consultative Committee to administer this mechanism were left to the COP.

[1264] UNFCCC (1995b) supra note 1060, pp. 4-6.

[1265] UNFCCC (2019c) supra note 1090.

[1266] UNFCCC (2018b) Amendment to Annex B of the Kyoto Protocol, Process and Meetings: The Kyoto Protocol, United Nations Climate Change (UNCC). Accessed on 30 June 2018 at: https://unfccc.int/process/the-kyoto-protocol/amendment-to-annex-b

[1267] UNFCCC (2018a) supra note 1096.

[1268] United Nations (1998) supra note 17, Article 20(4).

[1269] United Nations (1992a) supra note 16, Article 13.

[1270] Id., Article 14.

The Ad Hoc Group on Article 13 completed its work in 1998, without being able to agree on the number of members of the Consultative Committee, the length of their term or their geographical distribution. The report of the Ad Hoc Group, which was adopted at COP-4 meeting in 1998, outlines the procedures for the consultative process.[1271] It is guided by the premise to be facilitative, cooperative, and non-adversarial as well as non-judicial. Parties have the possibility to address concerns about their own implementation difficulties, as well as about those of other parties to the Committee. The multilateral consultative process was eventually not adopted.[1272]

In case a dispute cannot be avoided by the consultative process, article 14 envisages possibilities for its resolution by the more traditional bilateral dispute settlement procedures of negotiation, the establishment of a conciliation commission upon request, or, if accepted by the States concerned, submission to the jurisdiction of the International Court of Justice or international arbitration.

4.1.2.3.4. Complementary Financial Incentives

A financial mechanism is established to provide financial resources on grant or concessional basis, including for the transfer of technology. It functions under the guidance of the COP and one or more existing international entities may be entrusted with its operation. The UNFCCC provides that the financial mechanism shall have an equitable and balanced representation of all parties with a transparent system of governance.[1273] The Global Environmental Facility, which was initially entrusted with an interim mandate (article 12 (3)), was restructured accordingly and by Decision 3/CP.4 at COP-4 was recognized as the financial mechanism of the Convention.[1274]

4.1.2.4. Lessons Learned from the Second Critical Success Factor

[1271] UNFCCC (1998) Multilateral consultative process, Decision 10/CP.4, Report of the Conference of Parties on its Fourth Session, held at Buenos Aires from 2 to 14 November 1998, FCCC/CP/1998/16/Add.1, 25 January 1999. Accessed on 31 August 2019 at: https://unfccc.int/resource/docs/cop4/16a01.pdf#page=42

[1272] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 380.

[1273] United Nations (1992a) supra note 16, Article 11(2).

[1274] UNFCCC (1988b) Review of the financial mechanism, Decision 3/CP.4, Report of the Conference of Parties on its Fourth Session, held at Buenos Aires from 2 to 14 November 1998, FCCC/CP/1998/16/Add.1, 25 January 1999. Accessed on 31 August 2019 at: https://unfccc.int/resource/docs/cop4/16a01.pdf#page=8

From the perspective of an iterative approach to policymaking and legislation, the climate change regime is more sophisticated than the earlier regimes. It contains some novel provisions, which includes (1) incorporation of general principles of international environmental law in the Convention;[1275] (2) reinforcement of the non-adversarial approach to ensure compliance with contractual obligations with two complementary mechanisms in the Convention for the resolution of questions regarding implementation[1276] and dispute settlement[1277] respectively, of which the multilateral consultative process for resolution of questions regarding implementation was novel; and (3) introduction of three flexible market-based mechanisms in the Protocol to facilitate compliance of the Annex I countries with their respective greenhouse gas emission reduction targets at the lowest possible costs. The outcomes of the three atmosphere global commons regimes, however, were very different.

First, there have been serious disputes as to the meaning and application of the ill-defined principles due to the North-South economic divide.[1278] Second, there is the non-implementation of the multilateral consultative process because the parties could not agree on the composition of its consultative committee due to the unwillingness of the parties to cede authority to a supranational body.[1279] Third, the failure of the market-based mechanisms because the experience with these highly complemented and flexible market-based mechanisms on a global scale has shown that such a system can be gamed[1280] and the carbon leakage of REDD projects is a substantive problem.[1281]

More importantly, unlike the earlier two regimes, the climate change regime after more than 25 years of intense effort by the international community has failed to achieve its overarching social goals, albeit the goals of the earlier regimes were far more modest than those of the climate change regime. For instance, the OECD estimates for meeting climate and development objectives are USD 6.9 trillion a year[1282] while the current

[1275] United Nations (1992a) supra note 16, Preamble and Article 3, pp. 2-10.

[1276] Id., Article 13.

[1277] Id., Article 14.

[1278] Mathias Friman (2007) Historical Responsibility in the UNFCCC, Centre for Climate Science and Policy Research, Report 07:01, Linkoping University, Sweden, p. 1.

[1279] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 380.

[1280] Michael Wara (2007) Is the global carbon marketing working? Nature, Volume 445 (8 February 2007), pp. 595-596.

[1281] Carbon Market Watch (2013) REDD, News and Press, 9 April 2013. Accessed on 11 August 2019 at: https://carbonmarketwatch.org/2013/04/09/redd/

[1282] OECD (2018) Financing Climate Futures: Rethinking Infrastructure, OECD/The World Bank/UN Environment, OECD Publishing, Paris, France, p. 1.

replenishment rate for the Montreal Protocol is only USD 150 million a year.[1283]

In the meantime, the two attempts to amend the Kyoto Protocol had yet to enter into force, which indicates that the international community has tacitly recognized that the top-down Kyoto Protocol cannot work in the current international political climate and has decided to focus efforts on the bottom-up Paris Agreement with voluntary nationally determined contributions, which allows the international community to go around the two key obstacles of fair burden sharing by all and strict national sovereignty, as discussed in Section 4.1.1.4.

4.1.3. Fair Burden Sharing by All

Strictly speaking from a legal positivist perspective, 'fair burden sharing by all' is not a legal principle *per se* as it would consider as utopian.[1284] However, from a natural law perspective, Chambers have concluded that MEAs can be considered successful only if they have the moral dimension of justice and equity.[1285] Meanwhile, Franck asserts that for a legal system to be effective "its decisions must be arrived at discursively in accordance with what is expected by the parties as right process".[1286] He also concludes that the "right process", i.e. procedural fairness, and the observance of distributive justice in MEAs were the indicators of fairness.[1287] Andersen and Hey also conclude that "differentiating obligations based on different interests and acknowledged norms of fairness enhances a regime's effectiveness".[1288]

'Fair burden sharing by all', however, is an essential principle in the international politics of climate change. All parties to the international environmental agreement must agree to share the burden of implementing the agreement fairly based on the ethical principle of equity. This factor of 'fair burden-sharing by all' can be considered

[1283] Multilateral Fund (2019) For the Implemenation of the Montreal Protocol, Secretariat of the Multilateral Fund. Accessed on 11 August 2019 at: http://www.multilateralfund.org/default.aspx

[1284] Martti Koskenniemi (2011a) supra note 389, p. 39.

[1285] W. Bradnee Chambers (2004) Towards an improved understanding of legal effectivenss of international environmental treaties, Georgetown International Environmental Law Review, Volume 16, Issue 3, p. 509.

[1286] Thomas M. Franck (1995) Fairness in International Law and Institutions, Oxford University Press, Oxford, UK, p. 7.

[1287] Id., pp. 7-8.

[1288] Steinar Andresen and Ellen Hey (2005) The effectivness and legitimacy of international environmental institutions, International Environmental Agreements: Politics, Law and Economics, Volume 5, Issue 3 (September 2005), p. 220.

as a structural element of the SEP system or the moral reflection or principle of the structure of the SEP system. It is a structural element of systems because there is stratification of modern society into East-West blocs due to differences in political ideology or into the North-South economic divide due to differences in socio-economic development. Hence, in the design of MEAs, special attention must be paid to this critical success factor, which is highly dependent on the evolution and context of the action situation arena of the social dilemma. A change in structure can significantly affect the preferences and actions of the agents.

4.1.3.1. Air Pollution Regime

For instance, one of the noteworthy features of the CLRTAP is that both the States in which the air pollution originated (perpetrator) and the States that were mainly receivers (victim) of the transboundary air pollution [structure] shared the burden of research and monitoring for the environmental protection of the region.[1289] It is important to note that the 'victims' in this particular case are developed countries while the 'perpetrators' are either developing or developed countries. One could argue that these 'rich' victims were prepared to sacrifice in the short-term for long-term benefits because they had the capacities to do so [actor preference].

4.1.3.2. Ozone Layer Regime

In the case of the ozone layer regime, the roles of 'perpetrators' and 'victims' were reverse. Hence, in the negotiation of the Montreal Protocol, persuading the developing countries (victim) to sign on to the Protocol was not an easy task. The 'victims' this time round were the developing countries and the 'perpetrators' were the developed countries. The developed countries (perpetrator) had invented the CFCs and had already exploited their usefulness for economic development and are now preventing the developing countries (victim). The North-South economic divide thus became the main obstacle in the negotiation of the Montreal Protocol.

The major reason for the reluctance of the developing countries to sign on the dotted line of the Montreal Protocol was because the developing countries felt that they have the right to use for their own development these ozone-depleting substances, which at any rate had greatly aided the industrialization of the developed countries (equity). This principle of the right to development had earlier been endorsed by the UN General

[1289] Reuters (1983) supra note 884.

Assembly in the 1986 Declaration on the Right to Development.[1290]

The minor reason was that due to the resistance of the developing countries to yet again surrender their sovereignty and control over how they should use their resources after the brutal experience with Western imperialism.[1291]

4.1.3.2.1. Common But Differentiated Responsibilities (CBDR)

Due to their large and rapidly growing populations and their right to pursue economic development for their peoples, the developing countries will in time undermine and render ineffective the Montreal Protocol if they were not included in the agreement. Hence, a compromise had to be struck between the developed and developing countries of the North-South economic divide to ensure a sustainable process of eliminating the ozone-depleting substances via the Montreal Protocol. The result of this compromise was an earlier version of the emergent principle of the Common But Differentiated Responsibilities (CBDR).[1292]

This principle of CBDR has two elements. The first element states "the common responsibility of states for the protection of the environment, or parts of it, at the national, regional and global levels."[1293] Meanwhile, the original version of the second element of this principle in the Montreal Protocol clearly states that the Parties acknowledge "that special provision is required to meet the needs of developing countries" for these ozone-depleting substances (ODS).[1294]

4.1.3.2.2. Special Provisions for Developing Countries

The provisions of the Montreal Protocol therefore grant the developing countries of the South a ten-year grace period before they were required to start phasing out the ODS as well as the promise to address financial and technological assistance at the next meeting

[1290] UNGA (1986) Declaration on the Right to Development, United Nations General Assembly Resolution, A/RES/41/128, 4 December 1986. Accessed on 22 July 2016 at: http://www.un.org/documents/ga/res/41/a41r128.htm

[1291] Shangrila Joshi (2015) North-South relations: colonialism, empire and international order. In: Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, pp. 272-283.

[1292] Id., p. 276.

[1293] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, pp. 244-248.

[1294] UNEP (1987) supra note 896, Preamble.

of the Conference of the Parties.[1295] The Multilateral Fund was then established under the Montreal Protocol[1296] to provide substantial funds to meet the costs of replacing ODS with substitutes for direct use or as intermediate goods for use in manufacturing.[1297] Twenty years after the adoption of the Montreal Protocol, these developing countries have reduced their use of ODS by over 80%, which is a good measure of the success of the Montreal Protocol.[1298]

It is important to note that the 'victims' focused mainly on the issue of their right to future development and less on past grievances [future temporal equality rather than past temporal equality]. Hence, both 'perpetrators' and 'victims' were able to come to a compromise with the Montreal Protocol providing the developing countries of the South with a ten-year grace period before they were required to phase out the ODS as well as financial assistance in the form of direct compensation from the Multilateral Fund.

4.1.3.3. Climate Change Regime

The North-South economic divide surfaced again, with even greater intensity, during the negotiation of the UNFCCC and after its adoption. Article 3.1 of the UNFCCC states that the parties of the convention "should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity".[1299]

Unlike the case of the Montreal Protocol, although the conflict between the 'victims' and the 'perpetrators' in the negotiation of the multilateral climate change agreements still revolved around the right to future development, the 'victims' were also adamant that the perpetrators should pay for their past 'offences', which is essentially invoking the Polluter Pay Principle.[1300]

[1295] Id., Article 5.

[1296] Id., Article 10.

[1297] UNEP (1992c) Annex VIII: Indicative List of Categories of Incremental Costs. In Report of the Fourth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.4/15, 25 November 1992, pp. 58-59.

[1298] UN Secretary General (2007) Message on the International Day for the Preservation of the Ozone Layer, United Nations, New York, 16 September 2007. Accessed on 20 July 2016 at: http://www.uneptie.org/ozonaction/information/mmcfiles/4870-e-sgmsg.pdf

[1299] United Nations (1992a) United Nations Framework Convention on Climate Change, United Nations, New York, 9 May 1992 [hereinafter UNFCCC], Article 3.1. Accessed on 7 July 2016 at: http://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

[1300] Mathias Friman (2007) supra note 1278, p. 43.

The developing countries were very concerned that "institutionalization of something like current emissions levels (or ratios) that would condemn them to permanent economic inferiority because of the advantages the rich countries had derived from their historic reliance on fossil fuels to power the industrial revolution."[1301] At least some of this reasoning did find its way into the UNFCCC under the collective phrase "common but differentiated responsibility", an important principle paving the way for the divide of the world into Annex I and non-Annex I Parties. But it has also been characterised as a principle that permits "all parties to enjoy equity […] while retaining quite different notions of what would actually be fair".[1302]

4.1.3.3.1. Different Perspectives in Applying the Principle of Equity

The principle that all people have equal rights and obligations is an accepted cornerstone in discussions on the application of equity in general international law. Hence, to apply this concept of equity in the climate change context would imply that there should be equal distribution of rights to the use of the atmosphere for all nation-States (spatial equality). However, there were very different interpretations from the North-South divide on the equal distribution of rights to the use of the atmosphere among the different nation-States.[1303]

4.1.3.3.2. Polluter Pays Principle

The developing countries of the South continue to uphold that the notion of historical responsibility (past temporal equality) has to be taken into consideration in the discussion on equity in the climate change context. Hence, equal distribution of rights to the use of the atmosphere means that those who caused the climate change problem have the responsibility to should fix it (spatial-past temporal equality), which is essentially the polluter pays principle in international environmental law.[1304]

However, the polluter pays principle has not received as much support as compared to the principle of preventive action or as much attention compared to the precautionary

[1301] Stephen J. DeCanio (2003) Economic Models of Climate Change: A Critique, Palgrave Macmillan, Basingstoke, UK, p. 154.

[1302] Steve Rayner, Elizabeth L. Malone and Michael Thompson (1999) Equity Issues and Integrated Assessment. In: Fair Weather – Equity Concerns in Climate Change [Ferenc L. Toth (ed.)], Earthscan, London, UK, p. 20.

[1303] Mathias Friman (2007) supra note 1278, p. 1.

[1304] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, p. 240.

principle in the international community. The strong objections from the developed countries to the development of this principle is evident as inferred from the language adopted in Principle 16 of the Rio Declaration, which states that, "National authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the costs of pollution, with due regards to the public interests and, without distorting international trade and investment."[1305] The emphasis is, first, on the use of economic instruments to alleviate the problem and not on the polluter pay principle itself, and second, on national authorities to bear the costs of pollution without distorting the international system.

4.1.3.3.3. Common Responsibility for Solving the Climate Change Problem

Meanwhile, the developed countries often adopt a perspective based on the notion that solving the climate change problem is too important an issue to allow large parts of the world to continue emitting GHG without regulations (spatial-future temporal equality). Hence, historical responsibility (past temporal equality) is a secondary consideration when trying to solve the impending catastrophic climate change, and that the primary consideration should be based on the principle of the "common concern of humankind", as stated in the first statement in the Preamble of the UNFCCC.[1306]

Hence, the developed countries of the North are, therefore, of the opinion that this principle of the 'common concern of humankind' in international environmental law means sharing the burden equally regardless of history (past temporal equality).[1307]

4.1.3.3.4. Common Concern of Humankind (CCH)

However, contrary to the perception of the developed countries from the North, the concept of the 'common concern of humankind' (CCH) actually provides a framework that goes beyond national territories for approaching global problems, which "inevitably transcend the boundaries of a single state and require collective action in response."[1308] It is therefore particularly suited to addressing global environmental issues that do not respect national boundaries, e.g. climate change.

[1305] UNEP (1992a) supra note 75, Principle 16.

[1306] United Nations (1992a) supra note 16, Preamble.

[1307] Mathias Friman (2007) supra note 1278, p. 1.

[1308] Dinah Shelton (2009) Common Concern of Humanity, Environmental Policy and Law, Volume 39, Issue 2, p. 83.

Perhaps, even more important, from a scientific perspective, is that CCH is also a temporal framework, in which past, present, and future temporal equality must be taken into consideration. The spatial concept of the "common heritage of mankind"[1309] is a better framework for managing the sustainable exploitation of global common goods, e.g. the High Seas, Antarctica and Outer Space. The word 'heritage' primarily focuses on 'things' of the past that have been preserved for mankind in the present. The notion of the future is secondary. The word 'concern', however, primarily focuses on a sense of worry about the future due to the present. The notion of the past is secondary. Hence the principle of CCH is actually more suited to the management of the global common sinks for air pollutants, ODS, and GHG emissions, especially those with long-lasting effects. Hence, the concept of CCH implies the need to focus on intergenerational equity for future generations (future temporal equality).[1310]

4.1.3.3.5. Common But Differentiated Responsibilities and Respective Capabilities

The first element of 'common responsibility ' in the principle of CBDR is derived from both the concepts of 'common concern' and 'common heritage of mankind'.[1311] Hence, one of the sources of the key principle of CBDR in both the ozone-layer regime and the global climate change regime is the 'common concern of humankind'.

The outcome of the hotly contested debate by the countries of the North-South economic divide in climate change negotiations resulted in the creation of a even more elaborate version of the principle of CBDR, known as the Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC), in which the Parties of the UNFCCC also acknowledged the present capabilities of the nation-States and the notion of historical responsibility in the application of equity in the climate change context.[1312]

[1309] UNGA (1970) Declaration of Principles Governing the Sea-Bed and the Ocean Floor, and the Sub-soil thereof, beyond the Limits of National Jurisdiction, United Nations General Assembly Resolution A/RES/25/2749, 12 December 1970. Accessed on 17 June 2018 at: http://www.un-documents.net/a25r2749.htm

[1310] UNEP (1991) Report of the Ad Hoc Working Group of Legal and Technical Experts on Biological Diversity on the Work of its Second Session, Ad Hoc Working Group of Legal and Technical Experts on Biological Diversity, United Nations Environmental Programme, 7 March 1991, p. 4. Accessed on 17 June 2018 at: https://www.cbd.int/doc/meetings/iccbd/bdn-02-awg-02/official/bdn-02-awg-02-05-en.pdf

[1311] Lavanya Rajamani (2006) Differential Treatment in International Environmental Law, Oxford University Press, Oxford, p. 134.

[1312] Id., p. 136.

This principle of CBDR-RC was enshrined in Article 3.1 of the UNFCCC [1313], which has legally binding implications, while the principle of the 'common concern of humankind was stated in the Preamble, which informs and guides the interpretation of the treaty. Hence, the Parties have to take into consideration this principle of CBDR-RC when provisions on targets and timetables for the reduction of GHG emissions were established in future Protocols. This central principle in the climate change regime paved the way for the divide of the world into Annex I and non-Annex I Parties.

4.1.3.3.6. Outcome of Application of CBDR-RC in Kyoto Protocol

Similar to the Montreal Protocol, the CBDR-RC served as the guiding principle during the negotiation on commitment targets and timetables of the Kyoto Protocol. However, unlike the Montreal Protocol, which only grant the developing countries a 10-year grace period and after which the same commitments (obligations) would kick in for the developing countries,[1314] the legally binding commitments in the Kyoto Protocol to reduce GHG emissions apply only to the developed countries listed in Annex I of the UNFCCC with the quantifiable emission limitations specified in Annex B of the Protocol.[1315] The developed countries were the OECD countries, which comprised of Western Europe, the United States, Canada, Japan, Australia, and New Zealand, and the EIT countries, which comprised mostly the countries in Eastern Europe and the former Soviet Union. China, India, Brazil, South Korea, and other fast growing developing countries were not included in the Annex I Parties. More importantly, there was no provision in the Kyoto Protocol for the eventual inclusion of these developing countries in similar legally binding commitments.

Hence, to reach agreement on the Kyoto Protocol, it was necessary for the developed countries of the North to sacrifice the fair burden sharing by all parties in order to appease the developing countries of the South into signing the agreement. In return, the developed countries were able to have several 'flexible mechanisms', including emissions trading and joint implementation among developed countries as well as a 'Clean Development Mechanism' (CDM) for emission reduction projects in developing

[1313] United Nations (1992a) supra note 16, Article 3.1.

[1314] Europa (2008) Summary of Treaty: Montreal Protocol on substances that deplete the ozone layer, Treaties Office Databse, Europe External Action Service, 16/05/2008. Accessed on 31 August 2019 at: http://ec.europa.eu/world/agreements/prepareCreateTreatiesWorkspace/treatiesGeneralData.do?step=0&redirect=true&treatyId=524#targetText=The%20parties%20committed%20to%20reduce,period%20to%20meet%20both%20obligations.

[1315] United Nations (1998) supra note 17, p. 20.

countries, incorporated into the Kyoto Protocol to supplement domestic action.[1316]

4.1.3.3.7. Differences in Perspectives of North-South Divide Continued Unabated

However, the differences in perspectives of the countries from the North-South economic divide when applying the principle of equity to solving the climate change problem continued unabated after the signing of the Kyoto Protocol. First, there is the perception among some of the developed countries that rapidly industrialized countries, e.g. China, Brazil and India, will be able to free ride on the sacrifices made by Annex 1 countries. Second, there is also the related concern among the some of the developed countries that the energy-intensive manufacturing industries will uproot and relocate to the developing countries not covered by the provisions of the Kyoto Protocol resulting in 'carbon leakage'.[1317] Third, even the innovative introduction of 'flexible mechanisms' into the Kyoto Protocol was criticized by some developing countries as "carbon colonialism" as the developing countries are being reconstituted as sinks for GHG emissions from the developed countries.[1318]

This decision to sacrifice the critical success factor of 'fair burden-sharing by all' became a source of contention immediately after the adoption of the Kyoto Protocol. Just before the adoption of the Kyoto Protocol, the US Senate, in its 105th Congress session in July 1997, had unanimously voted by 95-0 for the bipartisan (Senators Byrd and Hagel) Senate Resolution 98 that "declares that the United States should not be a signatory to any protocol to, or other agreement regarding, the United Nations Framework Convention on Climate Change of 1992, at negotiations in Kyoto in December 1997 or thereafter which would: (1) mandate new commitments to limit or reduce greenhouse gas emissions for the Annex 1 Parties, unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period; or (2) result in serious harm to the U.S. economy."[1319]

The issue of 'fair burden sharing by all' was certainly one of the main drivers for the failure of the United States to ratify the Kyoto Protocol. In 2001, President Bush, in a

[1316] Daniel Bodansky (2001) supra note 907, p. 36.

[1317] Harriet Buckeley and Peter Newell (2015) Governing Climate Change, 2nd Edition, Routledge, London and New York, p. 39.

[1318] Heidi Bachram (2004) Climate Fraud and Carbon Colonialism: The New Trade in Greenhouse Gases, Capitalism Nature Socialism, Volume 15, Issue 4, pp. 5-20.

[1319] US Senate (1997) supra note 1091.

letter to members of the US Senate, described the Kyoto Protocol as "fatally flawed" and "effectively dead," and stated that the non-participation of developing countries was one of the two main reasons for the withdrawal of the United States from the Kyoto Protocol. President Bush wrote that he "oppose the Kyoto Protocol because it exempts 80 percent of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the U.S. economy."[1320] Ultimately, it is interlinked to the more important issue, as emphasized in both the Senate Resolution and President Bush's letter of national interests.

It took the Parties another 14 years to rectify the problem by reinstating this critical third success factor of 'fair burden-sharing by all' with the 2015 Paris Agreement. First, by which time, the US was no longer the leading GHG emitter. Second, and more importantly, the means to 'fair burden-sharing by all' has taken a complete turn from a top-down legally binding approach to complete reliance on a bottom-up voluntary nationally determined contributions (NDCs). Third, and most importantly, critical time and energy have been wasted in the climate change governance process.

4.1.3.4. Lessons Learned from the Third Critical Success Factor

Hence, the key lesson learned from the third critical success factor is that change in the international system [structure] from the time of the Montreal Protocol in the mid-1980s to the time of the Kyoto Protocol in the 1990s had a highly significant impact on the preferences of the developing countries [actors].

First, from the political economy perspective, the developing countries did not view the use of CFCs as being tightly entangled with their future economic development. More friendly alternatives to CFCs were already made available for their use by the industrialized countries. Besides, they were been compensated directly and adequately for giving up CFCs with both financial and technical assistance [structure]. The developing countries clearly consider the access to cheap, readily available, and well-established supply of fossil fuel energy sources as tightly entangled with their future economic development and therefore of national interest importance just like the developed countries. The non-fossil fuel energy sources were not readily available as yet and will require time and resources to develop [structure]. The main 'compensation' to the developing countries in the Kyoto Protocol was not going to be direct but mediated via market-based mechanisms, similar to the ancient purchase of buying

[1320] George W. Bush (2001) supra note 1093.

indulgences by the rich and powerful from the global North for the privilege to continue GHG emissions by supporting questionable projects in the global South, which are often carried out at the expense of the interests of the local communities.[1321] Not only does it violate the critical success factor of fair burden sharing by all, it also does not result in behavioural change for both developed and developing countries. Putting the CDM into international practice proved to be very slow and inefficient,[1322] which significantly increased transaction costs and militate against the intent of the Coase theorem.

Second, with the use of the emissions trading system (ETS) the developed countries had hoped to reduce the cost of full compliance. But the establishment of an ETS in the first place requires the creation of emission permits worth hundreds of billions of dollars [structure], which gave governments and others strong financial incentives to game the system [actor preference]. Meanwhile, the difficult-to-measure sinks of forests also undermine public confidence in the value of such emission permits.[1323]

Third, the introduction of the three flexible market-based mechanisms with their neoliberal logic only serve to consolidate the status quo of the current economic system [structure], which is highly dependent on fossil fuels, and to foster a business-as-usual attitude that actually retarded the momentum in seeking a fundamental re-construction of the ways of life and the means of production that is needed in the long term to solve the climate change problem [actor preference].

Fourth, from the international politics perspective, the Montreal Protocol was adopted in 1987 when the Western and Eastern Blocs were still competing to show the world that their ideological system was the superior form of political governance. In that sense, the two blocs were acting as equals rather than as 'victims' and 'perpetrators'. However by the time of Kyoto Protocol ten years later in 1997, the international political system [structure] had changed completely. With the demise of the USSR and the breakup of the Eastern Bloc of communist nations, initiated by the fall of the Berlin Wall in 1989, there was a paradigm shift in the international system from grave concerns about international security to concerns about economic inequality, which strengthen the North-South economic divide. The developing countries acted as 'victims' insisted that the developed countries as 'perpetrators' pay for the past 'offences'.

[1321] Geoffrey Heal (2007) supra note 377, p. 74.
[1322] David G. Victor (2001) supra note 376, p. 10.
[1323] Id., p. 10.

For instance, the introduction of the principle of CBDR[1324], which is another expression of the 'fair burden sharing by all' principle, worked well for the Montreal Protocol although the definition of that principle was open to different interpretations. The developing countries [agent] at the time of the Montreal Protocol did not pursue past grievances about the use of CFCs because its use was not essential for their economic development at that stage in time [actor preference], substitutes for CFCs were already available in the market, and the switch to the more expensive substitutes by the developing countries would anyway be compensated adequately by the developed countries with both financial and technical assistance [structure].[1325]

However, by the time of the Kyoto Protocol, neoliberal ideology had spread to the rest of the world and both developed and developing countries were competing to liberalize their markets for economic development. In the light of this fundamental change in the international system, the developing countries [agent] completely changed their stance and decided to pursue past grievances about the use of fossil fuels [actor preference]. The tight interconnections between fossil fuel use, which is responsible for global warming, with the economic development of any country at any stage of development meant that the developing countries clearly viewed their access to the cheap, readily available and well-established supply of fossil fuel energy sources as entangled with their future economic development [structure]. The non-fossil fuel energy sources are not as readily available as yet and will require time and resources for further development. Instead of direct monetary compensation as in the case of the Montreal Protocol, 'compensation' in the Kyoto Protocol would be mainly through market-based mechanisms and the developing countries were not sure how effective these flexible market-based mechanisms would work out in their favor [structure].

The action situation arena received the Asian financial shock, soon after the signing of the Kyoto Protocol, in which countries in Asia as well as in Europe and South America were badly affected. The unpalatable aspects of neoliberalism were exposed during the crisis. Developing countries that had liberalized their financial markets more were affected more than the countries that had not liberalized their financial markets as much

[1324] This principle of Common but Differentiated Responsibilities (CBDR) has two elements. The first element states "the common responsibility of states for the protection of the environment, or parts of it, at the national, regional and global levels." The original version of the second element of this principle in the Montreal Protocol clearly states that the Parties acknowledge "that special provision is required to meet the needs of developing countries" for these ozone-depleting substances."

[1325] UNEP (1987) supra note 896, Article 10.

(historical narration).[1326] The developing countries [agent] became inward looking and became even more adamant that since the developed countries caused the climate change problem they have the responsibility to fix it.

4.1.4. Effective and Efficient International Organization

The inclusion of the principle of the 'common concern of humankind' in a MEA, e.g. UNFCCC, is an explicit recognition of the need for international cooperation to solve a shared global problem, in which the harm is widespread and the origin of that harm is diffused, making it difficult to rely on the "traditional bilateral notions of state responsibility to enforce international norms."[1327] Hence, there is the need to set up an IO to coordinate and implement the provisions of the MEA.

Although global environmental governance has been and is still dominated by the nation-States, the nation-States who are parties to the MEA, when setting up the IO, have essentially delegated the tasks of coordinating and implementing political and legal processes of the MEA to the IO.[1328] Hence, the effectiveness and efficiency of the IO and its sub-organs, established by the member-States to manage the MEA is the fourth critical success factor. It is a structural element of systems.

4.1.4.1. Measure of Effectiveness in International Organization

The two distinguishing characteristics of an Intergovernmental Organization (IGO) or International Organization (IO) as compared to other international institutional arrangements are centralization and independence. Both characteristics enhance the efficiency of the international regime via different ways of economizing transactional costs. However, these two distinguishing characteristics of centralization and independence have political and legal implications beyond mere efficiency.

4.1.4.1.1. Independence and Centralization

First, independence enables an IGO/IO [hereinafter IO] to "shape understandings, influence the terms of state interactions, elaborate norms, and mediate or resolve

[1326] David Harvey (2005) supra note 467, p. 97.

[1327] Dinah Shelton (2009) supra note 1308, p. 83.

[1328] Kate O'Neill (2015) International Organizations: Global and regional environmental cooperation. In Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London and New York, p. 97.

member states' disputes."[1329] The acts of an independent IO are also more likely to be accorded special legitimacy, and their legitimacy in turn will affect the legitimacy of the member-States' actions. Second, the international organizations perform a broad range of different functions, which could be of a legislative, judicial or executive nature, in the international regimes.[1330] The effect of centralization of these functions can alter the member-States' perception and the context of their interactions. Independence of the IGO/IO would enhance the opportunity for transfer of authority while centralization will enhance the opportunity for change of behavior among the member-States.

4.1.4.1.2. Capability of the IO

However, what really matters is the effect of the actual practice of the IO in initiating, encouraging, coordinating, and steering the consolidated political will of the member-States towards effective overall implementation of the objectives of the treaty, and the monitoring, reporting, reviewing, assessing and facilitating of each of the member-States in complying with their respective commitments in the treaty,[1331] which is a measure of its effectiveness in problem solving. Because the IO is an essential unit, together with member-States, in the governance of an international regime, it is the capability of the IO rather than its function in the anarchical system of the international regime that can bring about effective and efficient outcomes in the regime system.[1332]

4.1.4.2. Role of the IO in International Environmental Regimes

4.1.4.2.1. Basic Elements of the IO

There are three basic elements in the establishment of an IO.[1333] First is the constitutive element of the treaty, which represents the political will of the member-States to co-

[1329] Kenneth W. Abbott and Duncan Snidal (1998) Why States Act Through International Organizations, Journal of Conflict Resolution, Volume 42, Number 1, February 1998, p. 9.

[1330] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, pp. 57-59.

[1331] Georges Abi-Saab (1981) The concept of international organization: a synthesis. In The Concept of International Organization [Georges Ab-Saab (ed.)], United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris, France, p. 12.

[1332] Kenneth N. Waltz (1979) supra note 437, pp. 100-101.

[1333] The term 'International Institution' is used in International Regime studies, and the definition of 'Institution' comprises both the organization and mechanism for implementing, operating, evaluating, and expanding the regime and regime policy. In essence, it is identical to the structural and mechanistic elements of the Inter-Governmental Organization respectively. Hence, International Institution and Inter-Governmental Organization are used interchangeably in this thesis.

operate in certain fields and serving as the legal constitution of the organization. Second is the structural element, which provides for some permanence and stability in the functioning of the organization. Third is the process element, which is the set of functions, powers and sphere of competence of the organization, reflecting a certain degree of autonomy of action of the IO vis-à-vis its member-States. Hence, from a legal viewpoint, it means that there exists a decision-making process, within the organization, that allows the expression of an autonomous 'will' of the organization, which need not necessarily be identical to the will of each of the member-States.[1334]

4.1.4.2.2. Functions of the IO

The international organizations perform a broad range of different functions, which could be of a legislative, judicial or executive nature, in the international environmental regimes.[1335] These functions can be classified into five main categories:

(1) Provide a forum for cooperation and coordination among the member-States.
(2) Serve as an exchange for receiving and disseminating information, for formal and informal consultation between member-States, and between member-States and the organization.
(3) Contribute to the development of international legal obligations, including 'soft' law.
(4) Ensure implementation of and compliance with these obligations and standards.
(5) Provide an independent forum, or mechanism, for the settlement of disputes among the member-States.

Another minor yet important consideration at least for the developing countries is that the negotiation of a new MEA facilitated by an existing IO instead of a diplomatic conference can considerably lower the organizational costs of the negotiation process. These costs, which include the preparation of documents, translation of discussions into several conference languages, and the administrative and procedural matters associated with the negotiation process, increase dramatically with the number of nation-States involved in the negotiation process.[1336]

The categories of functions for the IO will depend to a large extent on the powers

[1334] Georges Abi-Saab (1981) supra note 1331, pp. 11-12.

[1335] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, pp. 57-59.

[1336] Thomas Gehring (2007) supra note 314, p. 471.

accorded to it by the member-States in its establishment during the negotiation of the MEA as well as how these powers are subsequently interpreted and applied by the member-States. However, from a governance viewpoint, it is not the sphere of competence or the legal powers of the IO that matters the most but the capability of the IO, as discussed in Section 4.1.4.1.2.

4.1.4.2.3. Permanent Decision-Making Institution

The establishment of a permanent decision-making internal institution as an integral part of a modern international environmental regime has been partly the consequence of negative experience with the more static arrangements of some early multilateral environmental agreements, especially in the area of the protection of nature.[1337] The more important reason is that a decision-making arrangement with a temporary existence such as a diplomatic conference or a preparatory committee is neither effective nor efficient for governance in a modern international environmental regime for the following reasons:[1338]

(1) The attempts to regulate the new type of global environmental problems are frequently initiated under conditions of scientific uncertainty. The highly complex substantive rules needed cannot be designed to account for all possible future scenarios in the early stages of the regime even within a narrow regulated area.

(2) The regime is usually initiated with a framework agreement to be followed by more substantive rules to regulate the subject matter in a comprehensive manner. Hence, further decision-making arrangement is indispensable.

(3) The decision-making arrangement must be flexible because global environmental problems develop dynamically, and constitute a highly unstable subject matter for regulation. These problems are created, and have to be solved, by human activities, which are highly dependent on such factors as economic growth, technological development and changing preferences of the principal actors.

[1337] S. Lyster (1985) International Wildlife Law: An Analysis of International Treaties Concerned with the Conservation of Wildlife, Grotius Publications, Cambridge, p. 124.

[1338] Thomas Gehring (2007) supra note 314, pp. 474-475.

(4) In the absence of a permanent internal institution, the regime does not have the necessary arrangement for the collective monitoring, reporting and verifying functions during implementation as well as for dispute resolution.

(5) Since successful environmental governance requires costly investments by the member-States, there are inherent issues of over-stretching the capacities of member-States as well as natural incentives for member-States to free ride, which require the consistent implementation of the substantive rules and regular monitoring by a permanent internal institution.

As a consequence of the need for the above-mentioned permanent decision-making institution in a modern international environmental regime, the law-making process in the development of international environmental law goes beyond the actual treaty itself.

4.1.4.3. Air Pollution

Transboundary air pollution or acid rain is a classic 'upstream-downstream' problem common to many environmental issues except that in this case the 'upstream' polluters are usually in one territorial unit and the 'downstream' victims are in other territorial unit/s. In such a 'upstream-downstream' problem, the 'upstream' State do not face the full environmental costs associated with their activities and hence do not have a strong incentive to address the problem while the 'downstream' States typically have limited leverage to force the 'upstream' State to alter its behavior.[1339]

The solution to such a 'upstream-downstream' problem requires some form of a regional agreement and the creation of a new IO or calling upon an extant IO to coordinate scientific research, to facilitate agreement in reducing emissions, to monitor compliance, and to support financial or other material transfers from downstream States to upstream States as inducements to compliance.[1340]

4.1.3.3.1. Role of UNECE

It was therefore fortuitous for CLRTAP that the United Nations Economic Commission for Europe (UNECE) had already been established to serve as a regional forum in Europe, in which all of the major European countries (East and West) as well as the

[1339] Loren R. Cass (2015) supra note 1225, p. 388.
[1340] Id., pp. 388-389.

USA and Canada were members. Hence, UNECE was a ready-made neutral platform for diplomats from both the Eastern Bloc and Western Bloc countries to launch international negotiations to address acid rain. More importantly, the UNECE was one of few international organizations existing in the 1980s during the Cold War with the capability to handle East-West issues.[1341]

4.1.4.3.2. Step-Wise Approach of Consensus Building and Rule-Making

Negotiations under UNECE produced the 1979 CLRTAP, which laid the foundation for gradual European efforts to address acid rain and other major air pollutants. The UNECE not only provided a neutral forum for international negotiations, it also served as secretariat of the convention, supported scientific research by helping member-States reached agreement on cost-sharing of the EMEP as well as helped raised awareness of the acid rain problem through dissemination of its publications.[1342]

Only when a sound scientific knowledge base had been put in place through the process of consensus building did the CLRTAP shifted its focus to the development and negotiation of more specific but comprehensive provisions via specific agreements called Protocols, which involves rule-making.

4.1.4.4. Ozone Layer

Similarly, the importance of the UNEP to the successful negotiation and adoption of the ozone-layer regime cannot be overestimated.[1343]

4.1.4.4.1. Role of the UNEP

The United Nations Environmental Programme (UNEP) was created in 1972 at the Stockholm Conference as a United Nations programme under the auspices of the United Nations General Assembly (UNGA) and its Economic and Social Council. The purpose

[1341] Lars Nordberg, Keith Bull, Radovan Chrast, Oddmund Graham, Andrzej Jagusiewicz, Peter H. Sand, Arne Tollan and Henning Wuester (2004) Chapter 7: The role of the secretariat: building the protocol tree. In Clearing the Air: 25 Years of the Convention on the Long-range Transboundary Air Pollution [Johan Sliggers and Willem Kakebeeke (eds.)], United Nations Publications, New York, pp. 97-98.

[1342] Id., p. 99.

[1343] David Leonard Downie (2014) International Environmental Regimes and the Success of Global Ozone Policy. In The Global Environment: Institutions, Law and Policy, 4th Ed. [Regina S. Axelrod and Stacy D. VanDeveer (eds.)], CQ Press, Thousand Oaks, California, USA, pp. 83-109.

of this international organization was to "promote international co-operation in the field of the environment and to recommend, as appropriate, policies to this end, [and] to provide general policy guidance for the direction and coordination of environmental programmes within the United Nations system."[1344] The General Assembly also established the UNEP secretariat "to serve as a focal point for environmental action and co-ordination within the United Nations system."[1345]

4.1.4.4.2. Model Approach in Establishing Multilateral Environmental Agreements

Similar to UNECE, the model approach adopted by UNEP to establish a MEA usually begins with seeking scientific consensus among the nation-States on a particular environmental problem. As it develops its core scientific position, UNEP also begins formulating its legal strategy. When its core technical and legal positions have coalesced, UNEP begins consolidating its political support. It identifies key constituencies, whom the UNEP can rely on to provide political support during the latter stage of negotiating an international environmental agreement. The UNEP then develops a strategy to control the activities that give rise to the problem as well as consolidates political support for its control measures.[1346]

4.1.4.4.3. Conference of the Parties (COP) and Meeting of the Parties (MOP)

The evolution of the ozone-layer regime is also greatly facilitated by its innovative internal institutional arrangements. The legal obligation to establish internal institutions within the Vienna Convention was expressed in Article 6.1, which provided for the Conferences of the Parties (COP) to meet at regular intervals in the future.[1347]

In addition to reviewing regularly the implementation of the Convention in terms of scientific, regulatory and administrative considerations as well as establishing subsidiary bodies deemed necessary for its implementation, the COP was also obliged to consider and adopt, as required, protocols and/or amendments to the Convention or

[1344] UNGA (1972) Institutional and financial arrangements for international environmental cooperation, United Nations, A/RES/27/2997, 15 December 1972, Part 1, paragraphs 2a-b. Accessed on 14 June 2018 at: http://www.un-documents.net/a27r2997.htm

[1345] Id., Part II, paragraph 1.

[1346] Carol Annette Petsonk (1990) The Role of the United Nations Environmental Progamme in the Development of International Environmental Law, American University International Law Review, Volume 5, Issue 2, Article 7, pp. 365-366.

[1347] UNEP (1985) supra note 850, Article 6.1.

Protocol for the overall achievement of the purposes of the Convention.[1348]

In the same vein, the Montreal Protocol utilizes the regular Meetings of the Parties (MOP)[1349] to review the implementation of the Protocol and to consider additional action required, including amendments to the Protocol, for the achievement of its objectives in the light of the best available scientific, technical and economic information, which is intimately linked to the first critical success factor that such information is regularly updated.

4.1.4.4.4. Unique Voting Mechanisms of the COP and MOP

While consensus is preferred, yet the Vienna Convention allows for amendment to the Convention by a majority of three quarters of those present and voting,[1350] which is an unusual feature for a framework/protocol international environmental agreement.

Similarly, a two-third majority of those present and voting may amend the Montreal Protocol[1351] although there is the constraint that the two-third majority must include a majority of developing countries as well as a majority of developed countries.[1352]

More importantly, when the decision to amend is approved by the two-third majority, the amendment is binding on all Parties, including those who had objected.[1353] In addition, neither the Convention nor the Protocol allows reservations.[1354] Essentially, the MOP is making international environmental rules that the Parties are not allowed to opt out, and all the amendments are binding to all Parties.

Such a voting mechanism is contrary to the standard approaches of international environmental rulemaking. However, there is still a constraint in that any amendment to the Protocol effectively creates a new legal instrument, which will require formal ratification by the signatories. If member-States do not wish to be bound by such an amendment, they do not formally ratify the amendment. The end result is a collection of different lists of Parties to the Amendments, which does make implementation of the

[1348] Id., Article 6.4.
[1349] UNEP (1987) supra note 896, Article 11.
[1350] UNEP (1985) supra note 850, Article 9.3.
[1351] Id., Article 9.4
[1352] UNEP (1987) supra note 896, Article 2.9(c).
[1353] Id., Article 2.9 (d).
[1354] Refer to Article 18 in both the Vienna Convention and the Montreal Protocol.

Montreal Protocol increasingly difficult.[1355]

4.1.4.4.5. Unique Adjustment Procedure of the MOP

The Montreal Protocol has a unique adjustment procedure in paragraph 9 of Article 2 that enables the MOP to make certain adjustments and reductions of production and consumption of the ODS listed in the Annexes of the Protocol, which is based on an identical voting mechanism for amendments to the protocol.[1356]

The adjustment procedure circumvents the lengthy and uncertain ratification process required by amendments to the protocol. It allows changes to be made on the ODS already covered by the Annexes when new information on environmental damage or technological options for replacement of the ODS suggests that a faster pace of phase-out is necessary or possible. It essentially provides for substantive adjustments to the abatement commitments quicker than would have taken place otherwise.

These adjustments are automatically applicable to all Parties that ratified the Protocol. Since its adoption, the Montreal Protocol has been adjusted six times, namely, the Second, Fourth, Seventh, Ninth, Eleventh and Nineteenth Meetings of the Parties.[1357] In fact, many of the most significant changes in the phase-out schedule for various ozone depleting substances have come through such adjustments rather than amendments.

For example, the original Montreal Protocol called upon the developed countries to cut their use of the major CFCs by 50% of 1986 levels by 1999.[1358] It was brought forward to 1995 at the Second Meeting of the Parties in 1990.[1359] It was further accelerated to a complete phase-out by 1996 at the Fourth Meeting of the Parties in 1992.[1360] Meanwhile, the original Montreal Protocol called for a freeze of the main halons at 1986 levels by 1993 for the developed countries.[1361] This freezing action was brought forward to 1992 and brought to a complete phase-out by 2000 at the Second Meeting of the Parties in 1990.[1362] The complete phase-out was further accelerated to 1994 at the Fourth Meeting

[1355] Alexander Gillespie (2006) supra note 1234, p. 244.

[1356] UNEP (1987) supra note 896, Article 2.9.

[1357] Ozone Secretariat (2012) Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme (UNEP), Nairobi, Kenya, pp. 654-666.

[1358] UNEP (1987) supra note 896, Article 2.4.

[1359] Ozone Secretariat (2012) supra note 1357, pp. 654-655.

[1360] Id., p. 656.

[1361] UNEP (1987) supra note 896, Article 2.2.

[1362] Ozone Secretariat (2012) supra note 1357, pp. 655.

of the Parties in 1992.[1363]

4.1.4.4.6. Autonomy of the Assessment Panels

The Montreal Protocol called for the establishment of appropriate panels of experts to assess the control measures specified in the Protocol on the basis of available scientific, environmental, technical and economic information and to report their conclusions to the MOP.[1364]

In pursuant to Article 6, the MOP initially set up four assessment panels to assess the scientific issues of ozone depletion, environmental effects of ozone depletion, and the status of alternative substances and technologies and their economic implications. Shortly after the Second Meeting of the Parties in 1990, the Panels for Technical Assessment and the Panel for Economic Assessment were merged into one Panel called the Technology and Economic Assessment Panel (TEAP), which together with the Scientific Assessment Panel (SAP) and the Environmental Effects Assessment Panel (EEAP), make up the three assessment panels active today.[1365]

Of greater importance, from a political perspective, is that although the assessment panels analyse and present scientific, technical and economic information relevant to policy, they do not evaluate nor recommend policy, or judge the merit or success of national plans, strategies, or regulations.[1366] Meanwhile, panel members are required to function as experts on a personal basis, regardless of the source of their nomination and to accept no instructions from, nor function as representatives of governments, industries, NGOs or others.[1367] Both terms of reference are to ensure that the assessments panels are free from intergovernmental politics as much as possible.

4.1.4.4.7. Autonomy of the Non-Compliance Implementation Committee

[1363] Id., p. 656.

[1364] UNEP (1987) supra note 896, Article 6.

[1365] Ozone Secretariat (2018b) Institutions: Assessment Panels, Ozone Secretariat, UNEP. Accessed on 25 June 2018 at: http://ozone.unep.org/en/institutions

[1366] UNEP (1996a) Paragraph 1 to Annex V: Terms of the Technology and Economic Assessment Panel (TEAP). In Report of the Eighth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.8/12, 19 December 1996, p. 61.

[1367] UNEP (1996b) Paragraph 3.5 to Annex V: Terms of the Technology and Economic Assessment Panel (TEAP). In Report of the Eighth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.8/12, 19 December 1996, p. 64.

In pursuant to Article 8 of the Montreal Protocol, the MOP initially set up the Implementation Committee on an interim basis of two years. Later, the Parties agreed to establish the Implementation Committee on a permanent basis along side the Non-Compliance Procedure under which the committee operates.[1368]

The Implementation Committee comprises 10 members selected by the MOP on the basis of equitable geographical distribution. In practice, each of the five United Nations regional groups, namely Western Europe and others, Africa, Asia and the Pacific, Latin America and the Caribbean, and Eastern Europe, selects two members to the committee. One of the two members from each region is replaced each year. The outgoing members may be re-elected for one immediate consecutive term. The committee elects its President and Vice-President annually, with the Vice President serving as the Rapporteur of the committee as well.[1369] The functions of the Implementation Committee are mandated as follows:[1370]

(1) To receive, consider and report on any submission by parties related to non-compliance with the Montreal Protocol.

(2) To receive, consider and report on any information or observations forwarded by the Secretariat in connection with the preparation of the reports referred to in Article 12 (c) of the Protocol and on any other information received and forwarded by the Secretariat concerning compliance with the provisions of the Protocol.

(3) To request, where it considers necessary, through the Secretariat, further information on matters under its consideration.

(4) To identify the facts and possible causes relating to individual cases of non-compliance referred to the Committee, as best it can, and make appropriate

[1368] UNEP (1992d) Decision IV/5: Non-Compliance Procedure. In Report of the Fourth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.4/15, 25 November 1992, p. 16.

[1369] Ozone Secretariat (2018c) Institutions: Implementation Committee under the Non-Compliance Procedure of the Montreal Protocol, Ozone Secretariat, UNEP. Accessed on 25 June 2018 at: http://ozone.unep.org/en/institutions

[1370] Ozone Secretariat (2007) Primer for Members, Implementation Committee Under the Non-Compliance Procedure of the Montreal Protocol on Substances that Deplete the Ozone Layer, October 2007, Ozone Secretariat, UNEP, Nairobi, Kenya, pp. 5-6.

recommendations to the Meeting of the Parties.

(5) To undertake, upon the invitation of the Party concerned, information-gathering in the territory of that Party for fulfilling the functions of the Committee.

(6) To maintain, in particular for the purposes of drawing up its recommendations, an exchange of information with the Executive Committee of the Multilateral Fund related to the provision of financial and technical co-operation, including the transfer of technologies to Parties operating under Article 5, paragraph 1, of the Protocol.

In drawing up the recommendations for its report to the MOP, the committee is guided by the desire to secure an amicable solution to any non-compliance matter. Upon receiving the committee report, the Parties may, taking into consideration the circumstances of the non-compliance matter, decide upon and call for steps to bring about full compliance with the Protocol, including measures to assist the Parties' compliance with the Protocol, and to further the Protocol's objective.[1371]

4.1.4.4.8. The Multilateral Fund

The Multilateral Fund is often considered as the most important internal institution of and a key ingredient in the success of the ozone-layer regime.[1372] It provides financial assistance to the developing countries to facilitate their transition from the use of ODS to more friendly substitutes in order to meet their Montreal Protocol commitments. The Fund is replenished with new contributions from the developed country donor parties once every three years at levels negotiated by the MOP. Some 45 countries have contributed a total of over US$3.7 billion till November 2017 and the Fund has disbursed over US$3.6 billion to support projects in industrial conversion, technical assistance, training and capacity building.[1373]

The decision-making body of the Fund is the Executive Committee, which composed of representatives from 14 member-States – 7 developed country donor parties and 7

[1371] Ozone Secretariat (2018c) supra note 1369.

[1372] David Leonard Downie (2014) supra note 1343, pp. 89-89.

[1373] Multilateral Fund (2018) Welcome to the Multilateral Fund for the Implementation of the Montreal Protocol, Secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol, UNEP. Accessed on 19 June 2018 at: http://www.multilateralfund.org/default.aspx

developing country recipient parties.[1374] The Executive Committee approves the projects, and the World Bank, UNEP, United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO) assist with the implementation of these projects.[1375]

It is not so much the technical aspect of the Multilateral Fund that it is of major importance to the ozone-layer regime; rather it is of major importance to the ozone-layer regime because the Multilateral Fund was an innovative yet practical expression of the principle of CBDR that the international community created when it had to address the issues of financing and technology transfer necessary for compliance to be realistically feasible for much of the developing world.[1376] It was a major leap in the development of the principle of CBDR with the establishment of this internal mechanism at the 1990 London Amendment to the Montreal Protocol.[1377]

4.1.4.5. Climate Change

It is ironical that despite the instrumental role of UNEP in the successful negotiation of the Vienna Convention and its Kyoto Protocol, when it came to the negotiation of the global climate change agreement, the UNEP was shunted aside.

4.1.4.5.1. Intergovernmental Negotiating Committee (INC)

The developing countries of the South wanted the more political body of the United Nations to handle the climate change issue rather than the more technically oriented IPCC, UNEP and World Meteorological Organisation (WMO), which were preferred by the North.[1378] In the end, the South succeeded in their demands, and the UN General Assembly decided to establish an Intergovernmental Negotiating Committee (INC) for the purpose of negotiating a framework convention on climate change.[1379]

[1374] UNEP (1987) supra note 896, Article 10.

[1375] David Leonard Downie (2014) supra note 1343, pp. 89-89.

[1376] Bryan A. Green (2009) Lessons from the Montreal Protocol: Guidance for the Next International Climate Change Agreement, Environmental Law, Volume 39, p. 265.

[1377] UNEP (1990) Decision II/8: Financial Mechanism. In Report of the Second Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, UNEP/OzL.Pro.2/3, United Nations Environmental Programme, 27 June 1990, pp. 12-14.

[1378] Daniel Bodansky (1994) Prologue to the Climate Change Convention. In Negotiating Climate Change: The Inside Story of the Rio Convention [Irving M Mintzer and J Amber Leonard (eds.)], Cambridge University Press, Cambridge, p. 60.

[1379] UNGA (1990) supra note 118.

The UN resolution A/RES/45/212 stipulated that the INC had to hold the first of its five meetings in February 1991. A deadline was also given for the completion of negotiation before June 1992 to coincide with the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, also known as the Earth Summit. Consequently, the INC had only a short 18 months to get ready a framework convention for signature at the Earth Summit. The UN General Assembly even stipulated that the INC had to hold five negotiation sessions with a maximum duration of two weeks for each negotiation session. Nevertheless, a consensus framework agreement was agreed in time for signature at the Earth Summit.[1380]

4.1.4.5.2. Conference of the Parties (COP) and Meeting of the Parties (MOP)

The main driver to foster evolution of the global climate change regime, similar to the ozone-layer regime and other MEAs with framework/protocol agreements, is the establishment of the COP and COP/MOP with conferred powers to review and adopt instruments that may contain new commitments. The deliberations of the COP produce a range of outputs, mainly in the form of annexes, amendments, protocols, rules and procedures, with different legal status, which can be used individually or in combination to develop commitments beyond the framework/protocol agreements.

4.1.4.5.3. Voting Mechanism of the COP/MOP

The rules of procedure for the COP of UNFCCC apply *mutatis mutandis* to the COP/MOP of the Kyoto Protocol, unless otherwise decided by consensus of the COP/MOP.[1381] These rules, which broadly mirrored those of the UN General Assembly and in other MEAs, were drafted in the run-up to COP-1. However, these rules were not adopted at COP-1 due to disagreements relating to the decision-making procedures set out in draft Rule 42, including the specified voting majorities required for adoption of particular decisions.[1382]

Unlike for the COP/MOP of the Montreal Protocol, there is no specific rule based on the majority of those present and voting for the COP/MOP of the Kyoto Protocol. Hence, there is a broad understanding in the climate change regime that substantive

[1380] Id., Paragraphs 4-7.

[1381] United Nations (1998) supra note 17, Article 13.5.

[1382] COP-1 (1995) Part 1: Proceedings, Report of the Conference of the Parties on its First Session, held in Berlin from 28 March to 7 April 1995, FCCC/CP/1995/7, 24 May 1995, paragraphs 9 & 10.

decisions, e.g. amendments to the Kyoto Protocol, should be adopted by consensus.[1383]

4.1.4.5.4. Subsidiary Body for Scientific and Technological Advice

Similar to the provisions made in the ozone-layer regime, in which assessment panels of experts were established to assess the control measures on the basis of available scientific, environmental, technical and economic information and to report their conclusions to the MOP of the Montreal Protocol,[1384] the provisions of the global climate change regime has also established the permanent Subsidiary Body for Scientific and Technological Advice (SBSTA) to provide timely information and advice on scientific and technological matters as they relate to the UNFCCC, Kyoto Protocol and the Paris Agreement.[1385]

However, unlike the assessment panels of the ozone-layer regime, which can work directly or indirectly through international bodies in the conduct of such assessments on ozone layer depleting substances,[1386] the SBSTA relies primarily on the IPCC for similar assessments on climate change.[1387] Hence, while the scientific assessment reports of the ozone-layer regime are published under the international auspices of the WMO and UNEP, the scientific assessment reports of the global climate change regime are published directly by the IPCC.

The SBSTA also studies the impacts of, and the vulnerability and adaptation, to climate change, promotes the development and transfer of environmentally-sound technologies, conducts technical work to improve the guidelines for preparing and reviewing GHG emission inventories, provides guidelines on methodologies, and facilitates collaboration in the field of research and systematic observation of the climate system.[1388]

4.1.4.5.5. Subsidiary Body for Implementation

[1383] Robbie Sabel (1997) Procedure at International Conferences: A Study of the Rules of Procedure of International Inter-governmental Conferences, Cambridge University Press, Cambridge, p. 420.

[1384] UNEP (1987) supra note 896, Article 6.

[1385] United Nations (1992a) supra note 16, Article 9.

[1386] UNEP (1985) supra note 850, Article 3.

[1387] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 464-465.

[1388] United Nations (2018) Subsidiary Body for Scientific and Technological Advice (SBSTA), United Nations Framework Convention for Climate Change, United Nations, New York. Accessed on 25 June 2018 at: https://unfccc.int/process/bodies/subsidiary-bodies/sbsta

Similar to the Implementation Committee of the ozone-layer regime, the global climate change regime has the Subsidiary Body for Implementation (SBI). It is the other permanent subsidiary body besides the SBSTA.[1389]

4.1.4.5.6. The Unique Flexible Market-Based Mechanisms of the Kyoto Protocol

The most innovative and controversial provisions in the Kyoto Protocol were the flexible market-based mechanisms to enable Annex I countries to meet their commitments under the Protocol by purchasing or acquiring credits representing GHG emissions reduction that had or are taking place in other countries.[1390] These flexible mechanisms were not found in the provisions of the Montreal Protocol.

The rationale advanced by the proponents of the flexible mechanisms of international transfer was that as the geographical location of climate change abatement is largely irrelevant, it is perfectly acceptable from a cost-effectiveness perspective to carry out the mitigation project where it is the cheapest option regardless of location.[1391] If the location happened to be in a developing country there is also the additional benefit of fund transfer and possibly technology transfer as well.

(1) Emissions trading permit an Annex B country to 'buy' emissions reduction credits in the form of assigned amount units (AAU) from another Annex B country where it is more cost-effective to do so rather than to undertake the emissions reduction domestically.[1392]

(2) Joint Implementation provides any Annex I country to transfer to, or acquire from, any other Annex I country emission reduction units (ERU) resulting from cross-border projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks of GHG in any sector of the economy for the purpose of meeting its commitments under Article 3.[1393]

(3) The Clean Development Mechanism (CDM) provides an Annex I country to

[1389] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 423-430.

[1390] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, p. 310.

[1391] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 136.

[1392] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, p. 310.

[1393] United Nations (1998) supra note 17, Article 6, pp. 6-7.

acquire certified emission reductions (CER) by investing in emission reduction projects, similar to JI projects, in the *non-Annex I countries* for the purpose of achieving compliance with its commitments under Article 3.[1394]

4.1.4.5.7. Compliance Committee

The "procedures and mechanisms relating to compliance under the Kyoto Protocol" annexed to Decision 24/CP.7 [1395] are the strongest and most sophisticated non-compliance procedures adopted by MEA to date, including the Montreal Protocol.[1396]

The tasks of ensuring the Kyoto Protocol commitments are complied with can be categorized into three types, namely:

(1) Assessment of compliance with specific obligations
(2) Enforcement of those obligations
(3) Reviews of adequacy and revision of commitments

It is very stringent on assessment of compliance, weak on enforcement, and somewhat ambiguous on review of adequacy and revision of commitments.[1397]

4.1.4.5.8. General Environment Facility

The General Environment Facility (GEF) was a joint pilot project set up by the World Bank, UNDP and UNEP in 1991. Developing countries have objected to the GEF because of its governance structure, which is dominated by donor countries, and the lack of transparency. They preferred the setting up of new funds under the Kyoto Protocol similar to the Multilateral Fund of the Montreal Protocol.[1398]

The GEF was, therefore, initially designated as the entity to operate the financial mechanism on an interim basis, but it's interim status ended with the decision of the COP-4.[1399] Since then, relations between the COP/MOP and the GEF have been more

[1394] Id., Article 12, pp. 11-12.

[1395] UNFCCC (2002) Decision 24/CP.7: Procedures and mechanisms relating to compliance under the Kyoto Protocol, Report of the Conference of the Parties on its Seventh Session, held at Marrakesh from 29 October to 10 November 2001, FCCC/CP/2001/13/Add.3, 21 January 2002, p. 64.

[1396] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 386.

[1397] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 142.

[1398] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 386.

[1399] Id., pp. 265-266.

constructive and less confrontational. In fact, at the second review of the financial mechanism of the Kyoto Protocol, the GEF had been evaluated as performing effectively its role as an entity operating the financial mechanism.[1400]

4.1.4.6. Lessons Learned from the Fourth Critical Success Factor

The key lesson learned from the fourth critical success factor is that in the case of climate change governance, the nation-States, except for the small island developing nation-States, were not ready throughout the course of its evolution to cede national sovereignty and transfer authority to an international organization.

4.1.4.6.1. Relegating Climate Science to a Purely Advisory Role

In 1987, Gro Harlem Brundtland in the Report of the World Commission on Environment and Development (WCED) decried in her Chairman's Foreword that when, "… scientists bring to our attention urgent but complex problems bearing on our very survival: a warming globe … we respond by demanding more details, and by assigning the problems to institutions ill-equipped to cope with them …" and "… of the widespread feeling of frustration and inadequacy in the international community about our own ability to address the vital global issues and deal effectively with them …" and that "there is no alternative but to keep on trying to find them."[1401] Thirty years later, the situation remains the same. For instance, the IPCC Special Report on Global Warming of 1.5°C, which had been formally requested at the 2015 Paris Climate Change Conference, became a major source of tension at the 2018 Katowice Climate Change Conference. The US, Saudi Arabia, Russia and Kuwait refused to "welcome" the report. They only wanted to "note" it. Hence, as a compromise, the final COP decision text did not "welcome" the report; the final decision text "welcome[d]" instead its "timely completion" and "invited" countries to make use of the report in subsequent discussions at the UNFCCC.[1402]

When the policymakers started appreciating the seriousness of climate change following the 1987 Villach Conference[1403] and the 1988 Toronto Conference,[1404] few governments were ready to accept the conclusions reached by the epistemic community of climate

[1400] Id., p. 266.
[1401] WCED (1987) supra note 831.
[1402] Carbon Brief (2018) supra note 1195.
[1403] Spencer R. Weart (2012) supra note 914 p. 50.
[1404] WMO (1989) supra note 980.

scientists as the final word on climate change, least of all the United States government. The US government would not accept an international scientific assessment consensus that did not involve its own US government scientists, who could speak for the interests of the US government administration when establishing such an assessment.[1405] For instance, the policy board of the US National Climate Program (NCP) recommended that a new intergovernmental body, this time led by official national government representatives rather than by independent scientists, to oversee another comprehensive international assessment of climate change.[1406] Responding to this request, WMO and UNEP soon parlayed this NCP proposal into a permanent mechanism for building consensus on climate change and jointly created the Intergovernmental Panel on Climate Change (IPCC) in 1988, which was tasked to take stock on a regular basis of the science of climate change for government purposes and examine options for responding to human-induced climate change.[1407] The creation of IPCC did provide the institutional base for a more focused, better-coordinated examination of needed science-policy interactions at the international level and through their participation in the IPCC, many skeptical governments had tacitly agreed that the climate change problem merited some sort of international solution.[1408] However, its prime significance is that the epistemic community of climate scientists, including the international organizations of WMO and UNEP, is now relegated to a purely advisory role on climate change.

4.1.4.6.2. Non-Ceding National Sovereignty

There was a general feeling among the invited delegates present at the 1989 Ministerial Conference on Atmospheric Pollution and Climate Change in Noordwijk, the Netherlands, that they would come to an agreement to freeze GHG emissions at 1990 levels by 2000. In fact, most ministerial delegates present were ready to sign on the Dutch proposal. However, at the final negotiating session with just the environment ministers present, the US ministerial delegate, with the acquiescence of the ministerial delegates of Britain, Japan and the Soviet Union, forced the ministerial conference to abandon the commitment to freeze emissions. The US approach was exemplified by the comments of Dr. John Sununu, who was then White House Chief of Staff under US President George H. W. Bush:

"It couldn't have happened," he said, "because, frankly, the leaders in the world at that

[1405] Joshua P. Howe (2014) supra note 962, p. 158.
[1406] Alan D. Hecht and Dennis Tirpak (1995) supra note 968, p. 381.
[1407] Joshua P. Howe (2014) supra note 962, p. 158.
[1408] Id., p. 159.

time were at a stage where they were all looking how to seem like they were supporting the policy without having to make hard commitments that would cost their nations serious resources." He added, "Frankly, that's about where we are today."[1409]

Neoliberal ideology was at its ascendancy in the US under the Reagan administration in the late 1980s. President Reagan not only advocated free competitive market mechanisms to solve global commons problems, he also took a tough stand on not ceding national sovereignty and national interests. For instance, President Reagan made it clear that the US acceptance of the LoS Convention was premised on the satisfaction of six key objectives in the Convention's deep seabed provisions. Three out of the six key objectives touched on the issue of national sovereignty or national interests:

(1) Would not deter development of any deep seabed mineral resources to meet national and world demand
(2) Would assure national access to these resources by current and future qualified entities to enhance U.S. security of supply, to avoid monopolization of the resources by the operating arm of the International Seabed Authority, and to promote the economic development of the resources
(3) Would not allow for amendments to come into force without approval of the participating states, including in our case the advice and consent of the Senate

As a result of its tough stand on not ceding national sovereignty and national interests, the US in the end did not ratify UNCLOS III.[1410]

Meanwhile, the communist system of the former Soviet Union had just been dismantled in the early 1990s, and the neoliberal ideology was spreading from its American epicenter to the rest of the world. President Bush succeeded President Reagan and he essentially continued with the neoliberal ideology espoused by Reagan. In his acceptance speech at the Republican National Convention in August 1988, George Bush stressed the successes of the Reagan years and his ability to continue to build on them.[1411] Just before the 1992 Earth Summit in Rio de Janeiro, environmental activists had criticised the industrialized nations, especially the United States, for their high

[1409] Nathaniel Rich (2018) supra note 764.

[1410] UNTC (2019) Law of the Sea, Chapter XXI, Status as at: 09 September 2019, United Nations Treaty Collection. Accessed on 09 September 2019 at: https://treaties.un.org/Pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en

[1411] Stephen Knott (2019) supra note 1019.

consumption of the world's finite resources, including food, water and energy. Hitting back at critics, US President George H.W. Bush famously declared: "The American way of life is not up for negotiations. Period."[1412]

Just before the adoption of the Kyoto Protocol, the US Senate, in its 105th Congress session in July 1997, had unanimously voted by 95-0 for the bipartisan (Senators Byrd and Hagel) Senate Resolution 98 that "declares that the United States should not be a signatory to any protocol to, or other agreement regarding, the United Nations Framework Convention on Climate Change of 1992, at negotiations in Kyoto in December 1997 or thereafter which would: (1) mandate new commitments to limit or reduce greenhouse gas emissions for the Annex 1 Parties, unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period; or (2) result in serious harm to the U.S. economy."[1413] Later, President W. Bush announced that the US did not intend to ratify the Kyoto Protocol.[1414]

In the latest salvo, President Donald Trump decided to withdraw from the 2105 Paris Agreement on 1 June 2017 in order to fulfill his presidential campaign pledge to help American business and workers.[1415]

4.1.4.6.3. Non Transfer of Authority to an International Organization

One of the six key objectives that President Reagan insisted as mandatory requirements for the acceptance of the LoS Convention was that it would not set undesirable precedents for international organizations. Similarly, in the case of the climate change regime, the unanimous Senate Resolution 98, the non-ratification of the Kyoto Protocol by President W. Bush, and the expected withdrawal from the 2015 Paris Agreement are all actions by the US government so as not to set undesirable precedents for international organizations.

[1412] Thalif Deen (2015) U.S. Lifestyle is Not Up for Negotiation, Inter Press Service: News Agency, 1 May 2012. Accessed on 8 September 2019 at: http://www.ipsnews.net/2012/05/us-lifestyle-is-not-up-for-negotiation/

[1413] US Senate (1997) supra note 1091.

[1414] US President Bush (2001) supra note 1093.

[1415] Timothy Cama and Devin Henry (2017) supra note 1190.

4.2. LONGITUDINAL ANALYSIS OF LEGAL INSTRUMENTS

The longitudinal analysis of the core legal instruments of the international climate change regime, namely the United Nations Framework Convention for Climate Change (UNFCCC),[1416] Kyoto Protocol,[1417] and Paris Agreement,[1418] would provide the international law research student not only with insight as to how effective was the regime from the perspective of international law but also how the internal architecture of the three MEAs have evolved in response to changes in the SEP system.

In terms of effectiveness, the questions to ask from a product or rule approach would be based on the seven essential legal aspects of an MEA, namely:[1419]

(1) Is the Agreement a treaty under international law?
(2) Are the provisions in the Agreement mandatory or prescriptive?
(3) Are the provisions specific and precise to constrain the Parties?
(4) Are there rules, procedures and institutions to hold Parties accountable?
(5) Are there enforceable sanctions?
(6) Is there domestic acceptance of the Agreement and what is its legal status?
(7) Are the provisions justiciable in national courts?

The questions to ask from a process approach would be did the MEAs influence State behavior.[1420] From the process viewpoint, the effectiveness of a specific MEA is determined not based on its internal architecture but rather the implementation and compliance with the rules and obligations of the specific treaty by the parties.[1421]

4.2.1. Legal Character of UNFCCC

The UNFCCC is a multilaterally agreed, international legally binding framework treaty

[1416] United Nations (1992a) supra note 16.
[1417] United Nations (1998) supra note 17.
[1418] United Nations (2015a) supra note 18.
[1419] Daniel Bodansky (2016) The Legal Character of the Paris Agreement, RECIEL, Volume 25, Issue 2.
[1420] W. Bradnee Chambers (2004) supra note 1285, p. 504.
[1421] Harold K. Jacobson and Edith Brown Weiss (1998) A Framework for Analysis. In: Engaging Countries: Strengthening Compliance with International Environmental Accords [Edith Brown Weiss and Harold K. Jacobson (eds.)], MIT Press, Cambridge, MA, USA, p. 1.

under the Vienna Convention on the Law of Treaties.[1422] As a framework agreement, it does not contain a clear commitment to reduce GHG emissions over a specified time period. It does contain the following key provisions for addressing climate change:

4.2.1.1. Objectives

It has an 'ultimate objective' to stabilize atmospheric concentrations of greenhouse gases at a 'safe' level in order to prevent dangerous anthropogenic interference with the climate system within a time frame that allows ecosystems to adapt naturally, that does not threaten food supplies and still enables sustainable development.[1423] It is non-prescriptive, non-specific and non-precise. However, the significance of the "time frame that allows ecosystems to adapt naturally" in the objective, however, does imply that the Earth's ecological limits must be respected and thereby set a constraint on both the timing and scale of human actions to stay at a 'safe' level.[1424] Hence, future negotiations would have to spell out what is the 'safe' level of GHG emissions in terms of concentration and within what time frame.[1425]

4.2.1.2. General Principles

UNFCCC incorporates several general principles of international environmental law in both the Preamble and Article 3.[1426] The principles in Article 3 have more legal force. However, these principles have not provided the needed guidance to the international community for concerted collective action.

4.2.1.2.1. Substantial Gap in the Understanding of the Key Principles

First, there is a big gap in the understanding of their substantive meaning and legal implications between developed and developing countries of the North-South economic divide. The United States and other developed countries generally viewed such an open-ended set of principles in Article 3, which is part of the body of the convention text, with caution. They questioned their legal necessity, and argued that their inclusion would require spelling out their practical implications in the form of commitments. Otherwise, these principles should have been relegated to the Preamble, where they

[1422] United Nations (1969) supra note 300.
[1423] United Nations (1992a) supra note 16, Article 2, p. 9.
[1424] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 60-61.
[1425] Richard H. Moss (1995) supra note 1259, pp. 3-6.
[1426] United Nations (1992a) supra note 16, Preamble and Article 3, pp. 2-10.

would serve as references to the rationale for collective action. The developing countries, including China, on the other hand, preferred the inclusion of these principles in the body of the convention text in the belief that having these principles in there would be more effective as compared to mere references in the Preamble in providing guidance to the Parties when implementing the Convention. However, the practical implications of these principles had not been spelled out in the commitments.[1427]

Second, the Parties to the Convention acknowledge that "change in the Earth's climate and its adverse effects are a common concern of humankind", which was relegated to the Preamble.[1428] However, the 'common concern of mankind' formulation is seen as a much weaker principle than the 'common heritage' concept found in the Preamble of the 1982 UN Convention on the Law of the Sea.[1429]

4.2.1.2.2. Key Principles in Article 3

First, the Convention calls on Parties to "protect the climate system for the benefit of present and future generations of humankind on the basis of equity",[1430] emphasizing not only intra-generational equity but also inter-generational equity as well.[1431]

Second, it prescribes "common but differentiated responsibilities[1432] and respective capabilities" by calling upon the developed countries to take the lead in combating climate change and giving special consideration to the specific needs and special circumstances of developing countries, especially those that are particularly vulnerable to the adverse effects of climate change.[1433]

Third, the Parties, in mitigating the adverse effects of climate change, should apply the precautionary principle[1434] where there are threats of serious or irreversible damage by

[1427] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 66.

[1428] United Nations (1992a) supra note 16, Preamble, p. 2.

[1429] United Nations (1982) supra note 785, Preamble, p. 25.

[1430] United Nations (1992a) supra note 16, Article 3.1, p. 9.

[1431] Edith Brown Weiss (1989) In Fairness to Future Generations: International Law, Common Property and Intergenerational Equity, Transnational Publishers, New York.

[1432] United Nations (1992a) supra note 16, Article 3.1, p. 9. The principle of 'common but differentiated responsibilities' was reflected in the UNEP (1987) Montreal Protocol on Substances that Deplete the Ozone Layer, Article 5, which gives developing countries a ten-year grace period to comply with its control measures.

[1433] Id., Article 3.2, p. 9.

[1434] One of the primary foundations of the precautionary principle is in Principle 15 of the 1992 Rio Declaration on Environment and Development.

not allowing the lack of full scientific certainty to be used as a reason for postponing the necessary measures.[1435] The precautionary principle has been confirmed as a binding principle of customary international law.[1436]

Fourth, the policies and measures to combat climate change should be "cost-effective, ensuring global benefits at the lowest possible cost", and comprehensive, taking into account different socio-economic contexts, covering all relevant sources, sinks and reservoirs of greenhouse gases, and comprising all economic sectors".[1437]

Last but not least, the Convention acknowledges the right of the Parties to promote sustainable development and calls upon Parties to cooperate in promoting a supportive and open international economic system, so that measures taken, unilateral or otherwise, "should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade".[1438]

4.2.1.3. Commitments

While the use of consensus was one of the two critical factors moving the convention process to completion, it also meant that the language used in the Convention for its objective and commitments was ambiguous and its legal status uncertain.[1439]

For example, although the Convention calls upon the developed countries, essentially OECD countries and economies in transition (EIT), listed in Annex 1, to take measures to limit its anthropogenic emissions of GHG with the general aim of returning to 1990 emission levels by the year 2000 such that the developed countries are seen to be taking the lead in modifying the current trends in anthropogenic emissions.[1440] Yet at the same time, all the countries, who are Parties to the Convention, have the general commitments to develop national GHG inventories, formulate national mitigation and adaptation programs, carry out sustainable management, cooperate in conserving and enhancing sinks and reservoirs of GHG, promote and cooperate in scientific research,

[1435] United Nations (1992a) supra note 16, Article 3.3, p. 9.

[1436] ICJ (1996) supra note 407.

[1437] United Nations (1992a) supra note 16, Article 3.3, p. 9.

[1438] Id., Articles 3.4 & 3.5, p. 10.

[1439] Daniel Bodansky (1997) The History and Legal Structure of the Global Climate Change Regime. In International Relations and Global Climate Change [Detlef Sprinz and Urs Luterbacher (eds)], PIK Report No. 21, Potsdam Institute for Climate Impact Research, Potsdam, Germany, p. 26.

[1440] United Nations (1992a) supra note 16, Article 4.2, pp. 11-13.

education, training and in creating public awareness.[1441]

4.2.1.4. Finance Mechanism

The Convention does provide for the transfer of financial resources from the rich industrialized countries to the less industrialized countries. Its inclusion in the Convention reflects the emergence of a strong North/South polarization in global environmental politics in the late 1980s.[1442] More importantly, from a legal perspective, is that it was left to the COP to agree upon the arrangements for the operation of the financial mechanism.

Essentially the OECD countries, a sub-group of the developed countries, as listed in Annex 2 to the Convention, is to provide funding to developing countries to pay for the agreed full costs incurred by these countries in complying with their obligations to communicate their national GHG inventories and climate change reports [Article 12 (1)], to meet the agreed full incremental costs of implementing mitigating measures [Article 4 (1)], to assist in meeting the adaptation costs of the particularly vulnerable developing countries to the adverse effects of climate change, and to promote and facilitate the transfer of environmentally sound technologies and know-how to enable the developing countries to implement the provisions of the Convention.[1443]

The Convention also defines that the mechanism for the transfer of financial resources, inclusive of the transfer of technology,[1444] has been entrusted to the restructured Global Environment Facility (GEF), established by the World Bank, United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) on an interim basis.[1445]

4.2.1.5. Institutions

In addition to the usual Conference of the Parties (COP) and a Secretariat, the Convention also establishes a standing Subsidiary Body for Scientific Body for Scientific and Technological Advice (SBSTA) and a Subsidiary Body for

[1441] Id., Articles 4.1, 5 & 6, pp. 10-17.

[1442] Daniel Bodansky (1997) supra note 1439, p. 27.

[1443] United Nations (1992a) supra note 16, Articles 4.3 - 4.5, pp. 13-14.

[1444] Id., Article 11, pp. 22-23.

[1445] GEF (2016) 25 Years of the GEF, Global Environment Facility (GEF), World Bank, United Nations Development Programme (UNDP) and United Nations Environment Progamme (UNEP).

Implementation (SBI). These two standing subsidiary bodies perform technical analysis, provide scientific and technological advice to COP, and assist COP with the implementation of the provisions of the Convention.[1446]

4.2.1.5.1. Conference of Parties (COP)

Meanwhile, the chapeau of Article 7.2 established the COP as "the supreme body of this Convention" with the mandate to "keep under regular review the implementation of the Convention and any related legal instruments that the Conference of the Parties may adopt, and shall make, within its mandate, the decisions necessary to promote the effective implementation of the Convention."[1447]

The COP itself, however, has been silent as to whether the COP exists in the international legal space as an international organization with the necessary legislative powers to develop climate policy or have the adjudicatory function to enforce the COP rules. Nor has the COP confirmed or rejected the opposing view that the COP is essentially a forum for a rolling series of intergovernmental meetings. Both these views find some support in the three opinions expressed by the United Nations Office of Legal Affairs (UNOLA) in response to legal advice on the nature of UNFCCC institutions.[1448]

4.2.1.5.2. Rules of Procedure

Both Articles 7.2(k) and 7.3 of the Convention mandated that COP agree upon and adopt by consensus the rules of procedure for itself and for any subsidiary bodies.[1449]

The rules of procedure were drafted and presented to COP-1 in Berlin. These draft rules, however, could not be adopted due to disputes pertaining to the decision-making procedures set out in draft Rule 42, including the specified voting majorities required for adoption of particular decisions. In the absence of any consensus, these draft Rules of Procedure were applied rather than adopted, with the exception of the disputed draft Rule 42, for all subsequent sessions despite the efforts of successive COP Presidents to resolve these disputes. Instead, there is a broad understanding that all substantive decisions of the COP should be adopted by consensus.[1450]

[1446] United Nations (1992a) supra note 16, Articles 7-10, pp. 17-22.
[1447] Id., Article 7.2, p. 9.
[1448] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 401-403.
[1449] United Nations (1992a) supra note 16, Articles 7.2(k) & 7.3, p. 10.
[1450] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 432-434.

4.2.1.5.3. Independence of COP

The reluctance of the COP to specify clearly its legal nature and its failure to adopt the rules of procedure to allow majority decision-making are clearly indicative of the reluctance of the member-States to surrender their sovereignty to the COP other than on an ad hoc and in an incremental manner. The implication then is that COP of the UNFCCC presently enjoys a fairly limited degree of independence from the will of its Parties and that its status as an international organization are not necessary identical to those of other formal international organizations.[1451]

4.2.1.6. Self-Reporting and International Review

The integrated procedure of regular national reporting by the Parties according to specified guidelines and the systematic international review of these reports is the legal backbone of the UNFCCC. Each concerned Party must submit an annual inventory of national GHG emissions as well as periodic national communication on its climate change policies and projections of how these policies will affect GHG emissions.[1452] Both the annual inventory and the periodic communication are checked, synthesized and assessed by the Secretariat to determine its overall progress in the implementation of the Convention before being presented to the COP via the SBI.[1453]

In addition, the national communication is subjected to in-depth review by teams of experts, nominated by the Parties and selected by the Secretariat. The review procedure, which is conducted according to procedures adopted at COP-1, is intended to be "facilitative, non-confrontational, open and transparent manner" in order to ensure a thorough and comprehensive technical assessment of the implementation of the Convention. It does not, however, provide policy recommendations.[1454]

However, since the report and review procedure relies primarily on self-reporting rather than on international monitoring and inspection, it falls short of the strict verification

[1451] R. Churchill and G. Ulfstein (2000) Autonomous Institutional Arrangements in Multilateral Environmental Agreements: A Little-noticed Phenomenon in International Law, American Journal of International Law, Volume 94, Number 4, pp. 623-659.

[1452] United Nations (1992a) supra note 16, Article 12.2, p. 13.

[1453] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 331.

[1454] UNFCCC (1995j) Review of first communications from the Parties included in Annex I to the Convention, Decision 2/CP.1, FCCC/CP/1995/7/Add.1, English, pp. 7-12.

procedure, e.g. in nuclear weapons treaties, which may be needed to deter free riders should the UNFCCC eventually adopt strict commitments and liabilities.

Like the more recent MEAs, e.g. Montreal Protocol[1455], the UNFCCC provides for the periodic reviews of the adequacy of its commitments in light of new scientific information and assessment on climate change and its impacts.[1456] In fact, the COP undertook such a review at its first session (COP-1) and concluded that the specific commitments for the Annex I Parties were inadequate. It then created an *ad hoc* negotiating group to develop a legal instrument by 1997 containing additional commitments for the industrialized countries.[1457]

However, unlike the Montreal Protocol, which authorizes its Parties to "adjust" control measures through qualified majority voting, the UNFCCC does not delegate any legislative authority to the COP. Consequently, the amendments and protocols to the UNFCCC will apply only to those parties that accept them.[1458]

4.2.1.7. Dispute Resolution

The traditional mechanism of dispute settlement in which one state takes legal proceedings against another, which is adversarial, is still an avenue in which states can be held accountable but it has never been used in a MEA to enforce compliance.[1459]

4.2.1.7.1. Non Use of Traditional Dispute Settlement

The two main reasons for the non use of the traditional dispute settlement mechanism are because there is great difficulty in attributing clear cause-effect, as required by traditional dispute settlement and the breached obligation in a MEA, e.g. global climate change, is not owed to a single state but to the international community as a whole.

Especially in the case of global climate change, there is insurmountable difficulty in disentangling the complex cause-effect linkages. First, there is significant uncertainty in differentiating anthropogenic-induced climate changes from natural variability. Second, there is difficulty to decide who is responsible as all countries emit GHG emissions.

[1455] UNEP (1987) supra note 896.
[1456] United Nations (1992a) supra note 16, Article 4.2(d), p. 6.
[1457] UNFCCC (1995b) supra note 1060, pp. 4-6.
[1458] Daniel Bodansky (1997) supra note 1439, p. 29.
[1459] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 378.

Third, the underlying mechanism of cause and effect attribution is complicated by both positive and negative feedback loops present within the global climate system itself.

There is also the great difficulty in assessing the nature of the damages as well as the appropriate compensations that might be awarded. Even if a case is 'won', the legal remedies often do not help to remedy the environmental damages inflicted. For example, it may result in an order of cessation of activities, which may or may not be obeyed by the 'offending' State. Compensatory payments may not make good the damage that has already occurred because the damage turned out to be irreversible or is likely to impact significantly on the well-being of future generations.[1460]

4.2.1.7.1. Prevention of Non-Compliance

It is for these reasons that recent MEAs, including the Montreal Protocol, have developed multilateral non-compliance procedures, involving the collective review by the parties, to replace the traditional bilateral dispute settlement.[1461]

The essence of these current approaches to non-compliance in MEAs is to prevent non-compliance. Hence, procedures established by the MEA supreme body to address compliance are both pro-active and non-confrontational. These procedures are usually overseen by specialized institutions, created within the MEA, which comprise of state representatives from across the political spectrum. The emphasis has therefore shifted from legal proceedings initiated by individual states seeking recourse in dispute settlement procedures to multilateral oversight of compliance by international institutions, which seek to facilitate compliance by providing incentives, such as the transfer of technology and the provision of financial assistance.[1462]

The UNFCCC in Article 13 calls on the COP to "consider the establishment of a multilateral consultative process, available to Parties on their request, for the resolution of questions regarding the implementation of the Convention."[1463] COP-1 created "an ad hoc open-ended working group of technical and legal experts to study all issues relating to the establishment of a multilateral consultative process and its design."[1464]

[1460] Id., pp. 379-380.

[1461] Daniel Bodansky (1997) supra note 1439, p. 30.

[1462] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 378-379.

[1463] United Nations (1992a) supra note 16, Article 13, p. 14.

[1464] UNFCCC (1995k) Establishment of a multilateral consultative process for the resolution of questions regarding the implementation of the Convention, Decision 20/CP.1, FCCC/CP/1995/7/Add.1,

But, unlike the Montreal Protocol, the UNFCCC does not mandate the establishment of such a procedure. In contrast to the Montreal Protocol procedure, which explicitly focuses on "non-compliance," the UNFCCC uses the more neutral language of "resolving questions regarding implementation".[1465]

4.2.1.8. Non-Compliance and Sanctions

Without a "non-compliance" procedure established, it is not surprising that UNFCCC does not provide specific sanctions for non-compliance. Although it does not exclude the possibility of trade sanctions like those mandated by the Montreal Protocol, the UNFCCC, in adopting as one of its principles the promotion of "a supportive and open international economic system that would lead to sustainable economic growth and development in all Parties", basically laid down an out-of-bounds marker for the future in stating that "measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade."[1466]

There is no specific agreement dealing with the environment within the World Trade Organization (WTO). While the goals of allowing the optimal use of the world's resources in accordance with the objective of sustainable development and seeking to protect and preserve the environment are fundamental to the WTO and enshrined in the Preamble of the Marrakesh Agreement, such goals must, however, be mutually supportive of the central objective of the WTO to reduce trade barriers and eliminate discriminatory treatment in international trade relations. Under WTO rules, members can adopt trade-related measures aimed at protecting the environment but there are a number of specific conditions to be fulfilled in order to avoid the misuse of these measures for protectionist ends.[1467] Hence, the use of trade sanctions to enforce compliance in UNFCCC would not be looked upon favorably by WTO and is highly likely to be contested rigorously by WTO members.

4.2.1.9. Liabilities

The UNFCCC is officially neutral between possible response strategies in addressing

English, p. 59.

[1465] Daniel Bodansky (1997) supra note 1439, p. 30.

[1466] United Nations (1992a) supra note 16, Article 3.5, p. 4.

[1467] WTO (2018) Trade and Environment, World Trade Organization. Accessed on 7 March 2018 at: https://www.wto.org/english/tratop_e/envir_e/envir_e.htm

climate change and the focus throughout the INC negotiation process was on mitigation rather than adaptation. Despite the strong urging of the small island states, represented by AOSIS, the INC declined to establish an insurance or liability scheme for damage resulting from climate change.[1468]

The nation-States have been able to agree on a regulatory regime aiming at prevention of damage accompanied by a liability and compensation scheme only in the case of discrete, acute pollution incidents, such as oil spills or nuclear accidents,[1469] which can be managed by the traditional dispute settlement mechanism. The nation-States have been unwilling to do the same for more distant and open-ended damages resulting from long-term issues, such as stratospheric ozone depletion and global climate change, where the potential liability exposure is extremely high and the task of establishing cause and effect is an insurmountable obstacle.[1470]

4.2.2. Legal Character of Kyoto Protocol

From a legal perspective, the Kyoto Protocol is the most legally binding of the three MEAs for international climate change governance.[1471] It was adopted to strengthen the UNFCCC, not to replace it.[1472] Hence, the Kyoto Protocol shares the Convention's underlying structure and ultimate objectives. Although the Parties to the Kyoto Protocol form a separate legally autonomous body to the COP of the Convention, they must, however, observe all the rules and principles of the Convention. The distinguishing features of the Kyoto Protocol are essentially the following:[1473]

(1) Emissions reduction commitments of the Annex I Parties
(2) EU redistribution of emissions reduction commitments
(3) Policies and measures
(4) Flexible mechanisms of international transfer

[1468] Daniel Bodansky (1997) supra note 1439, p. 30.

[1469] Michael Faure and Marjan Peeters (2011) Part I: Introduction. In: Climate Change Liability, [Michael Faure and Marjan Peeters (eds)], Edward Elgar Publishing Ltd, Cheltenham, p. 7.

[1470] Daniel Bodansky (1997) supra note 1439, p. 30.

[1471] Jacob Werksman (2016) International Legal Character of the Paris Agreement, Notes for the Third Environmental Law Brodies Lecture, 9 February 2016, University of Edinburgh in association with Brodies LLP, Edinburgh, UK, p. 7. Accesssed on 12 September 2019 at: https://www.law.ed.ac.uk/sites/default/files/2019-06/BrodiesLectureontheLegalCharacteroftheParisAgreementFinalBICCLEdinburgh.pdf

[1472] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 423.

[1473] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, pp. 115-152.

While the emission reduction commitments of the Annex I Parties and the rules for the EU redistribution of emissions reduction commitments are mandatory and prescriptive. The policies and measures and the use of the flexible mechanisms of international transfer are, however, neither mandatory nor prescriptive to allow for flexibility.

The other significant part of the Kyoto Protocol are the institutions, which are more or less translated from the Convention, and modified, where necessary, to ensure legal distinctiveness. The other institutional arrangements include those responsible for addressing self-reporting and international review, dispute resolution, compliance and enforcement. Unlike the Convention, there are strict rules in the Protocol for sanctions against specific non-compliances.

4.2.2.1. Emissions Reduction Commitments of Annex I Parties

The signal achievement of the Kyoto Protocol was getting the Annex I Parties to commit to legally binding quantified emission reduction targets and a timetable for their achievements. The overall target was to reduce the gases listed in Annex A[1474] by at least 5% below 1990 levels in the commitment period 2008-2012. This basic obligation was set up in Article 3.1.[1475] While the different 'assigned amounts' listed for individual countries and regional economic organizations were listed in Annex B. For example, the EU and its member states agreed to an emission limitation of 92% of the base year 1990, or an 8% reduction in the first commitment period of 2008-2012 while the US agreed to a 7% reduction. Both Australia and Iceland were actually permitted to increase their emissions by 8% and 10% respectively while Russia agreed to stabilize its emissions at 100% of the base year.[1476] Meanwhile, the Annex I Parties with economies in transition (EIT) were permitted to use a base year other than 1990, when their economies were badly disrupted following the breakup of the Eastern Bloc of communist nations, calculated in accordance with Article 3.5.[1477]

Overall, the Annex I Parties, without the US, who had withdrawn from the Kyoto Protocol in 2001, and Canada, who had withdrawn in 2011, met their target by cutting their collective emissions by around 24% as compared to the base year of 1990 for the

[1474] The gases covered by the Kyoto Protocol are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

[1475] United Nations (1998) supra note 17, Article 3.1, p. 3.

[1476] Id., Annex B, p. 20.

[1477] Id., Article 3.5, p. 4.

first commitment period 2008-2012. The level of overachievement is mainly due to the generous allocation to the EITs, known as "hot air", which was equivalent to 18.5% of total base-year emissions. Still the Annex I Parties would have fulfilled their modest objectives even without this "gift".[1478]

Besides a less-emissive industrial sector, the low-carbon growth among the Annex I Parties can be explained, first, by the growing share of the service sector in the developed economy and, second, by a higher use of imported goods – "outsourced emissions" – from the developing countries. Hence, most of the GHG emissions reduction came with little mitigation effort on the part of the developed countries.[1479]

More importantly, from a long-term perspective, the modest cuts in GHG emissions by the developed countries did little for the abatement of climate change because the global GHG emissions have surged by 50% since 1990, driven mainly by the economic growth in the developing countries. The developed countries, including the United States, had accounted for two-thirds of global GHG emissions in 1990. Their contributions, however, have dropped to less than 50% by 2012.[1480]

4.2.2.2. EU Redistribution of Emissions Reduction Commitments

Article 4 of the Protocol enables a group of countries, when they ratify the Protocol, to redistribute their emissions commitments in ways that preserve the collective total. Redistribution cannot be modified after submission of the instrument of ratification and it shall remain in operation for the duration of the commitment period.[1481]

To ensure there is no dilution of efforts, Article 4.4[1482] was included in the Protocol so as to ensure that the group, e.g. European Union, cannot meet its commitments through expansion by including, e.g. Eastern Europe, countries, whose emissions had declined substantially because of economic transition.[1483] The Article also sets out the

[1478] Romain Morel and Igor Shishlov (2015) Ex-Post Evaluation of the Kyoto Protocol: four Key Lessons for the 2105 Paris Agreement, Climate Report No. 44 (May 2014), CDC Climat Research, p. 1. Accessed on 8 September 2019 at: http://www.cdcclimat.com/IMG/pdf/14-05_climate_report_no44_-_analysis_of_the_kp-2.pdf

[1479] Id., p. 1.

[1480] Quirin Schiermeier (2012) The Kyoto Protocol: Hot Air, Nature, Volume 491, 29 November 2012, pp. 565-568.

[1481] United Nations (1998) supra note 17, Article 4, p. 5.

[1482] Id., Article 4.4, p. 5.

[1483] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 122.

responsibilities in the event of failure to achieve the collective commitment. If such an event were to occur, each country is still responsible for its level of emissions set out in the agreement, and the group, as a Party to the Protocol, would share responsibility with its member-states is a situation of 'joint and several' liability.[1484] The EU had offered this provision in the belief that in practice it would be the only group of countries to utilize it but it turned out to be a general provision available to other groups as well.[1485]

4.2.2.3. Policies and Measures

Article 2 of the Protocol contains a list of policies and measures that Parties could adopt in order to achieve their emissions reduction targets.[1486] During the AGBM negotiation, the EU pushed for the adoption of mandatory and coordinated policies and measures but the proposal was resisted by the United States, Canada, Australia and some other Annex I countries that wanted more flexibility in ways to meet their commitment targets.[1487] A compromise, more in favor of the US position than that of the EU, was reached by the provision of a list of indicative measures in Article 2.1(a):[1488]

(1) Enhance energy efficiency
(2) Protect and enhance sinks and reservoirs of GHG
(3) Promote sustainable forms of agriculture
(4) Increase research on and develop the use of new and renewable forms of energy, carbon sequestration technologies, and advanced and innovative environmentally sound technologies
(5) Phase out incentives, exemptions and subsidies in GHG emitting sectors and apply market instruments
(6) Encourage appropriate reforms in the relevant sectors
(7) Limit or reduce emissions in the transport area
(8) Limit or reduce methane emissions

An important exception to this *laissez-faire* approach in adopting policy and measures was established in Article 2.2 emphasizing that Parties shall pursue limitations or reduction of emissions from aviation and marine bunker fuels in efforts outside the scope of this Protocol by working through the International Civil Aviation Organization

[1484] United Nations (1998) supra note 17, Articles 4.5 & 4.6, p. 5.
[1485] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, pp. 123-124.
[1486] United Nations (1998) supra note 17, Article 2, pp. 1-3.
[1487] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 124.
[1488] United Nations (1998) supra note 17, Article 2, pp. 1-2.

(ICAO) and the International Maritime Organization (IMO), respectively.[1489]

4.2.2.4. Flexible Mechanisms of International Transfer

By far the most innovative and controversial provisions in the Kyoto Protocol were the flexible mechanisms to enable Annex I countries to meet their commitments under the Protocol by purchasing or acquiring credits representing GHG emissions reduction that had or are taking place in other countries.[1490]

While Article 2.1(a) of the Protocol did recommend the use of market instruments, it was assumed during the AGBM negotiations that it would be applied domestically. The rationale advanced by the proponents of the flexible mechanisms of international transfer was that as the geographical location of climate change abatement is largely irrelevant, it is perfectly acceptable from a cost-effectiveness perspective to carry out the mitigation project where it is the cheapest option regardless of location.[1491] If the location happened to be in a developing country there is also the additional benefit of fund transfer and possibly technology transfer as well.

The three flexible mechanisms share a common basis in Article 3 on Commitments:

Article 3.10 specifies that any emission reduction units, or any part of an assigned amount, which a Party *acquires* [emphasis added] from another Party in accordance with the provisions of Article 6 [Joint Implementation] or of Article 17 [Emissions Trading] shall be added to the assigned amount for the acquiring Party.[1492]

Article 3.11 specifies that any emission reduction units, or any part of an assigned amount, which a Party *transfers* [emphasis added] to another Party in accordance with the provisions of Article 6 [Joint Implementation] or of Article 17 [Emissions Trading] shall be subtracted from the assigned amount for the transferring Party.[1493]

Article 3.12 specifies that any certified emission reductions that a Party acquires from another Party in accordance with the provisions of Article 12 [Clean Development

[1489] Id., Article 2.2, p. 2.

[1490] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, p. 310.

[1491] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 136.

[1492] United Nations (1998) supra note 17, Article 3.10, p. 4.

[1493] Id., Article 3.11, p. 4.

Mechanism] shall be added to the assigned amount for the acquiring Party.[1494]

Emission reduction credits, in the form of AAU, ERU and CER, gained through the use of these flexible mechanisms, as well as removal units (RMU) generated by sink activities, can be used to meet the emissions reduction commitments of Annex I parties under Article 3.1.[1495]

4.2.2.4.1. Emissions Trading

Emissions trading under the Protocol permit an Annex B country to 'buy' emissions reduction credits in the form of assigned amount units (AAU) from another Annex B country where it is more cost-effective to do so rather than to undertake the emissions reduction domestically.[1496]

The inclusion of this mechanism was strongly supported by the United States based on their domestic experience with similar schemes, albeit in the specific area of sulfur dioxide emissions, which have proven to be cost-effective.[1497] However, it was strongly opposed by China and G-77 while Japan and the EU were concerned that the US might use its political leverage to gain preferential access to the likely surplus of the former USSR whose emissions had declined substantially through economic transition.[1498] A last-minute compromise was reach for its inclusion in the Protocol by the insertion of Article 17, which allowed Annex B countries to "participate in emissions trading for the purposes of fulfilling their commitments under Article 3", but provided that such trading are supplementary to domestic actions taken to achieve reductions.[1499]

4.2.2.4.2. Joint Implementation Within Annex I Parties

Article 6 of the Protocol provides any Annex I country to transfer to, or acquire from, any other Annex I country emission reduction units (ERU) resulting from cross-border projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks of GHG in any sector of the economy for the purpose

[1494] Id., Article 3.12, p. 4.

[1495] Id., Article 3.1, p. 3.

[1496] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, p. 310.

[1497] Title IV of the Clean Air Act, 42 USC 7651.

[1498] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, pp. 128-129.

[1499] United Nations (1998) supra note 17, Article 17, p. 15.

of meeting its commitments under Article 3.[1500]

Because such joint implementation (JI) projects occur between Annex I countries that are both subject to the same provisions in the Protocol, these JI does not have many of the political and technical complexities associated with JI projects in general.[1501] It was the least disputed of the flexible mechanisms under the Kyoto Protocol.

The eligible country is also permitted to authorize private legal entities, under its jurisdiction, to participate in such joint implementation projects that will lead to the generation, transfer or acquisition of ERU.[1502]

However, such joint implementation projects are required to result in a reduction in emissions that are additional to any that would otherwise occur and had to be supplementary to domestic actions.[1503] They must also be sanctioned by the governments of the participating industries for it to be legal under the Protocol.[1504]

4.2.2.4.3. The Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM) is an even more innovative flexible mechanism provided by Article 12 of the Protocol for an Annex I country to acquire certified emission reductions (CER) by investing in emission reduction projects, similar to JI projects, in the *non-Annex I countries* for the purpose of achieving compliance with its commitments under Article 3.[1505] The CDM also has a broader scope in that it was also designed to "assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention."[1506]

There are in addition three other features that distinguish CDM from JI:

(1) Strength of multilateral control over the CDM process as it "shall be subject to the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to this Protocol and be supervised by an executive board

[1500] Id., Article 6, pp. 6-7.
[1501] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 132.
[1502] United Nations (1998) supra note 17, Article 6.3, p. 7.
[1503] Id., Articles 6.1 (b) & (d), pp. 6-7.
[1504] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 131.
[1505] United Nations (1998) supra note 17, Article 12, pp. 11-12.
[1506] Id., Article 12.2, p. 11.

of the clean development mechanism."[1507]

(2) Strength of audit and verification over the CDM process as the COP/MOP shall, at its first session, "elaborate modalities and procedures with the objective of ensuring transparency, efficiency and accountability through independent auditing and verification of project activities."[1508]

(3) Concrete expression of the pledge in Article 4.4 of the Convention[1509] that developed countries that are listed in Annex II should assist countries that are particularly vulnerable to the adverse effects of change to meet the costs of adaptation by having a share of the proceeds from such CDM projects be used "to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation" as well as to cover the administrative expenses.[1510]

This enigmatic innovative flexible mechanism of the Kyoto Protocol had already spawned a rapidly growing literature and no discussion is intended to conclude this section on the Clean Development Mechanism except a few key points for the way forward with market-based mechanisms.

First, Raul Estrada-Oyuela, then chairman of the AGBM, noted at the time of the Kyoto Protocol adoption: "My reservation was that the CDM is considered a form of joint implementation but I don't understand how a commitment can be jointly implemented if only one of the parties involved is committed to limit emissions and the other party is free from a qualitative point of view. Such disparity has been at the root of every colonization since the time of the Greeks."[1511]

Second, Michael Grubb et al.,[1512] who had carried out a thorough analysis of the Kyoto Protocol, concluded that it "is unlikely that the CDM will work simply as a way to distribute abatement efforts globally at least cost." "The defining purpose of the CDM should be to help direct foreign corporate investments towards goals of sustainable development …it should be complement to the General Environment Facility. Indeed, if

[1507] Id., Article 12.4, p. 11.

[1508] Id., Article 12.7, p. 12.

[1509] United Nations (1992a) supra note 16, Articles 4.4, p. 7.

[1510] United Nations (1998) supra note 17, Article 12.8, p. 12.

[1511] Raul Estrada-Oyuela (1998) First Approaches and Unanswered Questions. In Issues and Options: The Clean Development Mechanism [J. Goldenberg (ed.)], UNDP, pp. 23-29.

[1512] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 247.

appropriately designed, these institutions should correspond to the natural complementarity between the private and public sectors." The GEF, which is the aggregate source of state funding, is required for education, infrastructure and public sector projects, and to stimulate technical and institutional innovation to abate climate change. Meanwhile, corporate finance can be the source of private funding for sustainable development with the CDM acting as catalysis.

4.2.2.5. Institutions

The institutions of the Kyoto Protocol sits upon the institutional infrastructure created under the UNFCCC. The Protocol deploys the Conference of the Parties (COP) to the Convention to serve as the meeting of the Parties (COP/MOP) to the Kyoto Protocol. The Protocol also draws upon the Convention's two subsidiary bodies, SBSTA and SBI, its secretariat, as well as its financial mechanism.[1513] Time will tell whether such institutional arrangements prove workable, given the different sets of Parties to the UNFCCC and the Kyoto Protocol.

The new specialized institutions, including the Executive Board of the CDM [flexible mechanism], the Article 6 Supervisory Committee [flexible mechanism] and the Compliance Committee [commitments], were created only to serve needs specific to the Protocol that cannot be met by the existing institutions.[1514]

Article 13.1 of the Protocol establishes a legally distinct body, termed the COP/MOP, to oversee the implementation of the Protocol.[1515] The formulation of Article 13 (1) means that the COP/MOP cannot, without its consent, be subjected to the COP. Attempts during the Kyoto Protocol negotiations to elevate the COP to a position of hierarchical superiority over the COP/MOP failed.[1516] This is because the Convention states in Article 17.5 that 'decisions under any protocol shall only be taken by the Parties to the protocol concerned",[1517] which is reiterated in Article 13.2 of the Protocol itself.[1518] It is functionally integrated with the COP but legally distinct. Hence, Protocol provisions dealing with the functions of the COP/MOP, as well as the timing and venue of the

[1513] Farhana Yamin and Joanna Depledge (2004) supra note 374, pp. 423-424.

[1514] United Nations (1998) supra note 17, Article 12.4, p. 11; Article 6.2, p. 7; Article 18, p. 15.

[1515] Id., Article 13.1, p. 12.

[1516] Sebastian Oberthur and Hermann E. Ott (1999) The Kyoto Protocol: International Climate Policy for the 21st Century, Springer Verlag, Berlin, pp. 241-242.

[1517] United Nations (1992a) supra note 16, Articles 17.5, p. 16.

[1518] United Nations (1998) supra note 17, Article 13.2, p. 12.

sessions, were subsequently defined to maximize cooperation between the two bodies and to minimize logistical and administrative inconvenience and yet preserving at the same time the legal and procedural distinctiveness of the Protocol institutions.[1519]

The case for the COP/MOP to be regarded as an international organization is even more compelling because the COP/MOP has permanent bodies, e.g. CDM Executive Board, to implement specialized functions on its behalf.[1520]

4.2.2.6. Self-Reporting and International Review

Because of the legally binding targets and the need to safeguard the integrity of the Kyoto Protocol mechanisms, the reporting requirements under the Kyoto Protocol have to be more accurate and are more elaborate than those under the Convention. However, it is still self-reporting of the same basic elements of annual GHG inventories and periodic national communications.[1521]

The reviews under the Kyoto Protocol are also based on the same general approach as that under the Convention. The information submitted by the individual Parties is complied by the Secretariat and reviewed by expert review teams. All the reports of the expert review teams will be made publicly available, and forwarded by the Secretariat, together with any written comments by the concerned Party, to the COP/MOP, the Compliance Committee and the Party concerned.[1522]

4.2.2.7. Dispute Resolution

Article 14.8 of the Convention specifies that Article 14 shall apply to any related legal instrument adopted by the COP unless the legal instrument itself provides otherwise.[1523] Article 19 of the Protocol states that "the provisions of Article 14 of the Convention on settlement of disputes shall apply, *mutatis mutandis*, to this Protocol." Hence, the essential features of Article 14 of the Convention are incorporated into the Protocol.[1524]

After the development of the multilateral consultative process (MCP) was initiated at

[1519] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 426.
[1520] Id., p. 425.
[1521] Id., pp. 343-344.
[1522] Id., pp. 353-356.
[1523] United Nations (1992a) supra note 16, Article 14.8, p. 15.
[1524] United Nations (1998) supra note 17, Article 19, p. 15.

COP-1 in Berlin in 1995, wide-ranging discussions were held with organizations and experts with experience in non-compliance procedures.[1525] However, parallel negotiation on the Kyoto Protocol compliance procedures meant that the design of the MCP under UNFCCC would differ significantly from the compliance procedures intended for a legally binding Kyoto Protocol. By 1997, the focus had shifted to the design of compliance procedures under the Kyoto Protocol.

4.2.2.8. Non-Compliance and Sanctions

The "procedures and mechanisms relating to compliance under the Kyoto Protocol" annexed to Decision 24/CP.7[1526] are probably the strongest and institutionally most sophisticated non-compliance procedures adopted by MEA to date.[1527] A Compliance Committee was to be established at the first meeting of the Parties, when the Kyoto Protocol enters into force, in pursuant of the procedure and mechanisms relating to compliance. It will be a standing body under the Kyoto Protocol with the authority to take a range of decisions applicable to individual Parties, including a range of consequences to be applied to Parties found in non-compliance.

The Parties at CMP-1 in 2006 at Montreal, Canada, after Kyoto Protocol entered into force, approved and adopted the procedures and mechanisms relating to compliance under the Protocol (Compliance Procedures).[1528] Later, the Compliance Committee, established by the Compliance Procedures, developed, and the CMP adopted, further rules of procedure (Rules of Procedure).[1529] The Committee further developed working arrangements to complement and give effect to the Rules of Procedure.[1530]

[1525] UNFCCC (1995k) supra note 1464, p. 59.

[1526] UNFCCC (2002) supra note 1395, p. 64.

[1527] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 386.

[1528] UNFCCC (2006) Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005, Addendum, Part Two: Action taken by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol at its first session, Annex to Decision 27/CMP.1 on Procedures and Mechanisms Relating to Compliance under the Kyoto Protocol, 92, FCCC/KP/CMP/2005/8/Add.3, 30 March 2006 (hereinafter "Compliance Procedures"). Accessed on 13 Febrary 2019 at: https://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf

[1529] See Annexes to FCCC/KP/CMP/2006/Add.1, Decision 4/CMP.2, 2 March 2007, and FCCC/KP/CMP/2008/11/Add.1, Decision 4/CMP.4, 19 March 2009 (hereinafter "Rules of Procedure"). Consolidated version accessed on 13 February 2019 at: onsolidated version available at: http://unfccc.int/kyoto protocol/compliance/items/3026.php

[1530] See Report on the Meeting, Plenary of the Compliance Committee, Third meeting, CC/3/2006/7, 18 September 2006, at Paragraph 5; Annual Report of the Compliance Committee to the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, FCCC/KP/CMP/2006/6, 22

The tasks of ensuring the Kyoto Protocol commitments are complied with, and ultimately ratcheted up towards achieving the ultimate objective of the Convention can be categorized into three types, namely:

(1) Assessment of compliance with specific obligations
(2) Enforcement of those obligations
(3) Reviews of adequacy and revision of commitments

The Protocol is remarkably stringent on assessment of compliance, typically weak on enforcement, and somewhat ambiguous on review of adequacy and revision of commitments.[1531]

The Compliance Committee comprises of four bodies: a plenary, a bureau, a Facilitative Branch and an Enforcement Branch.[1532] The plenary of the Compliance Committee is made up of twenty members, ten from each Branch, with the Chair of each Branch reserving as Co-Chairs of the plenary. The Bureau comprises of four persons: the Chair and Vice-Chair from each of the two Branches of the Committee.

The Facilitative Branch provides advice and facilitates the implementation of the Protocol. While it promotes compliance, it also provides an early warning system for potential non-compliance. Hence, the mandate of the Facilitative Branch covers everything that has not been expressly assigned to the Enforcement Branch. The Enforcement Branch has been mandated to determine whether each Annex I Party is in compliance with:

(1) Quantified emission limitation or reduction commitment under Article 3.
(2) Methodological and reporting requirements under Articles 5.1, 7.1, & 7.4.
(3) Eligibility requirements for flexible mechanisms under Articles 6, 12, & 17.

The ability of the Enforcement Branch to impose consequences has been strictly defined to match the type of non-compliance failings.[1533] Non-compliance of target commitment

---

September 2006, Paragraph. 11; (hereinafter "First Annual Report of the Compliance Committee"). All reports and other documents of the plenary of the Compliance Committee are available accessed on 13 February 2019 at: http://unfccc.int/kyoto protocol/compliance/plenary/items/3788.php

[1531] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 142.

[1532] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 387.

[1533] Id., pp. 393-394.

will trigger the following sanctions:

(1) Deduction of 1.3 tonnes for every 1 tonne over-emitted from a Party's assigned target for the next commitment period.
(2) Submission of a detailed compliance plan from the concerned Party as to how and by when the Party will meet its new target.
(3) Inability to transfer under Article 17 emissions trading.

Failure to meet methodological and reporting requirements will lead to a declaration of non-compliance and a requirement from the concerned Party to submit an action plan with measures and timelines the Party intends to remedy the failing. Failure to meet the flexible mechanisms eligibility means a general suspension from mechanisms eligibility depending on the eligibility requirement for particular mechanisms.

4.2.3. Legal Character of the Paris Agreement

The legal character of the 2015 Paris Agreement and its core provisions has been a highly controversial issue of diplomatic negotiations[1534] since the adoption of the 2011 Durban Platform for Enhanced Action.

4.2.3.1. A New Multilaterally Agreed, Legally Bind Treaty

The Paris Agreement was clearly negotiated and adopted under the Convention for the Durban Platform, which set the general framework for the negotiations, had prescribed that the outcome shall be 'a protocol, another legal instrument or an agreed outcome with legal force under the Convention'.[1535] For many of the delegations, the entire point for the continuation of diplomatic negotiations, following from the non-multilateral, non-binding Copenhagen Accord, was to establish a new, multilaterally agreed, legally binding treaty.[1536]

More importantly, there was sufficient ambiguity in the turn of phrase, "to develop a protocol, another legal instrument or an agreed outcome with legal force under the

[1534] Lavanya Rajamani and Jacob Werksman (2018) The legal character and operational relevance of the Paris Agreement's temperature goal, Philosophical Transactions of the Royal Society A, Volume 376, Issue 2119 (2 Apirl 2018): 20160458 p. 3.

[1535] UNFCCC (2011a) supra note 1144, Decision 1/CP.17.

[1536] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534 p. 3.

Convention applicable to all Parties", for consensus among the Parties to allow the negotiations to move forward.[1537] Hence, the legal character of the outcome – the Paris Agreement – can be viewed from four different lenses:

First, the EU, and other progressive countries, has consistently been pushing for higher ambition from the nation-States since the 1989 Noordwijk Conference.[1538] They consider the legal character of the climate change agreement as the key indicator of ambition. For the EU, it is about raising the other nation-States up to the same standards to which we have been held to since the establishment of the Kyoto Protocol.[1539]

Second, for small island nation-States and the least developed countries, climate change has always been an existential threat since global warming became known outside the epistemic community of climate scientists. They need to know that any climate change agreement on which their survival depended upon would have to be as strong as possible. Both groups of countries also share the concern that a deal struck between the US and the major fast developing countries, each uncomfortable for different reasons with an agreement of legally binding provisions, would lead to the establishment of the lowest common denominator agreement[1540] with a weak legal character.[1541]

Third, the fast developing countries have never signed up for binding commitments to reduce their GHG emissions. Among these countries are China and India, which have grown to be the largest and third largest GHG emitters in the world respectively, still have millions of people, especially India, living below the poverty line.[1542] These countries wanted to avoid signing up to any binding commitments that could compromise their development priorities. For them, the principle of CBDR-RC means that that historical responsibility[1543] for past GHG emissions must be taken into account and the developed countries must continue with their mandatory GHG emissions reduction commitments while the developing countries will only volunteer their 'equitable' share so that the Parties can achieve "an agreed outcome with legal force under the Convention applicable to all Parties".[1544]

[1537] Jacob Werksman (2016) supra note 1471, p. 3.
[1538] See Section 3.2.2.3.
[1539] Jacob Werksman (2016) supra note 1471, p. 6.
[1540] See Section 4.1.2.1.1.
[1541] Jacob Werksman (2016) supra note 1471, pp. 6-7.
[1542] UCS (2015) supra note 60.
[1543] See Section 4.1.3.3.5.
[1544] UNFCCC (2011a) supra note 1144, Decision 1/CP.17.

Last but not least, the US Obama administration was keen to join in and mould the Paris Agreement amenable to the American viewpoint.[1545] The executive branch of the US government administration faces constitutional and political constraints. The Obama administration since the Durban Platform had made it clear that the US could not join if the form of the Paris Agreement is such that it would require the advice and consent of a Republican dominated and a historically reluctant Senate.[1546] Politically, the US could also not sign up to a climate change agreement that would hold the US to a higher standard of legally binding provisions than the fast developing countries, particularly China.[1547] To a lesser extent, this political constraint is also true for the EU and the other industrialised countries.[1548]

In response to the first question on legal form, the Paris Agreement is a treaty within the meaning of the Law of Treaties.[1549] First, the Agreement requires any nation-State that wishes to be a Party to notify its consent to be bound (through ratification, acceptance, approval or accession); allows for no reservations; and provides that Parties will remain bound unless and until they withdraw.[1550] Second, the Agreement was clearly negotiated and adopted under the UNFCCC.[1551] Third, although, it is not a "protocol" by name but it is legally indistinguishable in its basic legal form from the Kyoto Protocol and it met the only relevant UNFCCC rule on the adoption of protocols that the draft text must be circulated to the Parties six months in advance to ensure there was adequate time for the Parties to review it before adoption.[1552]

The US Obama administration has characterized the Paris Agreement as an executive agreement that does not contained legally binding GHG emissions reduction targets like the Kyoto Protocol and hence it does not require the advice and consent of the US Senate.[1553] However, the reaction from some of the domestic legal experts is that the "Paris Climate Agreement is a treaty by virtue of its costs and risks, ambition compared to predecessor climate treaties, dependence on subsequent legislation by Congress,

[1545] The two presidential terms of US President Barack Obama stretched from January 2009 to January 2017. It covered the key UN climate change conferences held in Copenhagen in Dec 2009, Cancun in Dec 2010, Durban in Dec 2011 and Paris in Dec 2015.

[1546] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 3.

[1547] US President Bush (2001) supra note 1093.

[1548] Jacob Werksman (2016) supra note 1471, p. 6.

[1549] United Nations (1969) supra note 300.

[1550] Jacob Werksman (2016) supra note 1471, p. 8.

[1551] UNFCCC (2011a) supra note 1144, Decision 1/CP.17.

[1552] United Nations (1992a) supra note 16, Article 17.2, p. 16.

[1553] Jacob Werksman (2016) supra note 1471, pp. 4-8.

intent to affect state laws, U.S. historic practice with regard to multilateral environmental agreements, and other common-sense criteria."[1554]

4.2.3.2. Legal Character of its Provisions

The very different perspectives of the Parties had led the negotiators to design an internationally legally binding agreement that contains provisions with variable legal character. First, it encourages participation in a binding treaty by enabling each Party to determine nationally the form of contribution and the level of ambition it was prepared to bind itself to in order to keep global warming within a safe level. Second, it clears the obstacles of US constitutional and political constraints with an agreement that contains 'contributions' that amount to binding obligations of conduct, without being binding as to their results. Third, the treaty was called 'Paris Agreement' that does not contain legally binding GHG emissions reduction targets like the Kyoto Protocol. Fourth, it does, however, contain a high degree of 'functional bindingness' by ensuring it had the highest standard transparency and accountability provisions. Fifth, it encourages the evolution of the legal character of Parties' contributions over time.[1555]

The resulting Paris Agreement is undoubtedly a legally binding treaty among the nation-States but it has a uniquely ambiguous legal character with respect to its core provisions.[1556] In comparison, it is a legal outcome that can be said to be more binding in its legal character than the UNFCCC but less binding than the Kyoto Protocol.[1557]

More important, from the perspective of the effectiveness of international climate change governance, is the intent of the Paris Agreement, which sets out a powerful vision of the concerted collective action need to prevent the Earth's climate from crossing over critical thresholds by getting all the countries to agree to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change".[1558] Hence, the Paris Agreement will rely less on its legal character than on its collective goal-setting, voluntary nationally determined contributions (NDCs), the

[1554] Christopher Horner and Marlo Lewis, Jr. (2017) The Legal and Economic Case Against the Paris Climate Treaty: Canceling U.S. Participation Protects Competitiveness and the Constitution, Issue Analysis 2017 No. 6 (May 2017), Competitive Enterprise Institute, Washington, DC, USA, p. 1.

[1555] Jacob Werksman (2016) supra note 1471, p. 7.

[1556] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 3.

[1557] Jacob Werksman (2016) supra note 1471, p. 7.

[1558] United Nations (2015a) supra note 18, Article 2.1(a), p. 22.

pursuit of "domestic mitigation measures, with the aim of achieving the objectives of such contributions",[1559] reporting and review mechanisms, and regular stock-takes to shape state behavior and world public opinion.

Equally important, is that by linking the voluntary NDCs with the pursuit of domestic policy measures, it does in such a way that commitment to the Paris Agreement should drive the domestic policy and law making processes to reduce GHG emissions that is key to the successful legal, social, political, economic and ethical transformations needed to achieve the social goals for the common good of humankind, namely the stabilization of "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" [1560] and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations.[1561]

The Paris Agreement is also more inclusive than both the previous treaties in terms of its coverage of the Parties and global GHG emissions, and its scope, which includes adaptation, loss and damage, and the means of implementation in the form of finance, technology transfer and capacity building.

4.2.3.3. Objectives

Unlike the UNFCCC, the Articles in the Paris Agreement do not have titles; however, Article 2 is characterized by the subsequent Article 3 as setting out the purpose of the Agreement. Thus Article 2 can be interpreted as describing what the Agreement is intending to achieve (Article 2.1) as well as how the implementation of the Agreement should be carried out: "to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances"(Article 2.2).[1562] It is not directed at any particular actors but rather at the 'objective' of the entire Agreement in itself. Hence, Article 2.1 is the equivalent to as well as refers to Article 2 (Objective) of the UNFCCC.[1563]

4.2.3.3.1. The Safe Level

[1559] Id., Article 4.2, p. 23.
[1560] United Nations (1992a) supra note 16, Article 2.
[1561] UNEP (1992a) supra note 75.
[1562] United Nations (2015a) supra note 18, Article 2, p. 22.
[1563] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 3.

Article 2 of the UNFCCC has been criticized as being non-prescriptive, non-specific and non-precise and that future agreements under the UNFCCC would have to spell out what is the safe level of GHG emissions in terms of concentration and within what time frame.[1564] Article 2.1(a) of the Paris Agreement essentially states the 'safe' in 'safe level' in terms of significantly reducing the risks and impacts of climate change and the 'level' of GHG emissions in 'safe level' in terms of the equivalent increase in the global average temperature above pre-industrial level.

The Agreement thus requires the Parties "[h]olding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels."[1565]

4.2.3.3.2. 1.5°C sub-goal versus "well below 2°C" sub-goal

There are two sub-goals articulated in Article 2.1(a) – the 1.5°C sub-goal and the "well below 2°C" sub-goal. The "well below 2°C" sub-goal has stronger normative force as it has been given more prominence in its order and the language used to describe the two sub-goals. Essentially, Article 2.1(a) describes the Agreement's purpose as 'holding' the temperature increase to 'well below 2°C' while aspiring to 'pursuing efforts to limit' the temperature increase to 1.5°C.[1566]

The temperature goal is precise enough an indicator that it could be quantified, within ranges of uncertainty, in terms of the global carbon budget equivalents in order to limiting the global average temperature rise well below 2°C or 1.5°C, and, more importantly, the global emissions reduction pathways to be followed in order to stay within the respective global carbon budgets.

The intent of some delegates, especially from the small island nation-States and the least developed countries and supported by the EU and Canada, to insist on including the sub-goal of 1.5°C in the objective of the Agreement was to drive home the message that a greater sense of ambition and urgency is needed to limit global warming. The carbon budgets and the emissions reduction pathways necessary to limit global average temperature rise to 1.5°C sub-goal would be far more constrained than those implied by the 2°C sub-goal. The US, meanwhile, was sticking to the 2.0°C sub-goal.[1567]

[1564] Richard H. Moss (1995) supra note 1259, pp. 3-6.

[1565] United Nations (2015a) supra note 18, Article 2.1(a), p. 22.

[1566] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 4.

[1567] Shawn McCarthy and Eric Reguly (2015) Catherine McKenna pushes for 1.5°C target in Paris

In fact, following the adoption of the Paris Agreement, COP-21 invited the IPCC to prepare a Special Report, known as SR1.5, by 2018 on what a 1.5°C warmer world would look like but also the different pathways by which global average temperature rise could be limited to 1.5°C. In 2016, the IPCC accepted the invitation and added that the SR1.5 would also look at these issues in the context of strengthening the global response to the threat of climate change, sustainable development and efforts to eradicate poverty.[1568]

Unfortunately, the US, Saudi Arabia, Russia and Kuwait refused to "welcome" the SR1.5 report. They only wanted to "note" it at the 2018 Katowice Climate Change Conference. Hence, in the final COP decision text it did not "welcome" the report, but instead "welcome" its "timely completion" and "invited" countries to make use of the report in subsequent discussions at the UNFCCC.[1569]

4.2.3.3.3. The Time Frame

Meanwhile Article 4 of the Paris Agreement specifies the end point of the time frame, "In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century [2050]."[1570]

4.2.3.4. Key Principles

The key principle articulated in the Paris Agreement is the principle of common but differentiated responsibilities and respective capabilities. However, it is to be viewed not in the light of international conditions, but "in the light of different national circumstances", in both the key Articles 2 & 4. In Article 2.2 and Articles 4.3 and 4.4 of

climate talks, The Globe and Mail, 6 December 2015. Accessed on 13 September 2109 at: https://www.theglobeandmail.com/news/world/climate-talks-hinge-on-financing-for-developing-nations/article27626639/

[1568] IPCC (2018b) IPCC Special Report on Global Warming of 1.5°C: Frequently Asked Questions, IPCC SR1.5, Pre-trickle back version, 6 October 2018. Accessed on 13 September 2019 at: https://report.ipcc.ch/sr15/pdf/sr15_faq.pdf

[1569] Carbon Brief (2018) supra note 1195.

[1570] United Nations (2015a) supra note 18, Article 4.1, p. 22.

the Paris Agreement, the principle of common but differentiated responsibilities and respective capabilities, however, has been modified to reflect "the light of different national circumstances".[1571] This modification is necessary to align the principle of CBDR-RC to the use of NDCs to curb GHG emissions as the primary means to achieve the temperature goals of the Paris Agreement.

In both these key Articles, the Paris Agreement also emphasized that action in response to climate change should be "in the context of sustainable development and efforts to eradicate poverty". In essence, integrating the environmental issue of climate change to the economic and social needs of contemporary society in order to ensure sustainable development for current and future generations, as articulated in the Sustainable Development Goals (SDG) under Agenda 2030.[1572]

4.2.3.5. Contributions (Commitments)

The Paris Agreement uses the term "contributions" instead of "commitments' to avoid association with the legally binding provision of commitments in the Kyoto Protocol.

4.2.3.5.1. Are NDCs Legally Binding?

The provision that received the most attention at the Paris Climate Change Conference concerned the legal character of the nationally determined contributions (NDCs) and the question as to whether the Paris Agreement make the NDCs legally binding or not?

The EU in particular sought a language that would allow them to characterize NDCs as legally binding. Requiring the parties to achieve their NDCs would have given the NDCs the same legal status as the Kyoto Protocol's emissions targets, which the major GHG emitting countries had already rejected, namely the US, China and India.[1573] The final accepted version in Article 4.2 uses the clause, "nationally determined contributions that it intends to achieve."[1574] The phrase "intends to achieve" establishes a good faith expectation that Parties intend to achieve their contributions, but stops short of requiring them to do so.[1575] It implies an obligation of 'conduct or process' rather

[1571] United Nations (2015a) supra note 18, Articles 2.2 and Articles 4.3 & 4.4, pp. 22-24.

[1572] UNDESA (2019) Sustainable Development Goals, Division for Sustainable Development Goals, Department of Economic and Social Affairs, United Nations. Accessed on 13 September 2019 at: https://sustainabledevelopment.un.org/sdgs

[1573] Daniel Bodansky (2016) supra note 1419, p. 146.

[1574] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 6.

[1575] United Nations (2015a) supra note 18, Article 4.2, p. 23.

than an obligation of 'result or product'.[1576]

4.2.3.5.2. Ratcheting Up The Level of Ambition

Meanwhile, Article 3 links the highest possible level of ambition in the Party's NDC to the temperature goal of Article 2, through Article 3, which states that "[a]s nationally determined contributions to the global response to climate change, all Parties are to undertake and communicate ambitious efforts as defined in Article[] 4 . . . with the view to achieving the purpose of this Agreement as set out in Article 2."[1577] The linkage to the temperature goal is also at the heart of the Paris Agreement's objective to ratchet up the level of ambition of the Party's NDC in time.

First, all Parties shall have binding obligations of conduct to prepare, communicate and maintain NDCs,[1578] and the "efforts of all Parties will represent a progression over time" towards limiting the global average temperature rise to 1.5°C or well below 2.0°C.[1579] Hence, Parties are expected to ensure that each successive NDC is the Party's highest possible level of ambition and is a progression from the previous NDC. Meanwhile, Article 13, which set out the "transparency framework' of self-reporting and international review will enhance the expectation on the intent and ratcheting of ambition. Each Party shall have the binding obligations of conduct to provide the information necessary for "technical expert review' in order to track progress and be subjected to "technical expert review" and a "facilitative, multilateral consideration of progress" with respect to the implementation and achievement of its NDC.[1580]

Second, all Parties shall also have the binding obligations of conduct to communicate existing or successive NDCs every 5 years.[1581] At the same time, these NDCs shall be informed by a 5-yearly global stock-take to assess the collective progress towards the long-term goals, which include the temperature goal.[1582] This ratcheting up the level of ambition is intended to enhance and strengthen Parties' NDCs over time given the mitigation shortfall in the initial NDCs submitted by Parties.[1583] Article 15 establishes a Committee to facilitate implementation and promote compliance of Parties with the

[1576] Daniel Bodansky (2016) supra note 1419, p. 146.
[1577] United Nations (2015a) supra note 18, Article 3, p. 22.
[1578] Id, Article 4.2, p. 23.
[1579] Id., Article 3, p. 22.
[1580] Id., Article 13, pp. 30-31.
[1581] Id., Article 4.9, p. 23.
[1582] Id., Article 14, p. 32.
[1583] UNEP (2018a) supra note 50, p. 4.

provisions of the Paris Agreement.[1584]

However, neither the transparency framework nor the global stock-take have the mandate to assess whether a Party's NDC has been designed "with a view to achieving the purpose of the Agreement as set out in Article 2".[1585] It is for each Party to determine nationally the level and progression of its ambition, including the extent to which its GHG emissions reduction pathways implied by its NDC will be a credible contribution to achieving the temperature goal of the Paris Agreement.

4.2.3.6. Means of Implementation

By connecting the voluntary NDCs with the pursuit of domestic policy and law making measures,[1586] it is intended that the binding obligations of conduct with respect to the preparation, communication and maintenance of the NDCs and the ratcheting of ambition with time via the 5-year cycle should drive the domestic policy and law making processes to reduce GHG emissions.

One of the strongest criticisms of the provisions in the Kyoto Protocol is that through the flexible market-based mechanism of CDM, the polluters in the developed countries of the global North would be able to buy themselves out of GHG emissions reduction efforts in their own countries by investing in GHG emissions reduction projects in the developing countries of the global South. Not only does it violate the critical success factor of fair burden sharing by all,[1587] it also does not result in behavioural change for both the developed and developing countries. Besides, putting the CDM into international practice proved to be very slow and inefficient,[1588] which significantly increased transaction costs and militate against the intent of the Coase theorem. Hence, by ensuring that there is substantive effort on the part of all Parties to come up with concrete and realistic plans to reduce GHG emissions in their own countries will be seen as fulfilling the key principle of CBDR-RC. In fact, UN Secretary-General António Guterres has already called on all leaders to come to New York on Septmber 23rd for the UN Climate Action Summit 2019[1589] with concrete, realistic plans to enhance their nationally determined contributions (NDCs) by 2020, in line with

[1584] United Nations (2015a) supra note 18, Article 15, p. 32.
[1585] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 7.
[1586] Id., Article 4.2, p. 23.
[1587] See Section 4.1.3.
[1588] David G. Victor (2001) supra note 376, p. 10.
[1589] United Nations (2019) supra note 86.

reducing GHG emissions by 45% by 2030, and to net zero emissions by 2050. There is also a good faith expectation that the Parties intend to and will aim to achieve the objectives of their contributions.[1590]

These intentions of the Paris Agreement are what the US Competitive Enterprise Institute, a neoliberal think-thank, are gravely concerned about, and the institute had issued an analysis paper to urge President Trump "to cancel U.S. participation in the Paris Climate Agreement and stop all payments to United Nations global warming programs." One of the eight misgivings as raison d'état for such actions is that the Paris Agreement "endangers America's capacity for self-government. It empowers one administration to make legislative commitments for decades to come, without congressional authorization, and regardless of the outcome of future elections."[1591] The other reason is that the US "cannot comply with the Paris Agreement and pursue a pro-growth energy agenda. Affordable, plentiful, reliable energy is the lifeblood of modern economic life. Yet, the Paris Agreement's central goal is to make fossil fuels, America's most plentiful and affordable energy source, more expensive across the board. Implementing the agreement's progressively more restrictive five-year emission-reduction pledges– called Nationally Determined Contributions (NDCs)–would destroy U.S. manufacturing's energy price edge."[1592]

4.2.3.7. Market-Based Mechanisms and Non-Market Mechanisms

While the Paris Agreement recognizes the benefits of countries cooperating to reduce emissions under a market-based system, it also insists that the cooperation should promote greater ambition in terms of mitigation of emissions and adaptation to the effects of climate change, foster sustainable development, and encourage broad participation in climate action from the private and public sectors.[1593]

More importantly, the Agreement is insistent that the Parties choosing such voluntary cooperation "shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement."[1594] The avoidance of double counting was further emphasized by reiterating that such emission reductions shall not be used to

[1590] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 7.
[1591] Christopher Horner and Marlo Lewis, Jr. (2017) supra note 1554, p. 1.
[1592] Id., p. 2.
[1593] United Nations (2015a) supra note 18, Article 6, pp. 24-25.
[1594] Id., Article 6.2, p. 24.

demonstrate achievement of the host Party's NDC if used by another Party to demonstrate achievement of its NDC.[1595] At the 2108 Katowice Conference to establish the rulebook for the implementation of the provisions of the Paris Agreement, the most contentious point was on the basic accounting rules to prevent "double counting" of emissions reductions by the buyer and seller of offsets. The draft text set out how each party should make a 'corresponding adjustment' to their emissions inventories to reflect the trade. However, the matter was not settled and deferred to COP-25.[1596]

The Parties also agreed to create a framework for non-market mechanisms. Just as details of the new market-based mechanism need to be worked out, the Parties will have to agree on how the new framework of non-market mechanisms will function. Until the COP decides, the non-market mechanisms could include the use of fiscal measures, such as putting a price on carbon or applying taxes to discourage emissions.[1597]

4.2.3.8. Adaptation and Liabilities

Understanding the scientific relationships between the global average temperature rise, the atmospheric GHG concentrations, and the GHG emission pathways will allow humankind to know years in advance whether the temperature goals of the Paris Agreement are attainable. Hence, adaptation planning for the purpose of "enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change ... ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2"[1598] is both possible and necessary.

However, most of the provisions on adaptation in Article 7 are expressed, not as legal obligations, but rather as acknowledgements, recommendations, expectations, or encouragement.[1599] Although it is obligatory for the developed countries to financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention,[1600] the provisions relating to funding for adaptation are carefully circumscribed to limit support obligations for developed countries, and potentially expand the base of donors to all Parties.[1601] For instance, Article 7.13 states in passive language[1602] that "[c]ontinuous

[1595] Id., Article 6.5, p. 25.
[1596] Carbon Brief (2018) supra note 1195.
[1597] United Nations (2015a) supra note 18, Articles 6.8 & 6.9, p. 25.
[1598] Id., Article 7.1, pp. 25-26.
[1599] Daniel Bodansky (2016) supra note 1419, p. 147.
[1600] United Nations (2015a) supra note 18, Article 9.1, p. 28.
[1601] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 11.

and enhanced international support shall be provided to developing country Parties" for specific activities, especially in the areas of technology development and transfer, and capacity-building.[1603]

The IPCC Special Report SR1.5 has stated that missing the 1.5°C goal would lead to more severe and irreversible effects,[1604] the relevance of Article 8 on loss and damage will also increase.[1605] While Article 8 does not provide a basis for any liability or compensation, yet it has been argued that all options for developing a system for loss and damage remain.[1606] Hence, the prospects of missing the 1.5°C goal may lead to further proposals to 'enhance and strengthen' the Warsaw International Mechanism for Loss and Damage.[1607]

4.2.3.9. Concluding Remarks on the Paris Agreement

The Paris Agreement is a legally binding treaty but not every provision creates a legal obligation. While, making a provision legally binding may provide a higher signal of commitment as well as greater assurance of compliance from the Parties, it is very difficult at this juncture to say how much the legally binding character of the various provisions really matters. Transparency, accountability and precision of the provisions can also make significant differences. Besides, legal bindingness can be a double-edged sword for it may lead the Parties to moderate its level of ambition in the 5-year cycle of progressively more ambitious NDCs or even to withdraw from the Agreement.[1608]

Politically and symbolically, the 1.5°C sub-goal in Article 2.1(a) is acknowledgement by the Parties of the Paris Agreement that the most vulnerable countries consider a temperature rise beyond this limit as an existential threat. It could serve as a benchmark against which the collective efforts of all Parties could be tracked via the global stock-take and which each Party could calibrate its own mitigation efforts. However, the Agreement falls short of converting this temperature goal into a provision with specific legal force applicable to the actions of individual Parties. The existential aspirations of

[1602] Id., p. 11.

[1603] United Nations (2015a) supra note 18, Article 7.13, p. 27.

[1604] IPCC (2018a) supra 416.

[1605] United Nations (2015a) supra note 18, Article 8, pp. 27-28.

[1606] M. J. Mace and Roda Verheyen (2016) Loss, Damage and Responsibility after COP21: All Options Open for the Paris Agreement, Review of European Comapartive and International Environmental Law, Volume 25 (27 July 2016), pp. 197-214.

[1607] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 11.

[1608] Daniel Bodansky (2016) supra note 1419, p. 150.

the most vulnerable countries that the 1.5°C sub-goal represents will thus have to depend on the quality of the political discourse the Paris Agreement is able to generate internationally and domestically, and on our individual and collective consciences.[1609]

4.3. NEXT STEP IN CLIMATE CHANGE GOVERNANCE

Out of the ashes of the disastrous Copenhagen Climate Change Conference to extend the top-down approach of the Kyoto Protocol arose the phoenix of a bottom-up approach to international climate change governance. It was this complete 'change of tack' in climate change negotiations from a top-down to a bottom up approach that led to the successful universal adoption of the Paris Agreement on 12 December 2015.[1610] An international agreement that had the complete backing of the Presidents of the two most important GHG emitting nation-States, who had earlier announced in Hangzhou, China, on the eve of G20 Summit that both nation-States will ratify the Paris Agreement.[1611] For the first time in the history of international climate change governance, the Paris Agreement have brought all nation-States, both the developed and developing, into a common cause to forge increasingly ambitious successive nationally determined contributions (NDCs) to mitigate climate change and adapt to its effects.

However, the "NDCs that form the foundation of the Paris Agreement cover only approximately one third of the emissions reductions needed to be on a least-cost pathway for the goal of staying well below 2°C. The gap between the reductions needed and the national pledges made in Paris is alarmingly high" as stated in the Executive Summary of the UNEP Emissions Gap Report 2017.[1612] The gap situation has since amplified. In the Executive Summary of the 2018 report, it mentioned that "the results of the new global studies prepared for the IPCC report, the emissions gap – especially to stay below 1.5°C warming – has increased significantly in comparison with previous estimates, as new studies explore more variations and make more cautious assumptions about the possibility of global carbon dioxide removal deployment. Pathways reflecting current NDCs imply global warming of about 3°C by 2100, with warming continuing

[1609] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, pp. 11-12.

[1610] United Nations (2015a) supra note 18.

[1611] Tom Phillips, Fiona Harvey and Alan Yuhas (2015) Breakthrough as US and China agree to ratify Paris climate deal, The Guardian, 3 September 2016. Accessed on 30 August 2018 at: https://www.theguardian.com/environment/2016/sep/03/breakthrough-us-china-agree-ratify-paris-climate-change-deal

[1612] UNEP (2017) Emissions Gap Report 2017: Executive Summary, United Nations Environmental Programme, Nairobi, Kenya, p. xiv.

afterwards. If the emissions gap is not closed by 2030, it is very plausible that the goal of a well-below 2°C temperature increase is also out of reach."[1613]

Hence, is the bottom up approach of the Paris Agreement a ground breaking functional hybrid, which can serve as a model for other areas of multilateral negotiations that need to capture ambition across Parties with highly diverse interests? Or are the politicians at home and the negotiators in the climate change conferences merely avoiding making tough decisions and kicking the can further down the road?

Perhaps, the Paris agreement is somewhere in-between. Humankind should remain hopeful that the international community has reached a unique compromise in that the process in which every nation-State has committed itself to prepare, communicate, pursue, account for, track and successively and progressively update its contributions will, in the glaring light of regular world public opinion and in the uncomfortable heat of a warming planet, quickly sink deep roots into its domestic scientific, technological, economic, political, legal and moral system.[1614]

4.3.1. Polycentric Governance in the Paris Agreement

In terms of policies and measures, the Cancun Agreements had already recognized the need to move to a form of polycentric governance by engaging "a broad range of stakeholders at the global, regional, national and local levels, be they government, including sub-national and local government, private business or civil society, including youth and persons with disability, and that gender equality and the effective participation of women and indigenous peoples are important for effective action on all aspects of climate change." [1615] The agreements also decided to consider the establishment of one or more market-based and non-market-based mechanisms to enhance the cost-effectiveness of, and to promote, mitigation actions,[1616] but keeping in view the need to maintain and build upon existing mechanisms, including those established under the Kyoto Protocol.[1617]

In fact, the chief means by which the Parties to the Paris Agreement will achieve the

[1613] UNEP (2018a) supra note 50, p. 6.
[1614] Jacob Werksman (2016) supra note 1471, p. 14.
[1615] UNFCCC (2010b) supra note 1143, Decision 1/CP.16, Paragraph 7.
[1616] Id., Paragraphs 80 & 84.
[1617] Id., Paragraph 83.

temperature goals set out in Article 2.1(a)[1618] are the mandatory nationally determined contributions (NDCs) [1619] from each Party, and the Agreement recognizes the importance of all levels of government [nation, sub-national, and local] and various actors [individuals, communities, corporations, and non-governmental organizations], in accordance with respective national legislations of the Parties, in addressing climate change."[1620] In addition, the Agreement also called for the enhancement of both public and private sector participation in the use of both market-based and non-market mechanisms for the implementation of the NDCs.[1621]

4.3.1.1. Evolution to Polycentric Climate Change Governance

The Kyoto Protocol, which was considered a more legally binding MEA than the Paris Agreement for international climate change governance[1622] was not enforceable at the international level. Hence, the Paris Agreement is clearly not enforceable at the international level. For the Agreement to succeed at achieving its expressed temperature goals, it is relying only on the self-commitment of all the nation-States to prepare, communicate, pursue, account for, track and successively and progressively update its NDCs and to enforce GHG emissions reduction efforts at the national, provincial and local levels, which is well within the jurisdiction of the respective nation-States.

Whether legislation, monitoring, and sanction to enforce the GHG emission reduction efforts at the national, provincial, and local levels will be acceptable to their respective citizenry will be the test of the political acumen of its respective governments.

To reinforce the polycentric approach, UN Secretary-General António Guterres has called for the 2019 Climate Action Summit to be held in New York on 23 September 2019.[1623] The Summit, with the theme of "A Race We Can Win", will bring together leaders of governments, the private sector, civil society, local authorities and other international organizations to develop ambitious solutions in six areas: (1) energy transition, (2) climate finance and carbon pricing, (3) industry transition, (4) nature-based solutions, (5) cities and local action, and (6) resilience and adaptation.

[1618] United Nations (2015a) supra note 18, Article 2.1(a), p. 22.
[1619] Id., Article 4.2, p. 23.
[1620] Id., Preamble, p. 21.
[1621] Id., Article 6.8(b), p. 25.
[1622] Jacob Werksman (2016) supra note 1471, p. 7.
[1623] United Nations (2019) supra note 86.

Such a multi-factorial, multi-level solution set is a viable and necessary step to reduce the catastrophic climate risks associated with GHG emissions. As systemic climate change is a multi-factorial, multi-level problem, it requires a multi-factorial, multi-level solution set that will "constrain and work with the dynamics of the system".[1624]

4.3.1.1.1. Origin of the Concept of Polycentricity

Michael Polanyi (1951) first envisaged the concept of polycentricity in his book, "The Logic of Liberty".[1625] The concept of polycentricity diffused to many other academic disciplines, and, more importantly, to governance studies through Vincent Ostrom (1961) in his study of US metropolitan governance[1626] and to integrated social-ecological studies through Elinor Ostrom and Vincent Ostrom and their colleagues in the Workshop in Political Theory and Policy Analysis of Indiana University.[1627]

In the 1940s and 1950s, Michael Polanyi had already analyzed "polycentric tasks" in a number of articles pertaining to the problems of balancing a large number of elements. These articles ranged from the mathematically calculable displacements of multiple independent but connected dots in a graphical network to the non-calculable manageability of complex social tasks.[1628] In the management of social tasks within a plurality of inter-related units, one should start with the individual centers organizing its own actions and relationships with the other units involved in a common task, which is equivalent to the principle of subsidiarity.[1629]

Although a physical chemist by training, Michael Polanyi's application of the concept of polycentricity was the outcome of his interest in the social system preserving the freedom of expression to intellectual inquiry in the context of his opposition to central planning. Polanyi's social analysis was highly original in that he based it on an analogy of the organization of the scientific community.[1630] Polanyi argued that the success of science was mainly due to its "polycentric organization." In such a system, the scientists

[1624] Robert Jervois (1997) supra note 29, p. 291.

[1625] Michael Polanyi (1951) supra note 1202.

[1626] Vincent Ostrom, Charles M. Tiebout and Robert Warren (1961) supra note 49, pp. 831-842.

[1627] Elinor Ostrom (2009) supra note 51.

[1628] Michael Polanyi (1951) supra note 1202, p. 213.

[1629] Subsidiarity is the principle of allowing the lowest level of human organization, e.g. individual members in a large organization, to make decisions on issues that affect them, rather than leaving those decisions to be made by the larger organization.

[1630] Paul D. Aligica and Vlad Tarko (2012) Polycentricity: from Polanyi to Ostrom, and beyond, Governance, Volume 25, Issue 2 (April 2012), pp. 237-238.

have the freedom to make personal contributions by structuring their research activities in the best way they consider fit for purpose. Their purposeful efforts do not usually dissipate in unproductive directions because they share the common ideal of an abstract end goal of objective truth. The crux of his argument is that such an abstract and underoperationalized ideal cannot be imposed on the scientists by an overarching authority using strict operational rules and progress directives. The authority has to allow a multitude of opinions to flourish. The attempt to impose progress directives toward an abstract ideal is doomed to failure as progress is the outcome of a trial-and-error evolutionary process of many agents interacting freely.[1631]

Vincent Ostrom and colleagues adopted the notion of polycentricity in the context of metropolitan governance to describe a system "of (1) many autonomous units formally independent of one another, (2) choosing to act in ways that take account of others, (3) through processes of cooperation, competition, conflict, and conflict resolution".[1632] They showed that in the case of US metropolitan areas, under certain conditions, such attempts generate better community management than the predominant standard mode of centralized organization. This concept of polycentricity was subsequently used to analyze collective action problems within the Ostroms' research program at the Workshop in Political Theory and Policy Analysis of Indiana University.

4.3.1.1.2. Principle of Subsidiarity

The international climate change regime, centered on the UNFCCC, the Kyoto Protocol and the Paris Agreement, has been 30 years in the making but it still remains a work in progress. In fact, the climate change regime has been heavily criticized as being far too slow to produce the needed results.[1633] To have a truly enforceable MEA evolving from the non-enforceable Paris Agreement will take a long time. However, it does not mean that humankind should just wait for such a global solution and doing nothing for the present. Humankind should instead take immediate substantive remedial action at the national, provincial, and local levels and by various actors to prevent the Earth's climate system from tipping over and creating a major catastrophe. Afterall, the accumulation of GHG emissions in the atmosphere is the cumulative result of actions taken by

[1631] Id., p. 238.

[1632] Vincent Ostrom (2014) (1991) Polycentricity: The Structural Basis of Self-Governing Systems. In: Choice, Rules and Collective Action: The Ostroms on the Study of Institutions and Governance [Paul Dragos Aligica and Filippe Sabetti (eds.)], ECPR Press, Colchester, UK, pp. 45–60.

[1633] David G. Victor (2011) Global Warming Gridlock: Creating More Effective Strategies for Protecting the Planet, Cambridge University Press, Cambridge, UK.

individuals, families, communities, and corporations as well as by the local, provincial, and national governments.[1634] Hence, going by the principle of subsidiarity, the decision to cut down on GHG emissions should be taken up by all these various actors.

Besides, even when an enforceable MEA is eventually negotiated at the international level, if the MEA is then not backed up by a variety of efforts at the national, provincial, and local levels, it is not guaranteed to work well. Even the current Paris Agreement cannot succeed in the absence of strong support from national legislation of GHG emissions reduction strategies and sanctions in the event of non-compliance, and the monitoring and enforcement activities at the provincial and local levels. Meanwhile, effective monitoring and enforcement will require the active participation of communities and non-governmental groups at the local level. Hence, effective international climate change governance is inevitably polycentric in essence.[1635]

While the level of GHGs in the atmosphere may be relatively uniformly distributed on a global level resulting in relatively uniformly global average temperature rise, yet the impacts of climate change have widely differentiating impacts. Because of these widely differing impacts of climate change, the polycentric approach is highly compatible because it connotes many centers of decision making that are formally independent of each other and these decision making centers can adapt their decisions to suit the widely differing conditions with respect to geographic location and ecological conditions, social, economic and political system, prior preparation for extreme weather events, and past investments in resilient infrastructure and facilities.[1636] "To the extent that they take each other into account in competitive relationships, enter into various contractual and cooperative undertakings or have recourse to central mechanisms to resolve conflicts, the various political jurisdictions ... may function in a coherent manner with consistent and predictable patterns of interacting behavior. To the extent that this is so, they may be said to function as a 'system'".[1637]

4.3.1.1.3. General Characteristics of Polycentric Governance

The polycentric approach is not just about hierarchy at multiple levels of government, in which lower levels of government simply carrying out orders from those at higher levels.

[1634] Elinor Ostrom (2010) supra note 37, p. 550.

[1635] Daniel H. Cole (2011) From Global to Polycentric Climate Governance, EUI Working Paper RSCAS 2011/30, EuropeanUniversity Institute, Florence, Italy, p. 1.

[1636] Elinor Ostrom (2010) supra note 37, p. 550.

[1637] Vincent Ostrom, Charles M. Tiebout and Robert Warren (1961) supra note 49, pp. 831-832.

Polycentricity requires a certain level of independence and interdependence among the various units, including governments at the national, provincial, and local levels, together with a non-governmental organization, a corporation, a community, even a family or an individual. The crux of the issue is to determine the appropriate division of responsibility and authority among the various units at the global, national, provincial, and local levels.[1638] Hence, each unit within a polycentric system has considerable independence to create norms and rules within its specific domain. More importantly, the actors in a particular unit of the polycentric system, especially at the lower levels, have the advantage of using local knowledge as well as learning from others who are also engaged in similar trial-and-error learning processes.

This process-oriented approach neither relies on the impersonal invisible hand of the free market exchange mechanisms nor on the impersonal rules established by the legislature of the state. The rules-in-use established by the group of actors in the CPR are flexible and not fixed, and adapted to the local social and environmental conditions; the authorized users are personally involved in the establishment of the rules-in-use to ensure that the rules are fair in the monitoring of users and the commons; in the sanctions that starts with very low penalties and becoming stronger with repeated violations; and in the provision of rapid and low-cost conflict resolution mechanisms that are user-centric and, hence, more personalized.

Hence, although problems associated with free riders, local tyrants, and inappropriate discrimination, especially as larger units enter the system, will continue to be present, a polycentric system has considerable advantages given that their mechanisms for mutual monitoring, graduated sanctions, and rapid, low-cost conflict resolutions.[1639]

Besides, because the rules-in-use established by the units, especially at the lower levels, in a polycentric system are flexible, as new scientific information and innovations are made available, these rules-in-use can be adjusted and better strategies adopted over time for continuous improvement. In fact, the relative inflexibility of international rules once established especially via the multilateral parliamentary process is one of the major obstacles because the nation-States are reluctant to set undesirable precedents that would be a constraint on their own domestic legislative process in the future.

For instance, the US Competitive Enterprise Institute is of the opinion that the Paris

[1638] Daniel H. Cole (2011) supra note 1635, p. 2.

[1639] Elinor Ostrom (2010) supra note 37, p. 552.

Agreement "endangers America's capacity for self-government. It empowers one administration to make legislative commitments for decades to come, without congressional authorization, and regardless of the outcome of future elections" and had called for US President Trump to withdraw from the Paris Agreement.[1640]

4.3.1.1.4. Trust, Reciprocity and Reputation in Smaller Scale Collective Units

Enabling citizens to form smaller scale collective units encourages repeated face-to-face communication, which can change the structure of an action situation.[1641] Laboratory experiments have demonstrated that when players are grouped so that they are more likely to interact with one another than with the general population, and when the expected number of repetitions are sufficiently large, reciprocating strategies such as tit-for-tat can prove successful in fostering cooperation.[1642] The use of reciprocity norms means that in tit-for-tat games, the player must also be willing to "punish" another player who defected in the previous round by defecting in the current round.[1643] When many individuals use reciprocating norms in cooperative games, there is an incentive then to acquire a reputation for keeping promises and performing actions with short-term costs but long-term benefits.[1644] Thus, face-to-face communication allows the players to know the reputation of the other players and to increase or decrease accordingly their trust in the reliability of others. With success in their reciprocity strategies, the players will change their expectations from the initial probability that the other players will use reciprocity norms to a higher probability that the said players will reciprocate trust and cooperation for higher cooperative dividend.[1645]

Extensive empirical evidences collated by Elinor Ostrom and colleagues associated with the Workshop in Political Theory and Policy Analysis at Indiana University have shown that the establishment of norms, rules and policies at smaller scale collective units are relevant and necessary to complement the larger scale norms, rules and policies needed at the national and international levels for managing the global commons.

[1640] Christopher Horner and Marlo Lewis, Jr. (2017) supra note 1554, p. 1.

[1641] Elinor Ostrom (1998) supra note 55, p. 13.

[1642] Robert M. Axelrod (1984) The Evolution of Cooperation, Basic Books Publishers, New York, NY, USA.

[1643] Drew Fudenberg and Eric Maskin (1986) The Folk Theorem in Repeated Games with Discounting or with Incomplete Information, Economica, Volume 54, Number 3, pp. 533-554.

[1644] Gary J. Miller (1992) Managerial Dilemmas: The Political Economy of Hierarchy, Cambridge University Press, Cambridge, UK.

[1645] Elinor Ostrom (1998) supra note 55, p. 13.

4.3.1.1.5. Five Key Propositions in Polycentric Theory

There is currently an absence of a single canonical summary of the essential features of polycentric systems[1646] or clearly articulated hypotheses.[1647] There are, however, five key propositions in polycentric theory, which will be the guide to the way polycentric climate change governance in the future will be described, explained and designed:[1648]

(1) Local Action: Governance initiatives are likely to take off at a local level through self-organization.
(2) Mutual Adjustment: Actors in the unit are likely to develop collaborations with one another, producing more trusting inter-relationships.
(3) Experimentation: There is both willingness and capacity to experiment, which is likely to facilitate governance innovation and learning about what works.
(4) Trust: Trust is likely to build up more quickly when actors can self-organize, this increasing collective ambitions.
(5) Overarching Rules: Local initiatives are likely to work well when they are bound by a set of overarching rules that enshrine the goals or allow conflicts to be resolved.

4.3.1.1.6. Complementary Approach to 'Market' and 'State'

The polycentric approach to the governance of climate change according to Elinor Ostrom and colleagues is a viable complementary solution to the 'market' and 'state' solutions. The encouragement of multiple actors at multiple levels making independent decisions to curb GHG emissions does not preclude the use of 'market' and 'state' solutions to avoid the tragedy of the commons. Even at the smaller scale collective levels of climate action, it will often involve the use of market-based mechanisms to incentivize participation and the establishment of rules-in-use to enforce non-compliance and penalties to sanction non-compliance. In many cases at the smaller scale collective level, the process-oriented approach with the substantive involvement of the authorized users of a specific CPR to establish rules of use for the joint management of the CPR can bring additional benefits.

[1646] Marcel J. Dorsch and Christian Flachsland (2017) A Polycentric Approach to Global Climate Governance, Global Environmental Politics, Volume 17, Issue 2 (May 2017), pp. 45-64.

[1647] Paul D. Aligica and Vlad Tarko (2012) supra note 1630, pp. 237-262.

[1648] Andrew Jordan, Dave Huitema, Jonas Schoenefeld, Harro van Asselt and Johanna Forster (2018) Governing Climate Change Polycentrically: Setting the Scene. In: Governing Climate Change: Polycentricity in Action [Andrew Jordan, Dave Huitema, Harro van Asselt and Johanna Forster (eds.)], Cambridge University Press, Cambridge, UK, pp. 3-25.

Meanwhile, Robert Keohane and David Victor, from an international relations perspective, had also argued that, "a climate change regime complex, if it meets specified criteria, has advantages over any politically feasible comprehensive regime, particularly with respect to adaptability and flexibility."[1649] Their definition of the "regime complex," as somewhere in the middle between the continuum from the "fully integrated institutions that impose regulation through comprehensive, hierarchical rules" to the "highly fragmented collections of institutions with no identifiable core and weak or nonexistent linkages between regime elements," is consistent with the theory of polycentric governance.[1650]

Kenneth Abbott, who had carried out a analysis of complex governance arrangements in terms of the regime complex theory and polycentric theory, concluded that both theories identifies important benefits of decentralization. Regime complex theory, however, stresses the significant costs involved in decentralization while the polycentric theory views it more positively, especially for the smaller scale collective units. However, for both theories, Abbott did suggest that some degree of orchestration with a non-hierarchy "light coordination mechanism"[1651] by an international organization is essential to manage fragmentation.[1652] Hence, the important lesson learned from the analysis of the regime complex theory or the polycentric theory is that relying on just one unit, instead of decentralized units for implementation and a centralized for orchestration, to solve the climate change problem is futile.

4.3.1.2. National Governance in Polycentricity

The cast of climate change governance has changed considerably in the recent decades. It was for a considerable period of time populated only by the epistemic community of climate scientists and the policymakers and negotiators of nation-States. Today, the evolving cast include not only climate scientists, policymakers and negotiators from the nation-States but also individuals, e.g. Greta Thunberg,[1653] families, e.g. Mayer and

[1649] Robert O. Keohane and David G. Victor (2010) supra note 502, p. 1.

[1650] Daniel H. Cole (2011) supra note 1635, p. 15.

[1651] P. H. Pattberg (2010) Public-private partnerships in global climate governance, Wiley Interdisciplinary Reviews: Climate Change, Volume 1, Number 2, pp. 279-287.

[1652] Kenneth W. Abbott (2011) The Transnational Regime Complex for Climate Change, Version 2 (November 2011), Arizona State University, Tempe, AZ, USA, pp. 31-32.

[1653] David Crouch (2018) supra note 526.

Morris Kaplan Family Foundation,[1654] local communities, corporations, transnational networks, e.g. C40 Cities[1655], local governments, provincial governments, international organizations, and non-governmental organizations.

The theory of polycentric governance attempts to explain this fluid and dynamic system by offering a holistic and inclusive view, which includes the five key propositions. Some scholars, in emphasising the lack of hierarchy in polycentric systems, suggest that states cannot, or will not, be relied on, because a multitude of other actors will provide the alternative mechanisms and solutions,[1656] while other scholars acknowledge the importance of the State and of actions taken at the national level. For instance, Elinor Ostrom had asserted that, "solutions negotiated at a global level, if not backed up by a variety of efforts at national, regional, and local levels, are not guaranteed to work well"

The international law research student, therefore, need to understand what is the role of the State in an increasingly polycentric global setting. Is the State only one of many actors in a non-hierarchical structure? Are the State's functions replaceable by equivalent functions of other actors? Or does it maintain a unique position?

The international consulting firm Booz & Company recently published a paper arguing that nationally-based climate mitigation and adaptation strategies, tailored to each country's specific needs and assets, constitute a more "realistic and viable approach to combating the effects of climate change" than a "top-down, internationally-directed approach." Moreover, national and sub-national policies, if adopted by key actors, could have a substantial positive impact on international climate regimes.[1657]

Regardless of the evolving cast of actors, the nation-States and their governments remain the key actors in climate change governance. They engage in international mini- and multi- lateral climate change negotiations, they create a growing number of unilateral national climate policies, and they steer and support a rising number of non-state initiatives, which are led by business, civil society groups, or individuals.[1658]

[1654] See Mayer and Morris Kaplan Family Foundation at: http://kapfam.com/site/program-areas/environment/

[1655] See C40 Cities at: https://www.c40.org/

[1656] Chris Skelcher (2005) Jurisdictional Integrity, Polycentrism, and the Design of Democratic Governance, Governance, Volume 18, Issue 1, pp. 89-110.

[1657] Elinor Ostrom (2010) supra note 37, p. 550.

[1658] Nick Pennell et al (2010) Bottom Up & Country Led: A New Framework for Climate Change Action, Booz & Co., 23 November 2010. Cited in: Daniel H. Cole (2011) supra note 1635, p. 15.

4.3.2. Breaking the US Climate Change Impasse

One the main reasons for the many compromises struck in the Paris Agreement, which diluted the bindingness of the Agreement, was the necessity to accommodate the divisive domestic politics of the US and its continued reluctance, together with many other nation-States, to fully embrace the need for change of behavior.[1659]

Trent Lott was the Republican majority leader in the US Senate from 1996 to 2002, and John Breaux was a chief deputy whip for the US Senate Democrats. As former leaders of the two main parties in the US Senate, they acknowledged that "the politics of the issue have been divisive for decades and a new approach is needed to address this urgent problem."[1660] The two authors know what it takes to achieve a US bipartisan breakthrough on this divisive political issue of climate change. Despite all the discord currently on display in the US Congress, Trent Lott and John Breaux see the possibility, however small the probability, of finding common ground for agreement by the US Congress to break the US climate impasse.

They think that only one lever powerful enough to solve the climate change problem at the required scale and speed is for US Congress to approve legislation to "place a meaningful fee on carbon-dioxide emissions that ripples through all sectors of our economy, and return the revenues it generates to the American people in the form of cash payments." This carbon tax by the US congress must be set high enough so as to encourage an extensive and rapid turn towards cleaner energy sources and accelerate the transition to a low-carbon future in the United States.

The two former political leaders are proposing that the Democrats and Republicans put aside their differences and support the plan proposed by the two former Republican Secretaries of State, James Baker and George Shultz, known as the Baker-Shultz Carbon Dividends Plan.[1661] It stands out as the most politically viable plan not only to meet but to exceed current US Paris commitments as well.

4.3.2.1. Exceeding US Commitments to the Paris Agreement

[1659] Jacob Werksman (2016) supra note 1471, p. 14.

[1660] Trent Lott and John Breaux (2018) supra note 1203.

[1661] Climate Leadership Council (2018) Foreword. In Exceeding Paris: How the Baker-Shultz Plan Would Significantly Exceed the U.S. Paris Commitments, September 2018. Accessed on 3 Oct 2018 at: https://www.clcouncil.org/media/Exceeding-Paris.pdf

In signing the 2015 Paris Agreement, President Obama had committed the United States to reduce its net GHG emissions by 26-28% below 2005 levels by 2025. Even though the Trump administration has announced its intention to withdraw from the Paris agreement, the above-mentioned target remains the benchmark by which any other US climate change abatement plan will be judged.[1662]

Now even if all nations were to fully implement their NDCs, the best studies indicate that far more ambitious emissions reductions will be necessary for the world to maintain global temperatures below the agreed-upon 2°C threshold.[1663] Hence, the goal of US climate change policy moving forward should be to exceed the US Paris commitments of net GHG emissions reduction by 26-28% below 2005 levels by 2025.

4.3.2.2. Baker-Shultz Carbon Dividends Plan.

The Baker-Shultz Carbon Dividends Plan has been recently scrutinized by the Climate Leadership Council[1664] and endorsed by a former Head of the Federal Reserve, Janet L. Yellen, a former Treasury Secretary, Larry Summers, a former Head of US EPA, Christine Todd Whitman, and a former Chairman of Walmart, Rob Walton.[1665]

4.3.3.2.1. Legislation of Rising Carbon Price

An optimal climate change abatement policy would not only reduce carbon emissions, it should also limit regulatory intrusion, promote economic growth, help working-class Americans, and prove durable even when the political atmosphere changes.[1666] The Baker-Shultz Plan, therefore, rests on four pillars:

[1662] Janet L. Yellen and Ted Halstead (2018) The Most Ambitious Climate Plan In History, Commentary, Environment, Fortune Magazine, 10 September 2018. Accessed on 3 October 2018 at: http://fortune.com/2018/09/10/baker-shultz-climate-plan/

[1663] UNEP (2017) supra note 1612, p. xiv.

[1664] Climate Leadership Council is led by Ted Halstead, George P. Shultz and James A. Baker III. Its Founding Members include the economists, Larry Summers, Martin Feldstein and N. Gregory Mankiw, as well as business leaders, such as Ratan Tata, Rob Walton, and Michael Bloomberg. Corporate Founding Members of CLC include oil companies BP, ExxonMobil, Shell, and Total; General Motors; consumer goods giants Johnson & Johnson, P&G, and Unilever, and other multinational companies. NGO Founding Members include the Nature Conservancy and Conservation International.

[1665] Climate Leadership Council (2018) supra note 58.

[1666] Martin S. Feldstein, Ted Halstead and N. Gregory Mankiw (2018) A Conservative Case for Climate Action, Opinion, The New York Times, 8 February 2017. Accessed on 3 October 2018 at: https://www.nytimes.com/2017/02/08/opinion/a-conservative-case-for-climate-action.html

(1) The federal government would impose a gradually increasing tax on carbon dioxide emissions. This would send a powerful message to both businesses and consumers to reduce their carbon footprints.

(2) Carbon dividend payments to all Americans, funded by 100% of the revenue. The revenue would be returned to the American people on an equal basis via quarterly dividend checks, which could be administered by the Social Security Administration. Assuming a starting carbon tax of about $40 per ton, a family of four would receive about $2,000 in the first year. As the tax rate rose over time, so would the dividend payments.

(3) Border carbon adjustments to level the playing field. American companies exporting to countries without comparable carbon pricing would receive rebates on the carbon taxes they have paid on those products, while imports from these countries would face fees on the carbon content of their products to level the playing field for American products. More important, it prevents free riding by other nations and thereby encouraging them to adopt their own carbon pricing system.

(4) Once the US Congress enacts the carbon tax law, both national and state regulations that are not necessary can be eliminated for simplification, including an outright repeal of the Clean Power Plan.

In the study by the Climate Leadership Council, it was assumed that the Baker-Shultz plan would be legislated by the US Congress in 2019 and implemented in 2021. The carbon tax would start at the rate of US$43/ton CO_2 in 2021 (US$43/ton equates to a 2017 rate of US$40/ton, adjusted for expected inflation). From there, the carbon tax rate would increase on an annual basis on a standard escalator rate, e.g. 4%, plus inflation as measured by the Consumer Price Index (CPI).[1667]

To ensure that the intended emissions reduction commitments are met in the future, the Climate Leadership Council has recommended that an Environmental Assurance Mechanism be incorporated into the Plan, which would be triggered to increase the carbon tax faster if key emissions reduction benchmarks are not met.[1668] It would be the most ambitious carbon price enacted by any major emitter nation.

[1667] Climate Leadership Council (2018) supra note 58, p. 5.
[1668] Id., p. 1.

The carbon tax would be applicable for all domestic fossil fuels and non-fossil fuel CO_2 emissions. The carbon tax would also apply to imported fossil fuels, fossil fuel products and imported energy-intensive manufactured products but it would be rebated for exports of these same fuels and products.

4.3.3.2.2. Impact of Increasing Carbon Tax

The carbon tax increases the relative prices of fossil fuels according to their CO_2 emissions. For instance, bituminous coal would incur a tax of about US$96/ton (which is 200% of the average 2017 price), crude oil would be taxed at about US$18/barrel (which is 35% of the 2017 average U.S. crude price), and natural gas would be taxed at about US$2.28/thousand cubic feet (which is 74% of the average 2017 Henry Hub wholesale price or around 20% of the average residential price).[1669] Some of these increased costs because of the carbon tax would be borne by the producers themselves, but most of the increased costs would be reflected in the prices paid by consumers.

4.3.3.2.3. Impact on Fossil Fuel Use

There would be three main significant impacts at the wholesale level on fossil fuel use in all the energy-related sectors:[1670]

(1) The overall cost of fossil fuel energy would increase, thereby encouraging more efficient energy consumption.
(2) The carbon tax would encourage fuel switching. It would immediately increase the relative attractiveness of natural gas to coal in the power generation sector, and nuclear and renewable energy sources as compared to all fossil fuel sources.
(3) In the longer term, the most significant impact would be to increase significantly infrastructure and infrastructure-related investments to reduce energy consumption and to replace existing facilities relying on high-carbon fuel sources with lower- or zero- carbon fuel sources.

According to the Climate Leadership Council's analysis, a much higher carbon tax rate, will be required to secure significant emissions reduction in the transportation sector.

[1669] Climate Leadership Council calculations are based on EIA data for carbon content at https://www.eia.gov/tools/faqs/faq.php?id=73&t=11 and 2017 average fuel prices for petroleum and gas at https://www.eia.gov/ outlooks/steo/

[1670] Climate Leadership Council (2018) supra note 58, p. 6.

4.3.3.2.4. Impact on GHG Emissions Reduction

If all the President Obama-initiated climate regulations were to remain in place, it has been estimated that the Obama-era regulations would achieve approximately 18% in net GHG emissions reduction by 2025. With the Baker-Shultz Plan, it has been estimated that there would be approximately 32% in net GHG emissions reduction by 2025, thereby exceeding the US Paris commitments by a wide margin, and to 41-47% below 2005 by 2035.[1671]

The next step is to ratchet up national ambitions for further reduction of GHG emissions and here is where the United States can take back the mantle of leadership with a bipartisan US Congress approving legislation of the Baker-Shultz Carbon Dividends Plan to "place a meaningful fee on carbon-dioxide emissions that ripples through all sectors of our economy, and return the revenues it generates to the American people in the form of cash payments."[1672]

Although the devil is hidden in the details, the Baker-Shultz Carbon Dividends Plan can be a relatively straightforward piece of legislation, which is environmentally ambitious, ethically correct, acceptable by a broad spectrum of American society, administratively simple, economically sound, and politically viable.[1673]

A recent national poll found that the American public overall supports the Plan by a 2.5-1 (35-point) margin, and among Republicans by a 3-1 (42-point) margin. A more significant finding is that there is a 43-point margin in favor of the Baker-Shultz Carbon Dividends Plan among President Trump supporters.[1674] The Plan is politically viable because it addresses the legitimate concerns of all key stakeholders in the climate change problem and enables each one of them to turn out a winner. The popularity of the Plan itself further enhances its viability.

There is already a broad coalition of business sector leaders supporting the general features of the plan. Among the companies are BP, ExxonMobil, Shell, and Total, as

[1671] Id., p. 3.

[1672] Trent Lott and John Breaux (2018) supra note 1203.

[1673] Janet L. Yellen and Ted Halstead (2018) supra note 1662.

[1674] Nexus Polling (2018) The Yale Program on Climate Change Communication and George Mason University Center for Climate Change Communication, in conjunction with Nexus Polling, conducted an online survey of 1,876 registered voters 29-30 August 2018.

well as AECOM, Allianz, AT&T, Exelon, First Solar, General Motors, Johnson & Johnson, MetLife, Procter & Gamble, PepsiCo, Santander, Schneider Electric, and Unilever. These companies are all founding members of the Climate Leadership Council. The Plan also enjoys support from environmental organizations and opinion leaders from across the political spectrum.[1675]

The broad appeal of the Baker-Shultz Plan is that this Plan contains a series of grand exchanges. The most important exchange is exchanging a robust and rising carbon price for regulatory relief, which appeals to environmentalists, businesses, and conservatives at the same time. Because of its high environmental ambition, the effectiveness of the Plan in reducing emissions justifies the phase-out of the other carbon regulations that are far more intrusive.

It also unlocks the political viability of the other components of the Plan as well. For instance, it appeals to the American people because the rebates from the revenue raised by the carbon tax go back directly to them in an equal per capita amount. The recent national poll found that the respondents favor direct cash rebates over all other uses of the carbon tax revenue.[1676] This would allow the majority of American families to benefit from helping solve the climate change problem. To the economists, the reliance on a market-based carbon tax also makes it the most cost-effective solution. To protect the international competitiveness of American firms, the Plan also includes a border carbon tax adjustment. To ensure that the intended emissions reductions are met, the Plan may also include an Environmental Assurance Mechanism[1677] under which the carbon tax would increase faster if key emissions reduction benchmarks were not met.

Although the current odds of the Plan being accepted by the US Congress might be small, it is already attracted the broadest coalition of policymakers, corporations, opinion leaders, and the American public, in US history to unite in support of a concrete federal climate change solution, and its appeal continues to grow as the widening spectrum of American society are educated on its merits. It is clearly emerging as a consensus national climate solution, which shows that there is a realistic path for the United States to exceed its Paris commitments and restore its position as a global climate change leader.

[1675] Climate Leadership Council (2019) Founding Members. Accessed on 13 September 2019 at: https://www.clcouncil.org/founding-members/

[1676] Nexus Polling (2018) supra note 1674.

[1677] Gilbert E. Metcafe (2018) Enviornmental Assurance Mechanism: adding Environmental Certainty to a Carbon Tax, RFF Report (June 2018), Resources for the Future, Washington, DC, USA.

4.3.3. Breaking the Global Climate Change Impasse

More importantly, as Trent Lott and John Breaux remarked, is that if the US States were to take the lead on carbon pricing, the rest of the world would follow.[1678]

4.3.3.1. The Domino Effect

If China (30%), EU (9%), India (7%), Russia (5%) and Japan (4%) as well as the international aviation (2%) and international shipping (2%) sectors were to follow the US (15% of total GHG emissions)[1679] in ratcheting up their own GHG emissions reduction ambitions by legislating carbon prices, humankind will then be more confident that the Paris Agreement will succeed in maintaining global average temperatures well below the agreed 2°C threshold. If China [Asia], US [Americas], the EU [Europe] and India [Asia] with about 60% of the current total nominal GDP[1680] and about 60% of the current total GHG emissions[1681] were to introduce carbon tax legislation, it would have a domino effect on the rest of the world.[1682]

4.3.3.2. Game Theoretical Study of Non-Cooperative Games

Recent work on "non-cooperative games has shown that games with increasing differences have multiple equilibria as well as a 'tipping set', which is a subset of players who by changing from the inefficient to the efficient equilibrium can induce all other players to do the same." Geoffery Heal and Howard Kunreuther in a recent working paper argued that international climate change negotiations might be such a non-cooperative game and have a tipping set. This set of a small group of countries by

[1678] Trent Lott and John Breaux (2018) supra note 1203.

[1679] In 2014, the top carbon dioxide (CO_2) emitters were China, the United States, the European Union, India, the Russian Federation, and Japan. These data include carbon dioxide emissions from fossil fuel combustion, as well as cement manufacturing and gas flaring. Together, these sources represent about 70% of total global CO_2 emissions. Accessed on 3 October 2018 at: https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

[1680] World Bank (2018) Gross Domestic Product 2018: GDP Ranking, World Bank Group. Accessed on 11 August 2019 at: https://datacatalog.worldbank.org/dataset/gdp-ranking

[1681] UCS (2015) Each Country's Share of CO_2 Emissions, Union of Concerned Scientists, 11 October 2018. Accessed on 11 August 2019 at: https://www.ucsusa.org/global-warming/science-and-impacts/science/each-countrys-share-of-co2.html

[1682] Robert Jervois (1997) supra note 29, pp. 165-166.

adopting climate control measures could "make it in the interests of all others to do likewise."[1683]

In determining the conditions under which tipping can occur, one has to determine how many players are required to form the 'tipping set' that will change their behaviour to ensure that the others will want to change theirs. If it is a small 'tipping set', then we do not have to get everyone to agree to change; an agreement by the small set will suffice. The authors showed that the climate negotiation game has a tipping set if the following conditions are fulfilled: (1) the cost of joining the treaty drops as the number of joiners rises, (2) there is a cost to not joining that is constant or rising with the number who have joined, and (3) if once a sufficient number have joined this cost exceeds the cost of joining for those who have not yet joined.[1684]

One important characteristic of a tipping point is the ability of the tipping set to impose costs on non-joiners such as border adjustment tariffs to compensate for the lack of a price on carbon. One of the four pillars of the Baker-Shultz Carbon Dividends Plan is the use of such border carbon adjustments tariffs to level the playing field. American companies exporting to countries without comparable carbon pricing would receive rebates on the carbon taxes they have paid on those products, while imports from these countries would face fees on the carbon content of their products to level the playing field for American products. More important, it prevents free riding by other nations and thereby encouraging them to adopt their own carbon pricing system.

Hence, the formation of such a tipping set comprising of the US, China, EU and India would constitute a significant improvement to the global climate regime given the myriad flaws of the Kyoto market-based mechanisms. From a polycentric governance perspective, the shape of global climate change policy may well be determined more by what happens in the US, China, EU and India over the next five to ten years.[1685]

[1683] Geoffery Heal and Howard Kunreuther (2011) Tipping Climate Negotiations, Working Paper 16954 (April 2011), National Bureau of Economic Research, Cambridge, MA, USA, p. 1.

[1684] Id., p. 13.

[1685] Daniel H. Cole (2011) supra note 1635, p. 16.

CHAPTER 5: FUTURE OF CLIMATE CHANGE GOVERNANCE

I think international law has a wonderful political and intellectual potential (this is why I am interested in its history) but that it has in the 20th century become – malgre soi – a small bureaucratic discipline at law schools. My project is to try to revive a sense of its original mission, its importance. I suspect I am creating a myth (for it probably never was much better) – but myth-creation is an important aspect of political activity and activism.

Martti Koskenniemi[1686]

What is needed ... in order to save the world from self-destruction is not limitation of the exercise of national sovereignty through international obligations and institutions, but the transference of the sovereignties of individual nations to a world authority, which would be sovereign over the individual nations as the individual nations are sovereign within their respective territories.

Hans Morgenthau[1687]

5.1. LIMITATIONS OF INTERNATIONAL LAW

30 years after the failure of the Noordwijk Conference and 20 years after the Kyoto Protocol, where does the Paris Agreement and all the political compromises it had to accommodate in order to gain acceptance, leave the role of international law in shaping State behavior to avoid the tragedy of the commons? Bodansky in the introduction to his article on the legal character of the Paris Agreement,[1688] remarked, "The obsession with the Paris outcome's legal character may seem curious to scholars sceptical that international law significantly affects State behavior.[1689] Whether or not the Paris

[1686] Emmanuelle Jouannet (2011) Koskenniemi: A Critical Introduction [Martti Koskenniemi commenting at a Conference at the Law Faculty of the Sorbonne, February 2004.] In: Martti Koskenniemi: The Politics of International Law, Hart Publishing, Oxford, UK, p. 1.

[1687] Hans Morgenthau (1985) supra note 62, p. 505.

[1688] Daniel Bodansky (2016) supra note 1419, p. 142.

[1689] Jack L. Goldsmith and Eric A. Posner (2005) The Limits of International Law, Oxford University Press, Oxford, UK.

Agreement is legally binding, it lacks enforcement machinery and is not necessarily justiciable, at least in some countries. Nevertheless, States clearly thought the issue of legal form mattered, and this belief itself became an important reality in the negotiations, which significantly shaped the ultimate result." To understand the reason for such behavior among the nation-States when engaged in multilateral diplomatic negotiations, the international law research student need to know the evolution of international law and its doctrinal struggle against international politics.

This struggle for an international Rule of Law by the nation-States at the Paris Climate Change Conference is a doctrinal struggle against international politics, which is understood as furthering the subjective desires of the nation-States and leading into international anarchy. Although some measure of international politics is inevitable, the international system should be constrained by non-political rules for "... the health of the political realm is maintained by conscientious objection to the political."[1690]

5.1.1. Limitations of Modern Legal Doctrines

In an international society, in which the purpose of the nation-States is assumed to serve no higher purpose than the interests of the individual sovereign nation-States and if one assume the perfect equality of all these individual interests, then the Rule of Law seems the only principle of international organization short of *Bellum omnium contra omnes*.

5.1.1.1. Classical International Law in the 18th Century

As a result, since the publication of Emer de Vattel's 2-volume "Droit des gens ou principes de la loi naturelle appliquies d la conduite et aux affaires des nations et des souverains"[1691] in the mid-18th century, jurists in their writings have assumed that the liberal principles of the Enlightenment for social organization, which have been applied to domestic society could be extended to international society. The three liberal principles of social organization of freedom, equality and the Rule of Law follow from the simple denial of the existence of principles of natural justice or of our human capacity to know them. If man is born into a world without pre-existing norms, he is born free; if there are no pre-existing standard to establish the relative worth of men,

[1690] Martin Wright (1966) supra note 401, p. 122.

[1691] Emer de Vattel (1758) Droit des gens ou principes de la loi naturelle appliquies d la conduite et aux affaires des nations et des souverains, Tome I & II, A. Londres. Accessed on 18 Septmeber 2019 at: https://oll.libertyfund.org/titles/vattel-le-droit-des-gens-ou-principes-de-la-loi-naturelle-2-vols

men must be equal; and freedom and equality can only be guaranteed only if social constraint is governed by public, verifiable and determining rules. The circular argument goes as follows: "A free people obey but it does not serve; it has magistrates but not masters; it obeys nothing but the laws, and thanks to the force of laws, it does not obey men."[1692]

First, in subscribing to the ideology of the Enlightenment, Vattel purged Christian morality and theological authorities from his work. Second, he adopted the Hobbesian view[1693] throughout his work. Third, he used the domestic analogy for international society in a manner that characterizes all classical international legal discourse. "The law between States is thus analogous to the law between individuals. States are super-individuals, thrown in the world to seek their self-interest. The international community is only an aggregate of such States, and by itself, has no claim on them."[1694] The history of international law since then, in essence, has been an evolutionary account of the struggle against international politics.

5.1.1.2. Classical International Law in the 19th Century

Since the Vienna Congress of 1814-15[1695] and the defeat of Napoleon, the relations between the major European powers, who were then dominant in international politics, were no longer built on the pursuit of primacy by one power but of the balance of power among the major European powers, which was guaranteed by complicated diplomatic procedures and alliances.[1696] The 19th century law scholars interpreted and systematized these diplomatic practices into international legal rules. Soon, international law, as an academic discipline, was taught separately from theology, philosophy and natural law, as well as separately from civil law.[1697]

Meanwhile, contemporary nation-States increasingly saw Europe as a 'system' of independent and equal political communities instead of a Respublica Christiana.[1698]

[1692] Jean-Jacques Rousseau (1762) *Du contrat social; ou Principes du droit politique* [The Social Contract, translated with an introduction by Maurice Cranston (1968), Penguin, London, UK, p. 32.]

[1693] Thomas Hobbes (1651) supra note 191.

[1694] Martti Koskenniemi (2005) supra note 295, p. 113.

[1695] Brian E. Vick (2014) The Congress of Vienna: Power and Politics after Napoleon, Harvard University Press, Cambridge, MA, USA.

[1696] F. H. Hinsley (1962) Power and the Pursuit of Peace: Theory and Practice in the Relations between States, Cambridge Universitry Press, Cambridge, UK, pp. 186-271.

[1697] Martti Koskenniemi (2005) supra note 295, p. 122.

[1698] J. Neville Figgis (1911) Respublica Christiana, Transactions of the Royal Historical Society,

They therefore assumed that the governing principles needed to become neutral and objective were essential legal in character and that the behaviors of the European nation-States were determined and explicable by reference to a body of European public law. The plausibility of this assumption relied mainly on the procedural character of the then European public law, which contained mostly rules concerning diplomatic and consular contacts, procedures for attaining statehood, territory or neutral status.[1699]

First, the substance of that body of law, however, did not severely restrict the ends that the European sovereigns wanted to pursue. Second, it did renounce theories of the just war because by now war had become just one political procedure among others.[1700] Third, and more importantly, although the professional lawyers of the 19th century did speak about justice in the conduct of their sovereigns' affairs, they no longer perceived justice as being of a material entity. Theodore D. Woolsey said it succinctly: "By justice, however, we intend not justice objective, but as it appears to the party concerned or, at least, as it is claimed to exist. From the independence of nations it results that each has a right to hold and make good its own view of right in its own affairs."[1701]

5.1.1.2.1. Limitation of Classical International Law

The liberal theory of politics prioritizes "right" over "good".[1702] It places primacy on personal freedom and its inviolability over social goals. The same is true of classical international law. It places primacy on the sovereign rights and its inviolability of the member-States over the social values of justice and equity. The problem is that social organization is necessary. But as these values are subjective, social organization cannot justify itself by referring to these values. It is only justified if it is understood as existing for the protection of the sovereign rights and inviolability of its member-States.

5.1.1.2.2. Proposed Solution to Limitation

The important question then turns to the determination of the State's sphere of

Volume 5 (December 1911), pp. 63-88.

[1699] Martti Koskenniemi (1990) The Politics of International Law, International Journal of European Law, Volume 1, Issue 1 (1 February 1990), p. 6.

[1700] Henry Wheaton (1855) Elements of International Law [6th Edition by William Beach Lawrence], Little, Brown and Company, Boston, MA, USA, pp. 361-365.

[1701] Theodore D. Woolsey (1879) Introduction to the Study of International Law Designed as an Aid in Teaching, and in Historical Studies, 5th Ed., Scribner, Armstrong & Co., New York, NY, USA, p. 183.

[1702] John Rawls (1999) A Theory of Justice, Revised Edition, Belknap Press, Cambridge, MA, USA, p. 28.

inviolability. The initial liberal solution was to rely on the State's own self-definition. However, in conflicts where these spheres of inviolability seemed to overlap, international law was unable to solve the conflict. To skirt the issue, classical international lawyers proceduralized the law. Instead of substantive rules to delimit sovereign rights, lawyers focused on the use of diplomacy and international conferences, etc. The success of this procedural strategy is based on the assumption that these instruments will be used by its member-States to solve their conflicts and maintain international order. This assumption meets with two difficulties. First, by directing the member-States towards these procedural instruments, international law is telling them that their conflict is minor and will be resolved once the member-States get to know and understand each other's views. Proceduralization also ignores the fact that because resources are scarce, conflict resolution often will require unequal distribution. Second, international law assumes that the said member-States will now accept some external principles of distributive justice for unequal allocation, which would make superfluous the emphasis on the need to do away with these principles in the first place.[1703]

5.1.1.3. Modern International Law in the 20th Century

Modern international law shares the same problematique as classical international law because the 20th century international lawyers did not reject the liberal ideal of the Rule of Law. On the contrary, international law scholarship during the first half of the 20th century accused the pre-war international lawyers of not going far enough to uphold the Rule of Law. Wherever there were failures by jurists to construct a solid framework of public international law during this period, it had been ascribed not to some defect in the liberal assumptions behind but to jurists having deviated from these assumptions.[1704] The vision of a Rule of Law between nation-States re-emerged in the United Nations General Assembly through its Resolution 44/23 of 17 November 1989[1705] declaring the period 1990-1999 as the "United Nations Decade of International Law", which is yet another reformulation of the liberal desire to escape international politics.

Social organization through legal rules in the spirit of liberalism is predicated on the assumption that these rules are objective while political interests are not. To show that

[1703] Martti Koskenniemi (2005) supra note 295, pp. 155-156.

[1704] Martti Koskenniemi (1990) supra note 1699, p. 6.

[1705] United Nations (1990) Resolution 44/23, 17 November 1989, Resolutions and Decisions adopted by the General Assembly during its Forty-Fourth Session, Volume 1, 19 September 1989 to 29 December 1989, Supplement No. 49 (AQ/44/49). Accessed on 13 September 2019 at: https://www.un.org/ga/search/view_doc.asp?symbol=a/44/49

international law is objective, the international lawyer has to struggle on two fronts. To ensure concreteness of international law, the lawyer has to distance it from natural law. To guarantee the normativity of international law, the lawyer has to distance it from actual State behaviour. International law is independent from international politics only if both of these conditions are simultaneously present. International law is a social conception; it is not natural but constructed, reflecting social circumstances. To avoid political subjectivism and illegitimate constraint, international law should be based on something concrete, which is the verifiable behavior of the nation-State. At the same time, international law should be applicable regardless of the political interests of the nation-State. In particular, it should be applicable even against a nation-State that opposes it. International legal rules whose content or application depends on the will of the nation-State for whom they are valid are not proper legal rules at all but apologies for the said nation-State's political interests.[1706]

It is impossible to prove that a legal argument is both concrete and normative simultaneously. An argument, on the one hand, about concreteness is an argument about the closeness of a particular rule, principle or doctrine to actual State practice. But the closer to State practice a particular rule, principle or doctrine is, the less normative and more political it seems and hence an apology for the existing power. A legal argument about normativity, on the other hand, is an argument to show the rule's distance from actual State practice. But the further away from actual State practice, the less concrete and more political it seems and hence Utopian and, like theories of natural law, could be manipulated at will. The dynamics of international legal argument is the constant effort by international lawyers to show that their understanding of the particular rule, principle or doctrine is either concrete (ascending argument) or normative (descending argument) and thus it becomes vulnerable to the charge that the legal argument is in fact political because it is either apologist or Utopian.[1707]

As a result, two main criticisms are often expressed against international law. One group of critics accuses international law of being too political because it is too close to states' political power and therefore too apologetic to be taken seriously in the construction of international order. The other group argues that international law is too political because it is founded on speculative Utopias and hence too Utopian to the same effect. From one perspective, this criticism highlights the flexibility of international law, which can be manipulated by power politics. From another perspective, the criticism

[1706] Martti Koskenniemi (1990) supra note 1699, pp. 7-8.

[1707] Id., p. 8.

stresses the moral character of international law, which does not reflect the realities of power politics. Both these criticisms are directed at the lack of legislative instruments, compulsory adjudication, and enforcement procedures in international law,[1708] which will be discussed in Section 5.1.2.

International lawyers have attempted to answer these criticisms by reconstructing modern doctrines. Koskenniemi have identified four reconstructive doctrines, wherewith "threats to the [legal] argument's inner coherence or to its [liberal] assumptions are removed, or hidden from sight, in order to maintain the system's overall credibility." The four mutually exclusive and logically exhaustive positions for a full explanation of the possibilities of doctrinal argument are as follows:

1. Rule approach (the law is normatively strong but restricted in scope)
2. Process approach (the law is normatively weak but wide in scope)
3. Sceptical approach (law is both normatively weak and restricted in scope)
4. Idealistic approach (law is both normatively strong and wide in scope)

First, these four positions do not encompass any specific views about substantive norms. Second, each position is defined exhaustively by its response towards the problems of normative force and material scope. Third, they are purely relational one to another and hence are meaningful only vis-à-vis each other.[1709]

5.1.1.4. Rule Approach or Sources of International Law: Georg Schwarzenberger

The rule approach (sources) to international law is identifiable by reference to an objective test of its pedigree that will exhaustively tell what statements qualify as law and what do not. The ground for the reconstructive doctrine of the rule approach is due to the criticism of early and classical doctrines as being politically subjective because these earlier doctrines associate international law with either someone's political opinion of justice [morality] or simple State behavior [power politics]. Hence, the corpus of international law consists of an exhaustive statement of rules, which had been tested by the objective criteria of law creating processes. All else is politics, whether in the guise of morality or power politics.[1710]

[1708] Id., p. 9.
[1709] Martti Koskenniemi (2005) supra note 295, p. 185.
[1710] Id., pp. 189-190.

5.1.1.4.1. Key Characteristics of the Rule Approach or Sources of International Law

Schwarzenberger recognized that many disputes contain elements of both law and politics. However, he insisted on the clear-cut distinction between these elements of the dispute in order to determine the proper object of the law-ascertainment or judicial process, which is the principal legal procedure. "[F]acts, however undisputed, which are the results of conduct violative of international law cannot claim the ... right to be incorporated into the law of nations."[1711] Only binding rules are to be incorporated and they must be established by the objective criteria of law creating processes.[1712]

The objectivity of the rule-approach is based on its effort to create verifiable or falsifiable hypotheses on perception of the functioning of the "law-creating processes". Hence, law is created inductively by legal subjects and not deductively from abstract principles.[1713] These law creating processes are the social processes of custom, treaty and general principles, which are understood as convergences in municipal law.[1714]

Law-creation (legislative function) is strictly distinguished from law-ascertainment by law-determining agencies (judicial function, which include courts but also writers and States themselves). This distinction further strengthens the law/politics distinction. Law exists objectively through the regular functioning of the law-creating processes. Its ascertainment, however, can be more or less objective depending on the "degree of the skill and technical qualification of each law-determining agency".[1715]

Hence, the distinction between legal and political dispute follows as a matter of course. Schwarzenger admitted that it might sometimes be difficult to distinguish the political and legal elements in a given dispute. However, this difficulty is made easier by the optional character of the judicial process for it depends ultimately on the States themselves whether they choose to regard a dispute to be justiciable or not.[1716]

5.1.1.4.2. Limitations of the Rule Approach or Sources of International Law

[1711] Hersch Lauterpacht (1948) Recognition in International Law, Cambridge University Press, Cambridge, UK, p. 413.

[1712] Martti Koskenniemi (2005) supra note 295, p. 193.

[1713] Georg Schwarzenberger (1965) The Inductive Approach to International Law, Stevens & Sons, Ltd., London, UK, pp. 4-7.

[1714] ICJ (2019) supra note 151, Article 38 (1).

[1715] Georg Schwarzenberger (1965) supra note 1713, pp. 22-23.

[1716] Georg Schwarzenberger (1949) International Law, Volume 1, Stevens & Sons, Ltd., London, UK, pp. 389-391.

First, by agreeing that the judicial process, which is the principal legal process according to the rule approach, is optional, the rule approach is contradicting itself. Second, by insisting on a strict test of its pedigree, meaning a clear-cut distinction between what is law and non-law (*lex lata and lex ferenda*), the rule approach ended up with a reconstructive doctrine, which has only a marginal role in international affairs. For instance, creating the relevant international rules requires balancing and evaluative considerations in the law-creating process that cannot easily fit into the pedigree concept based on the sources of international law, no matter how exhaustive the corpus, especially in this age of rapid technological advances and increase in number and diversity of the human population. Besides, the views about what is the correct pedigree test are also divergent, and ascertaining the law is often very difficult, however, technically competent the law-determining agency. Third, and perhaps most important, is "its inability to provide a convincing account of how law and politics can be held so sharply distinct as assumed by it" for this is a problem that undermines the very ground upon which the rule approach justify itself.[1717]

In practice, the rule approach international lawyer has to concede that there is a margin of political discretion involved in legal activity and that this margin of discretion is uncertain. Hence, the distinction between law and politics cannot be made in a simple manner. Lawyers constantly disagree about legal norms and their application. These conflicting views about the correct norms seem capable of resolution only by taking a position based on a specific theory of justice. Consequently, he is faced with the objection that his inevitable interpretations are merely political constructions. Because political bodies under political procedures administer the law, it is difficult to ascertain that there is an actual objective rule behind the subjective interpretations.[1718]

Schwarzenberger admitted: "On a world scale, it may even be thought that, in our time, the role of international law in the relations between the world camps is more limited than in the relations between potential enemies in any pre-war period since the rise of contemporary international law."[1719]

In conclusion, law subsists away from the center of power politics.[1720] Even when some law is greatly needed at the center of power politics, for instance, in the illegality of

[1717] Martti Koskenniemi (2005) supra note 295, p. 196.
[1718] Id., p. 196.
[1719] Georg Schwarzenberger (1965) supra note 1713, p. 79.
[1720] Martti Koskenniemi (2005) supra note 295, p. 195.

nuclear weapons, the insistence on law's binding force is "hopelessly inadequate".[1721] The ultimate test for law is to what extent it is capable of sustaining a de facto order. On this test, international law fails.[1722] Hence, it will only have relevance at the center when the conditions of international society have changed, which could well be from the catastrophic impacts of climate change in the not-too-distant future.

5.1.1.4.3. Implications of Rule Approach for Climate Change Governance

The implications of the rule-based doctrine for international climate change governance are both positive and negative. First, the fact that the negotiators of the UNFCCC did not go with a strict rule approach MEA was a positive outcome for the evolution of international climate change governance although negative for the rule approach. To insist on a rule-based or sources of international law approach would have stymied international climate change governance right from the start for it was clear from the analysis of its evolution that the nation-States were prioritizing politics over law.

For instance, in 1989 at the Noordwijk Conference, the nation-States would have agreed to curb GHG emissions if not for the United States, supported by UK, Japan and the former Soviet Union, questioning the need to establish such emission targets and timetables. The reason for the US and UK especially to undermine the agreement was implicit in the sentiments expressed by John Sununu years later in an interview, "It couldn't have happened," he said, "because, frankly, the leaders in the world at that time were at a stage where they were all looking how to seem like they were supporting the policy without having to make hard commitments that would cost their nations serious resources."[1723] These sentiments quite correctly reflected the views of the US and UK government administrations although they were far from the mark in reflecting the views of the governments in Europe. Both the US and UK government administrations were then the epicenter of neoliberalism, advocating the superiority of neoliberal ideology, which, in essence, is the personal liberty to compete in the marketplace to solve even global commons problems. They were highly antagonistic to any suggestion of a rule-based supranational approach to curb anthropogenic GHG emissions from the use of fossil fuels, which is the economic life-blood of their national economies.

In an earlier instance before the Noordwijk Conference, the US had viewed the attempt

[1721] Georg Schwarzenberger (1971) International Law and Order, Stevens & Sons, Ltd., London, UK, p. 216.

[1722] Id., pp. 161-168.

[1723] Nathaniel Rich (2018) supra note 764.

by the epistemic community of climate scientists, in the form of the AGGG, to recommend policy actions based on independent scientific assessments as 'aggressive' and had sought, via the WMO, the establishment of an intergovernmental mechanism to conduct scientific assessments, which would include national government representatives for vetting climate change policy advice as well as suggestions for preventive measures in mitigating climate change prior to publication.

Second, a negative for the international climate change governance but a positive for the rule approach is that the inductive approach advocated by Schwarzenberger, grounded in the hard but verifiable facts of international power politics instead of the deductive approach of deriving international rules from general principles, has proven to be prescient. To Schwarzenberger, principles are an "unholy mixture of law and politics" and legal doctrine of international law must be "immunized" against it.[1724] The shortcomings of deducing international rules from principles have been amply demonstrated by the wide divergence in the perception of the key principle of CBDR-RC in climate change governance according to the North-South economic divide.

Third, which is another negative for international climate change governance but a positive for the rule approach is that Schwarzenberger clearly saw the United Nations as a "quasiorder", dominated by great power antagonisms and power politics in disguise, lacking legislative capacity or governmental functions.[1725] He had discussed the law of international institutions by reference to the "overriding realities of power politics".[1726] To Schwarzenberger, to see in international institutions the rudiments of an international community is "wishing thinking or escapism."[1727]

The evolution of the work programme of ICAO in reducing GHG aircraft emissions clearly reflects the "overriding realities of power politics", "wishing thinking" and "escapism" of international organizations. The ICAO Assembly at its 36th Session in September 2007 had already adopted Resolution A36-22, which provided for the establishment of a process for the development and recommendation of a Program of Action and a common strategy to limit or reduce greenhouse gas emissions attributable

[1724] Georg Schwarzenberger (1965) supra note 1713, p. 50.

[1725] Georg Schwarzenberger (1964) Power Politics: A Study of World Society, 3rd Edition, Stevens & Sons, Ltd., London, UK, p. 334.

[1726] Georg Schwarzenberger (1962) The Frontiers of International Law, Stevens & Sons, Ltd., London, UK, pp. 279-280.

[1727] Id., p. 281.

to international civil aviation to the Council.[1728] Yet it was only in October 2016 that the ICAO Assembly adopted a Carbon Offsetting Reduction Scheme for International Aviation (CORSIA), which is designed to achieve a collective medium term global aspirational goal of keeping the global net carbon emissions from international aviation at the same level from its 2020 baseline. This global market-based measure (GMBM) is intended to be the major contributor in the basket of measures to achieve carbon-neutral growth.[1729] Hence, the major objective of ICAO is achieving carbon neutral growth beginning 2020 with no end date with a basket of measures including CORSIA. It does not even have in place long-term plans to effect a steep reduction in carbon dioxide emissions. Yet, the ICAO has extolled its agreement on a GMBM scheme for international aviation (CORSIA) to offset aviation carbon dioxide emissions from 2020 onwards as being complementary to the ambition, and the most significant climate change agreement since adoption, of the 2015 Paris Agreement. It is, in the words of ICAO, "a resolute step from the international community in its efforts to mitigate greenhouse gas emissions by taking sector-wide action at a global level."[1730]

However, the current aspirational goals of the ICAO are not aligned even with achieving the lower ambition of the 2015 Paris Agreement to limit the temperature increase to 2°C above pre-industrial levels; not to mention the higher ambition of limiting the temperature increase to 1.5°C above pre-industrial levels. Analysis by the International Coalition for Sustainable Aviation, which has official environmental civil society observer status with ICAO, of the Assembly Resolution A39-03 and the commitments from the contracting States suggests that the measure will fall short of carbon neutral growth from 2020.[1731] It is clear that the CORSIA scheme may not even be adequate in helping ICAO to achieve the medium-term aspirational goal of carbon-neutral growth from 2020 onwards. Hence, there is a huge gap between the actual action program of ICAO and the ambition of the aviation sector to contribute to a steep reduction in carbon dioxide emissions, which is required for limiting the global

[1728] ICAO (2007) Resolution A36-22, Consolidated statement of continuing ICAO policies and practices related to environmental protection, Resolutions Adopted by the Assembly, 36th Assembly, Appendix K, Montreal, 18 – 28 September 2007, Provisional Edition, September 2016, ICAO, pp. 96-99.

[1729] ICAO (2016) Resolution A39-03, Resolutions Adopted by the Assembly, 39th Assembly, Montreal, 27 September – 6 October 2016, Provisional Edition, October 2016, ICAO, pp. 25-32.

[1730] ICAO (2018) Top 3 misconceptions about CORSIA, Environmental Protection, ICAO. Accessed on 28 September 2018 at: https://www.icao.int/environmental-protection/Pages/A39_CORSIA_FAQ6.aspx

[1731] Eoin Bannon (2016) Global Aviation CO2 Deal Adopted With Mixed Results, Just As Paris Agreement Takes Off, International Coalition for Sustainable Aviation (ICSA), 6 October 2016. Accessed on 28 September 2018 at: https://www.icsa-aviation.org/global-aviation-co2-deal-adopted-with-mixed-results-just-as-paris-agreement-takes-off/

temperature increase to 2°C above pre-industrial levels.

While ICAO seemingly used the iterative approach when it comes to decisions pertaining to the use of a GMBM scheme to achieve carbon-neutral growth, it has in essential been engaging more in the act of 'kicking the can down the road' for as long as possible until it is forced to take action because of an external threat to its privileged position as the international body to address aircraft GHG emissions reduction, e.g. the decision of EU to include aviation in the EU-ETS.[1732]

5.1.1.5. The Sceptical Approach: Hans Morgenthau

First, the sceptical approach regards classical legal doctrines as utopian and unaware of the overriding realities of politics. Like the rule approach, it believes that international law to have a restricted material scope. Unlike the rule approach, it does not believe that the rules of international law are uniformly and absolutely binding. Its bindingness is more or less determined by political realities. Although the sceptical approach is suspicious about the law/politics distinction, which is the crux of the rule-approach, contrary to the policy approach, it does not abolish this distinction altogether. It holds that the law/politics distinction is an ideal but is doubtful about the possibilities of its international realization. Hence, most sceptical writers prefer to leave some scope for international law or concede that it is binding at least in some marginal sense.[1733]

Many of the characteristics of the sceptical approach to international law are present in the work of Hans Morgenthau, who essential holds that politics takes priority over law and, from an international relations or politics perspective, is discussed in some detail in the section on classical realism in Section 1.3.3.1.

5.1.1.5.1. Key Characteristics of The Sceptical Approach

Morgenthau critiqued the classicists for defining ''law'' too narrowly as rules emerging by agreement between States but they also defined it too broadly by holding that all legally formulated agreement results in binding rules.[1734] The classical approach was beneficial in creating distance from early, naturalistic writing. However, by using the

[1732] Ruwantissa Abeyratne (2014) Aviation and Climate Change: In Search of a Global Market Based Measure, Springer, Cham, Switzerland, p. 91.

[1733] Martti Koskenniemi (2005) supra note 295, p. 197.

[1734] Hans J. Morgenthau (1940) Positivism, Functionalism, and International Law, American Journal of International Law, Voume 34, Issue 2 (April 1940), p. 265

written agreement as a criterion and by assuming that from these written agreements there emerges a logically consistent body of law and loses its ties to social reality.[1735] Morgenthau accused the classicists of excluding elements vital to the formulation of binding rules as sociological, ethical and other factors constantly penetrate into the legal rules, establish new ones, change old ones and so on.[1736] Contrary to the rule approach, Morgenthau assumed that these factors have direct significance in the normative study of law and not only merely as part of the description of the law's environment. Politics is primary and law secondary. Even where the international law exists, its content cannot be ascertained independently from political analyses.[1737]

Second, the test as to whether international law is binding or not does not refer to an abstract doctrine of sources. It refers to the concrete presence or absence of sanctions associated with it. The sceptic insists that hypotheses about valid law must be tested in State practice just as those about natural sciences must be tested in natural reality.[1738] Hence, rules unaccompanied by sanction are mere subjective wishes.[1739] In fact, the real test of law is in the time of crisis. It is precisely in such times that the rules of international law break down.[1740] International law is not binding in any uniform or absolute manner because sanctions do not exist in such manner either. Rules bind ''more or less'' as the likelihood of sanction grows or diminishes. There is also a fundamental difference in the understanding of the concept of sanction between the two approaches. To the rule approach lawyer, the concept of sanction is a matter of the existence of a rule providing for sanctions. For the sceptic, this has to be a matter of observable fact. Hence, to the sceptic, what is important is not whether a rule is associated with the existence of a sanction but rather what is the likelihood that actual sanction will follow. This likelihood varies with the political context.[1741] Beyond such political context, the rule has no reality. Hence, the pedigree for law is a complex and highly precarious pedigree that changes with the variations of the political context.

5.1.1.5.2. Limitations of the Sceptical Approach

[1735] Id., pp. 260-263.
[1736] Id., pp. 267-273.
[1737] Martti Koskenniemi (2005) supra note 295, p. 198.
[1738] Hans J. Morgenthau (1940) supra note 1734, p. 260.
[1739] Id., pp. 276-278.
[1740] Raymond Aron (1962) Paix et guerre entre les nations, Calmann-Levy, Paris, France, p. 705.
[1741] Hans J. Morgenthau (1940) supra note 1734, pp. 278-281.

The sceptic's argument is ambidextrous because it maintains and denies the law/politics distinction. This law/non-law distinction is maintained by assuming that it can be differentiated through the criterion of the likelihood of sanction. Yet this distinction is subsequently denied as the question of the likelihood of sanction becomes a sociological one. Binding force emerges with factual coercion. Law is merely a division of power politics. The distinction between legal and political disputes vanishes. What is binding is determined by what is politically effective. As binding force is a matter of degree and context, it happens regularly that law that is effective against one State is not vis-a`-vis effective against another. The lack of precision in international rules makes it possible for governments to interpret the law so as to suit their own purposes.[1742]

The sceptic argues that the importance of international law is minor as it is neither extensive nor normative. The immediate problem with the sceptical approach is its pure reliance on an external point of view. Associating law with actual sanction fails to count for the internal aspects of rules. By looking only at the outer behaviour, it fails to answer the question of whether and to what extent legal rules worked behind that outer behaviour, in the form of inner motivations, by structuring the decision-contexts, and delimiting alternative ways of action. Legal rules exist, but the chief assumption is that that it will always be overridden when important State interests are at stake. Hence, once law is understood in such a ''political'' way, its relevance is safeguarded.[1743]

5.1.1.5.3. Implications of Sceptical Approach for Climate Change Governance

The implications of the skeptical approach doctrine for international climate change governance are both positive and negative. First, the fact that the negotiators of the UNFCCC stuck to a framework convention/protocol model and did not attempt to negotiate a comprehensive 'package deal' in which nothing would be finally decided in the Conference until everything in the Conference was decided in *toto*[1744] was both positive for the evolution of international climate change governance and for the sceptical approach. In the case of UNCLOS III,[1745] the tedious and complex negotiations took more than 14 years to complete and another 12 years for entry into force. While it took less than 2 years from the time the UN General Assembly issued Resolution A/RES/45/212 to establish INC/FCCC on 21 December 1990[1746] to the

[1742] Martti Koskenniemi (2005) supra note 295, p. 199.
[1743] Id., pp. 200-201.
[1744] S.N. Nandan (1986) supra note 787.
[1745] United Nations (1982) supra note 785.
[1746] UNGA (1990) supra note 118.

opening for signature of the UNFCCC at UNCED in Rio de Janeiro on 4 June 1992.[1747] Because of the rapid increase in anthropogenic GHG emissions in the last decade of the 20th century and the first two decades of the 21st century, the early completion of the UNFCCC was in many ways a wise move on the part of the INC/FCCC committee for the rapidly changing landscape of global warming would have further hindered the highly tedious and complex negotiation process involved in climate change governance.

However, the post-Kyoto Protocol negotiation process was a negative for international climate change governance although it was clearly a positive for the skeptical approach. That politics took priority over law and the importance of international law was minor was clearly reflected in the post-Kyoto Protocol epoch, which was a time of crisis. The immediate post-Kyoto Protocol period was marked by the Asian financial crisis.[1748] The neoliberal ideology had by this time spread to the rest of the world from its American epicenter, and the countries in Asia that were adhering closely to the neoliberal approach of completely opening up their financial markets were most affected by the Asian financial crisis. The international politics of national interests started to reel its ugly head and the limitations of a top-down international law approach to climate change governance soon manifested itself when it came to the implementation of the legal instrument Kyoto Protocol to curb GHG emissions.

The same three issues of (1) the fear in the loss of national sovereignty to a supranational authority, (2) the prevalence of neoliberal ideology in the US, and (3) North-South economic divide that affected UNCLOS III in the early 1980s continued to contribute significantly to the failure of the top-down international law approach when it comes down to the implementation of the legal obligations of the Kyoto Protocol by the developed nations, especially the US. In the midst of the turmoil, US President George W. Bush on 13 March 2001 announced that the US did not intend to ratify the Protocol.[1749] More importantly, during this epoch the positions of the developing countries had hardened in the diplomatic negotiations in the aftermath of the Asian financial crisis and they were completely unwilling to concede to the need for the legislation of GHG emission targets and timelines for the developing countries, which eventually led to the non-entry into force of the Doha Amendment[1750] and the failure of the Copenhagen Climate Change Conference.

[1747] United Nations (1992a) supra note 16.
[1748] HKIEBS (2000) supra note 1088.
[1749] US President Bush (2001) supra note 1093.
[1750] UNFCCC (2012) supra note 837.

The post-Copenhagen Conference epoch was both positive for for the evolution of international climate change governance and for the sceptical approach. Out of the ashes of the disastrous Copenhagen Climate Change Conference to extend the top-down approach of the Kyoto Protocol arose the phoenix of a bottom-up approach to international climate change governance, which essentially an acknowledgement that while legal rules exist, it will always be overridden when important State interests are at stake and hence when international law is understood in such a ‘‘political’’ way, its relevance is safeguarded.[1751] It was this complete ‘change of tack’ in climate change negotiations from a top-down to a bottom up approach with voluntary nationally determined contributions (NDCs) from all the nation-States that led to the successful universal adoption of the Paris Agreement on 12 December 2015.[1752]

5.1.1.6. The Policy or Process Approach: Myres McDougal

First, the policy approach distinguishes itself from the rule approach by claiming that the binding force of legal rules is not from the application of an abstract test to determine whether it is law or non-law but from the factual authoritativeness of the legal decisions themselves. Second, it distinguishes itself by claiming the extensive scope of law as compared to the marginal scope of law of the sceptical approach.[1753]

Roscoe Pound in an article some 95 years ago had expressed the concerns of the policy approach, in which he criticized 19th century naturalism and positivism. The former was considered too far removed from State practice while the latter was too uncritical. A strategy, in which the conflicting or overlapping interests and claims, as well as the demands, of the peoples of this crowded world may be shared or satisfied with minimum of friction and waste, was needed. It has to be teleological jurisprudence that is aware of the social context, the values of the participants therein, and would apply utilitarian calculations to maximize global wellbeing through legal decision-making.[1754]

Since authoritative decision-making takes place at all levels of international affairs, international law, hence, has relevance at all such levels. Although the law’s normative force may not always be great, its scope is very wide. Myres McDougal’s policy

[1751] Martti Koskenniemi (2005) supra note 295, pp. 200-201.

[1752] United Nations (2015a) supra note 18.

[1753] Myres McDougal (1953) International Law, Power and Policy: A Contemporary Conception, Volume 082. In: Collected Course of the Hague Academy of International Law, The Hague, The Netherlands, pp. 157-160.

[1754] See Myres McDougal citation of Roscoe Pound in supra note 1753, p. 140.

approach about the relatedness of law and politics are shared by perhaps a majority of modern international lawyers.[1755]

5.1.1.6.1. Differentiation from the Rule Approach

Rules are accumulated trends of past decisions, which do not identify the variables that led to those decisions. Those variables are neither related to the different conditions of current problems nor are they indicative of preferences for the future.[1756] Hence, the rule approach law is far too narrow. By relying on a formal and abstract test, the rule approach lawyer is capable of seeing only very little law. He thereby fails to achieve a complete description of what goes on in international life. By using an arbitrarily restrictive doctrine of legal subjects he fails to produce an exhaustive account of the relevant actors and by concentrating on formal sources he also fails to achieve full description of the techniques of authoritative international decision-making.[1757]

The rule approach lawyer fails to grasp that contemporary normative process has shifted ''from formal, legally binding accords into other form of commitments''.[1758] It is not the rule's formal validity that is important but the degree of effective control that can be associated with it. There is a distinct difference between formal authority and effective control. While the rule approach lawyer prefers the former, a policy approach lawyer will focus on the latter.[1759] Hence, a policy approach has little or no room for formally neutral rules. It relies instead on value-dependent ''policies'' or ''processes'' to construct the relevant international law.[1760]

5.1.1.6.2. Differentiation from the Sceptical Approach

McDougal defines international law as the "flow of decision in which community prescriptions are formulated, invalidated and in fact applied."[1761] But the effectiveness

[1755] Martti Koskenniemi (2005) supra note 295, p. 201.

[1756] Rosalyn Higgins (1982) The Identity of International Law. In: International Law: Teaching and Practice [Bin Cheng (ed.)], Stevens & Sons, Ltd., London, p. 38.

[1757] Myres McDougal (1953) supra note 1753, pp. 160-164.

[1758] Gideon Gottlieb (1982) Global Bargaining: The legal and diplomatic framework. In: Lawmaking in the Global Community [Nicholas Greenwood Onuf (ed.)], Carolina Academic Press, Durham, NC, USA, p. 109.

[1759] Myres McDougal (1953) supra note 1753, pp. 172-173.

[1760] Oscar Schachter (1982) International Law in Theory and Practice: General Courses in Public International Law, Volume 178. In: Collected Course of the Hague Academy of International Law, The Hague, The Netherlands, pp. 44-54.

[1761] Myres McDougal (1953) supra note 1753, p. 181.

of community prescriptions varies. This is a consequence of the lack of common values and the individualized nature of situations in international life. To avoid utopianism, international law must therefore be responsive to such variations.[1762]

Because of the broad definition of international law as comprehensive processes of authoritative decision, it has a very wide scope. However, unlike the sceptical approach, these processes are not naked power. The right perspective is that within these processes, "people strive to maximize values by applying institutions to resources''.[1763] Legal processes seek to realize peoples' values, in the form of certain ''goal values of international human dignity''.[1764]

In McDougal's vocabulary,[1765] the policy or process approach proceeds from the ''clarification of values'' towards the ''identification of participants'' and the ''arenas of decision'' in which appropriate ''procedures'' are manipulated to achieve social ''effects''. All these components are relevant parts of the process as ''law''.[1766] In this way, international law according to the policy approach, unlike the sceptical approach, becomes extremely broad, taking in apparently everything that nation-States do such that policy and law become indistinguishable.[1767]

5.1.1.6.3. Limitations of the Policy Approach

In widening the law's scope, McDougal recognized that the normative force of the law would decrease.[1768] Hence, to avoid the charge of being a sceptic, he integrated teological values into the decision-making process. Hence, the policy approach lawyer can regard the approach as objective because he focuses on the observable decision-making, authority and effectiveness towards its teleological social goals and not on rules and their abstract validity. Its project, however, is vulnerable to the critique of lapsing either into uncritical apologism or naïve utopianism.[1769]

[1762] Martti Koskenniemi (2005) supra note 295, p. 203.

[1763] Myres McDougal (1953) supra note 1753, p. 167.

[1764] Id., pp. 190-191.

[1765] Id., pp. 165-191.

[1766] See Section 1.3.2.2 on the New Haven School of International Law (Process Approach).

[1767] Anthony D'Amato (1984) Jurisprudence: A Descriptive and Normative Analysis of Law, Kluwer Academic Publishers, Dordrecht, The Netherlands, p. 189.

[1768] Friedrich Kratochwil (1983) Is International Law "Proper" Law? Archiv für Rechts- und Sozialphilosophie (ARSP) [Archives for Philosophy of Law and Social Philosophy], Volume 69, Number 1, pp. 33-34.

[1769] Martti Koskenniemi (2005) supra note 295, p. 205.

First, the policy approach cannot ignore the fact that decision-makers do occupy themselves with the formal validity or binding force of the rules they apply.[1770] For such decision-makers the policy approach seems like a useless exercise in academic theory (uncritical apologism). What they are interested in is not what decisions will fulfil what values but which rules are valid and which are not. As the policy approach provides no answer to this question, it undermines its own claim for instrumental usefulness.[1771]

Second, and the most significant objection is that, the policy approach in order to avoid uncritical apologism, has taken a position that both undermines its scientist assumptions and make it seems naïve utopianism. If law were concerned only with describing processes or predicting outcomes and not with the ends to which they are used, it would remain unable to criticize particular State policy. However, to describe such ends in terms of the maximization of community welfare fails to guarantee the protection of State rights if the calculations of cost-benefit effectiveness overrule them.[1772]

Third, McDougal's approach is concerned about the enhancement of certain ''goal values of international human dignity".[1773] The problem is how to demonstrate the correctness of such values and the deductions made from them. It is assumed that reasonable men will agree to these values, held by McDougal himself. Lacking a system of demonstrating the correctness and content of these values, the policy approach will remain vulnerable to the same objections advanced against other kinds of naturalism.[1774]

Fourth, because of its normative intent based on teological values, has law become a technique of social engineering (both naïve utopianism and uncritical apologism)?

In summary, the limitations of the policy approach are, first, it undermines its claim of instrumental usefulness. Second, eliminating the law/politics distinction results in a law that seems to exist everywhere but which is devoid of normative force. To escape apologism, the policy approach has to postulate the existence of objective values. But as there is no test to demonstrate the correctness of these values, the policy approach contradicts itself on its own scientist standards. Third, as long as the teological values

[1770] Daniel Bodansky (2016) supra note 1419, p. 142.

[1771] Ahmed Shiekh (1974) International law and National Behaviour: A Behavioral Interpretation of Contemporary International Law and Politics, Wiley, New York, NY, USA, pp. 5-8

[1772] Oscar Schachter (1982) supra note 1760, pp. 25-26.

[1773] Myres McDougal (1953) supra note 1753, pp. 190-191.

[1774] Martti Koskenniemi (2005) supra note 295, p. 207.

remain controversial, they do not provide the kind of standards that lawyers could use in order to decide what might count as permitted or prohibited behaviour.

5.1.1.6.4. Implications of Policy Approach for Climate Change Governance

To facilitate the attainment of the two social goals for the common good of humankind, namely the stabilization of "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"[1775] and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations,[1776] a general analytical framework for understanding, explaining and solving the climate change problem, known as the "Integrated Systemic Process-Oriented" (ISPO) approach, was developed for this thesis. It is both holistic (integrated systemic) and process-oriented. It is a combination of the key elements of the integrated socio-ecological system (SES) approach, as developed by Elinor Ostrom and Vincent Ostrom, together with colleagues, in the Workshop in Political Theory and Policy Analysis of Indiana University,[1777] the process approach of global governance as recommended by the Commission on Global Governance,[1778] and the policy-oriented approach of the New Haven School of social jurisprudence to international law and politics, as developed by Myers S. McDougal and Harold D. Lasswell.[1779]

The policy approach of the New Haven School has been criticized for introducing arbitrary teological values into the decision-making process, and for the lack of a system to demonstrate the correctness and substance of these values. In the case of the ISPO approach, the teological values or social goals of the stabilization of "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"[1780] and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations,[1781] are not arbitrary goals and there is a system to demonstrate their correctness and the substance of these social goals.

[1775] United Nations (1992a) supra note 16, Article 2.

[1776] UNEP (1992a) supra note 75.

[1777] Elinor Ostrom (2009) supra note 51.

[1778] Commission on Global Governance (1995) supra note 79, pp. 2-7.

[1779] W. Michael Reisman, Siegfried Wiessner and Andrew R. Willard (2007) supra note 80, pp. 575-582.

[1780] United Nations (1992a) supra note 16, Article 2.

[1781] UNEP (1992a) supra note 75.

First, the stabilization of GHG atmospheric concentrations is the ultimate objective of the UNFCCC, which has near universal acceptance by the international community.[1782] There are two sub-goals articulated in Article 2.1(a) of the Paris Agreement. Essentially, Article 2.1(a) describes the Agreement's purpose as 'holding' the temperature increase to 'well below 2°C' while aspiring to 'pursuing efforts to limit' the temperature increase to 1.5°C.[1783] The temperature goals are precise enough as indicators that they could be quantified, within ranges of uncertainty, in terms of the global carbon budget equivalents in order to limiting the global average temperature rise well below 2°C or 1.5°C, and, more importantly, the global emissions reduction pathways to be followed in order to stay within the respective global carbon budgets in order to achieve the stabilization of GHG atmospheric concentrations. Similarly, balancing of economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations has been a general principle since the Rio Declaration in 1992.[1784] It has been the basis of the Sustainable Development Goals (SDGs), which were adopted by all the United Nations member-States in 2015 as a universal call for action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030. These 17 SDGs are integrated so that sustainable development must balance social, economic and environmental needs.[1785]

As explained earlier in Section 5.1.1.5.3, the fact that the negotiators of the UNFCCC stuck to a framework convention/protocol model and did not attempt to negotiate a comprehensive 'package deal' was positive for the evolution of international climate change governance, and for both the sceptical and policy approaches.

With the universal acceptance of the 2015 Paris Agreement, which is clearly not enforceable at the international level, to succeed at achieving the expressed temperature goals of the Agreement, would mean relying on the self-commitment of all the nation-States to prepare, communicate, pursue, account for, track and successively and progressively update its NDCs and to enforce GHG emissions reduction efforts at the national, provincial and local levels. To reinforce the polycentric approach, UN Secretary-General António Guterres has called for the 2019 Climate Action Summit to be held in New York on 23 September 2019.[1786] The Summit, with the theme of "A

[1782] UNFCCC (2019a) supra note 1054.

[1783] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 4.

[1784] UNEP (1992a) supra note 75.

[1785] UNDP (2019) Sustainable Development Goals, United Nations Development Programme. Accessed on 13 Septmeber 2019 at: https://www.undp.org/content/undp/en/home/sustainable-development-goals.html

[1786] United Nations (2019) supra note 86.

Race We Can Win", will bring together leaders of governments, the private sector, civil society, local authorities and other international organizations to develop ambitious solutions in six areas: (1) energy transition, (2) climate finance and carbon pricing, (3) industry transition, (4) nature-based solutions, (5) cities and local action, and (6) resilience and adaptation. Such a multi-factorial, multi-level solution set blurs the law/politics distinction and is very much aligned to the policy approach of the New Haven School of social jurisprudence, and it is a viable and necessary step to reduce the catastrophic climate risks associated with GHG emissions. As systemic climate change is a multi-factorial, multi-level problem, it requires a multi-factorial, multi-level solution set that will "constrain and work with the dynamics of the system".[1787]

5.1.1.7. The Ideal Approach: Alejandro Alvarez

The ideal approach in modern legal doctrine sees law to exist in and through the United Nations system and manifest itself in the new fields of economic law, human rights law, law of natural resources and environment, etc. This variation of law doctrine assumes that the new developments in international society have vastly enlarged the law's material scope. Meanwhile, law is uncritically assumed to be absolutely binding. The ideal approach contrasts itself to both the rule approach and policy approach theorizing. However, an analysis of the idealist argument is made difficult because it avoids expressed theorizing and is usually dressed in intangible generalities.[1788]

5.1.1.7.1. Key Characteristics of The Ideal Approach

Still, it is possible to isolate two key assumptions behind the ideal approach. On the one hand, international law is understood as a reflection of international society, which explains the law's wide material scope. On the other hand, the ideal approach is critical of the existing structures of international dominance, which explains the law's normative intent. But these two assumptions cancel out each other. As a result, idealism has to create strategies to explain away this contradiction, which requires moving back towards a rule or policy position or to succumb to scepticism.[1789]

According to the ideal approach, the old law of coordination, which remained silent on many important issues in international relations, is replaced by a modern law of

[1787] Robert Jervois (1997) supra note 29, p. 291.
[1788] Martti Koskenniemi (2005) supra note 295, p. 210.
[1789] Id., p. 211.

cooperation that translate into normative language the needs of interdependence, which has been prompted by modern economic and technological progress. International law has expanded from lateral coordination into regulating the most varied economic, humanitarian and social fields of endeavor. The emphasis of international law has also shifted from formal structure of the relationships between States and delimitation of their jurisdiction to the development of substantive rules vital to the growth of an international community.[1790] The transformational changes in international society have created this expanded need for legal regulation. As law mirrors society, it also reflects these profound changes. For idealism, the test of law is in its correspondence to the objective character (interests, needs, and changes) of international society.[1791]

Restricting legal sources to those articulated in Article 38 of the ICJ Statute is seen as narrow formalism.[1792] Instead, the lawmaking functions at the UN and its affiliated international organizations are emphasized. Concepts of consensus, interdependence, and the ‘‘needs of the international society’’ are grounds for legal argument, securing the breadth of the idealist's law. However, if law always mirrors society, on what ground can one adopt a critical posture? Hence, the fundamental question becomes: How can law both reflect society and be critical of it?

This tension is seen in the work of Alejandro Alvarez, a South American legal scholar and a long-time judge at the ICJ.[1793] For instance, in the Competence of the General Assembly Case (1950) Alvarez pointed out that there is no doubt that the Court must apply the existing law to the case that has been referred to it. The starting-point sounded like that of a rule approach lawyer, Alvarez asked, “What is this law to-day?”[1794]

Alvarez begins his argument with extended descriptions of the changes in the ‘‘life of peoples’’ that have emerged since the Second World War.[1795] New political, psychological, social and scientific ills have arisen, which need urgent treatment. These

[1790] Wilfred C. Jenks (1958) The Common Law of Mankind, Stevens & Sons, Ltd., London, UK, pp. 62-89.

[1791] Martti Koskenniemi (2005) supra note 295, p. 212.

[1792] Zdenek Slouka (1982) International Law-Making: A view from technology. In: Lawmaking in the Global Community [Nicholas Greenwood Onuf (ed.)], Carolina Academic Press, Durham, NC, USA, p. 131-171.

[1793] Manuel Alejandro Álvarez Jofré (9 February 1868–19 July 1960) was a Chilean professor of international law and a judge at the International Court of Justice from 1946 to 1955.

[1794] Alejandro Alvarez (1950) diss. op. ICJ: Competence of the General Assembly Case, Reports 1950, p. 12.

[1795] Alejandro Alvarez (1959) Le droit international nouveau dans ses rapports avec la view actuelle des peoples, Lebraire Pedone, Paris, France, pp. 11-30.

changes have transformed international society. Traditional science, including law, has shown itself incapable of treating them. A new global interdependence has emerged, reflected in the creation of supranational organizations and, in particular, the United Nations. "As a result of the increasingly closer relations between States, which has led into their ever greater interdependence, the old community of nations has been transformed into a veritable international society."[1796] This social change has been accompanied with a transformation in international law. A ''new'' international law is not merely a set of political desiderata. It is law now as it reflects the new ''juridical conscience of peoples''.[1797]

Consequently, the powers of the General Assembly must be decided, not on a narrow or legalistic construction of the travaux pr´eparatoires or of the text of the Charter. It must be interpreted so as to reflect the new conditions of international life and in particular the purposes and nature of the UN as an organized representative of mankind.[1798] The ''new'' international law is *law ex nunc* as it corresponds to the nature of present international society and peoples' cognition of it in their juridical conscience.[1799] There is no difference between *de lege ferenda* and *de lege lata* in this respect.[1800] Alvarez does not think his new law is a political programme. He holds it as a scientific truth, verifiable by recourse to the actual living conditions, needs and interests of the peoples. It is objective and therefore applicable as law.

5.1.1.7.2. Limitations of The Ideal Approach

Despite its style, Alvarez's work lacks critical bite. His criticisms are directed backwards towards the law and politics of a previous era while the present era is uncritically portrayed as one of all-encompassing interdependence where people are in agreement about the fundamentals of social life. Existing conflict is wiped away or presented as ''error'' that can be corrected when everybody understands his real interest, which can be demonstrated scientifically. His reconstructive approach does provide a law that is materially wide as it regulates nearly everything in society. But it

[1796] Alejandro Alvarez (1948) diss op. ICJ: Admission of a State to the United Nations, Reprots 1947-1848, p. 68.

[1797] Alejandro Alvarez (1959) supra note 1795, pp. 430-433.

[1798] Alejandro Alvarez (1950) supra note 1794, pp. 16-19.

[1799] Martti Koskenniemi (2005) supra note 295, p. 214.

[1800] Alejandro Alvarez (1950) supra note 1794, p. 16-19.

does so at great cost to its critical nature. Moreover, Alvarez did not succeed in treating ‘‘interdependence’’, ‘‘social needs’’ or ‘‘juridical conscience’’ in a concrete way.[1801]

The ideal approach is open to a familiar objection: There has been no theory of values or needs that could command a significant degree of consensus. Any view on the matter seems to encapsulate the arguer's political ideas. If the possibility of verifying needs and values by reference to what goes on in current society is excluded, how can they be verified at all? It does not have distance from the arguer's political ideas.[1802]

The idealist tries to argue that his law is based on international society and yet he is critical of international society. The argument will either dissolve in contradiction or turn out to be a rule approach or a policy approach argument in disguise. If he insists on the former, he will lose the justification of his criticism. If he insists on the latter, he cannot claim that his law is widely applicable without becoming a naturalist. It is therefore not surprising, then, that some idealists have turned sceptics with regard to the relevance of law as an instrument of change.[1803] Alvarez's writings started out by assuming international law reflects changes in international society and is critical of that society. In the course of argument, the sociological strand devours the critical strand.[1804]

5.1.1.7.3. Implications of The Ideal Approach for Climate Change Governance

For the ideal approach to avoid self-contradiction, contrary to the thinking of Alvarez, it has to be based on a political philosophy. One such philosophy that is widely recognized but not necessarily universally accepted is the Kantian political philosophy of republican states banding together to form a pacific "federation of free states",[1805] in which the member-states renounces the right to wage war with one another. Such a federation would eventually include all the nation-States and will facilitate trade and other linkages so that waging war would be even more damaging for its perpetrators. As more nation-States join the federation, they subscribe to the set of universal values, which guide how the growing number of member-States in the in-group must be treated.

In the 1990s, with the expansion of the United Nations system, end of the Cold War,

[1801] Martti Koskenniemi (2005) supra note 295, pp. 214-215.

[1802] Id., p. 216.

[1803] Richard Falk (1976) The Role of Law in World Society. In: Towards World Order and Human Dignity: Essays in Honor of Myres S. McDougal [W. Michael Reisman and Burns H. Weston (eds)], Free Press (1 October 1976), New York, NY, USA, pp. 148-149.

[1804] Martti Koskenniemi (2005) supra note 295, p. 212.

[1805] Immanuel Kant (1795) supra note 492, p. 115.

decline in Marxist ideology, and ascendancy of the modern liberal internationalist strand, the Kantian political system inspired liberal institutionalists to grapple with issues of governing the global commons collectively through international cooperation in an anarchical international political system. It became the dominant IR theory to deal with the global commons, including climate change.

Meanwhile, the liberal institutionalists were also much inspired by the collaborative approach of the epistemic community of climate experts, which was essentially apolitical. The liberal institutionalists combined the two strands to create the international regime. Both international law and international organizations (generally referred to as international institutions) are constituent parts in the broader concept of international regime, designed to analyze human interactions upon which international cooperation is built.[1806] The central concern of an international regime is with the form of governance, including international law, for international cooperation to solve a global commons issue, like climate change, in the absence of world government. It comprises the whole range of principles, norms, rules, and decision-making procedures that exist in relation to a specific global commons issue.[1807]

Contrary to the ideal approach, international regime governance goes beyond 'hard law' into 'soft law'. Hence, the types of international regime governance could range from one extreme of the functional equivalent of a government providing an international public good to reduce associated transactional costs to the other extreme of merely registering a minimal rule that a common resource or common sink is open access.[1808]

5.1.1.8. Modern International Law in the 21st Century

The four positions count as an exhaustive and exclusive framework of the possibilities of modern argument about the limitations of international law. As normativity and concreteness are both necessary and sufficient conditions for an objective doctrine, no other positions are available. Each approach is attempting to distance itself from earlier naturalism and positivism, understood as subjective because utopian or apologist. The more the reconstructive doctrines attempt to prove the normativity of the law and its autonomy from politics, the more they become vulnerable to the charge of utopianism.

[1806] F. Kratochwil and John G. Ruggie (1986) supra note 415.
[1807] See Section 1.3.4.3.
[1808] Donald J. Puchala and Raymond F. Hopkins (1983) supra note 501.

The more the reconstructive doctrines insist on the close connection between international law and state behavior, the less normative their doctrines appear.[1809]

We can now perceive the structuring effect of the tension between the descending and ascending modes of argument in modern legal doctrines. The former mode tries to prove law's normativity in terms of its binding character while the latter mode tries to ensure law's concreteness in line with State behaviour. Emphasizing one means de-emphasizing the other. A rule is normative only if it can be successfully opposed to a concrete fact-description while a rule is concrete only if it can correspond to a fact-description. Hence, an argument, doctrine or position can justify itself only by claiming normativity or concreteness. It cannot make reference to both without self-contradiction. In the 21st century, international lawyers are in constant movement from one position to another without being able to stay permanently in any one position because any of the positions seems possible on the basis of the valid criticisms it produces against the others. But none of them can sustain a positive programme based on one position.[1810]

As a result, many modern international lawyers, especially in the last decades of the 20th century, had come to support views that point beyond liberal doctrines. Two new legal doctrines, the Chicago school of law and economics[1811] and the Harvard school of critical legal studies (CLS)[1812] have emerged. Both the Chicago school and the CLS movement shared a critical view of modern liberalism, although their diagnoses of what was defective in the state and the social order in which it was embedded were very different. Their implications for climate change governance have been discussed therein.

These lawyers have argued on the basis of the justice or equity of their preferred norms, which is manifested in recent judicial and arbitral practice. However, it is difficult to know if this development is sustainable. Because such arguments would have to assume either that justice is, after all, in some sense objective, or that there is room for legal argument beyond objective rules. Neither assumption can be reconciled with the existing framework of modern legal doctrines.[1813]

[1809] Martti Koskenniemi (2005) supra note 295, pp. 218-219.

[1810] Id., p. 219.

[1811] See Section 1.3.2.2 on the Chicago School of Law and Economics, which includes implications for climate change governance.

[1812] See Section 1.3.2.3 on Critical Legal Studies, which includes implications for climate change governance.

[1813] Martti Koskenniemi (2005) supra note 295, pp. 219-220.

The crux of the theory of modern legal doctrines, regardless of the former four approaches or the latter two approaches mentioned above, lies in its opposition to early theories. First, each of the four approaches refuses to develop its concept of international law in terms of a material theory of justice. Instead, each attempts to develop a concept of international law based on an objective view over what seems to take place in the social world. In other words, what modern legal doctrines have in common is that they share a social conception of law. They believe that the international law is determined by social practice in the form of treaties, customs, precedents, policies, authority, or general patterns of history, in particular economic and technological development. They believe the law to be a social fact and that an adequate concept of international law is one which accurately describes these facts.[1814]

The obvious problem is that the facts, which constitute the international society, do not appear automatically but are the outcomes of choice. This conceptual choice cannot be evaluated in terms of facts because it has already singled out those facts on which it bases its relevance. The four approaches achieve different outcomes because they involve differing conceptual matrices. Each bases its superiority on its capacity to describe more accurately the social environment of international politics. Hence, the assumption that legal justice could be inferred from social facts proves false. Facts do not stand 'there' as impartial arbiters of our legal theoretical controversies. They are, as Nelson Goodman[1815] puts it, ''fabricated'' as international lawyers construct a law that would meet our social ideals. Reliance on the self-evidence of our views about ''facts'' is unwarranted. So is the idea that a just society could be established without discussing justice. However, the inevitable recourse to justice by the two latter approaches will either have to be condemned as mere ''subjectivism'' or it will undermine the modern project altogether and ultimately the liberal theory of politics.[1816]

The framework of the four approaches provides an argumentative structure, which is capable of providing a valid criticism of each substantive position but which itself cannot justify any. The fact that positions are constantly taken and solutions justified by lawyers, demonstrates that the structure does not possess the kind of distance from politics for which the Rule of Law once seemed necessary. Each of the four approaches will remain only a partial solution and fails to provide a fully convincing doctrine.[1817]

[1814] Id., pp. 220-221.

[1815] Nelson Goodman (1984) Ways of Worldmaking, Hackett Publishing Company, Indianapolis, IN, USA, pp. 91-107.

[1816] Martti Koskenniemi (2005) supra note 295, p. 223.

[1817] Id., p. 219.

It seems possible to adopt a position only if a political choice is taken: a choice, which must ultimately defend itself in terms of a universal conception of justice. Whether the Chicago school of law and economics, the Harvard school of critical legal studies, or to cut the Gordian knot and work towards global constitutionalism is the way to solve the climate change problem will have to be answered before the end of the 21st century.

5.1.2. Limitations of Multilateral Environmental Agreements

Treaties between nation-States have become the main source of international law. Strictly speaking, a treaty is not a source of law so much as a source of obligations under law. A treaty is only binding on the nation-States that become parties to the treaty. The choice of whether or not to become a party to a treaty is entirely a decision for the nation-State to make. There is no compulsion to sign up to a treaty. Once a nation-State becomes a party to a treaty, then as a party, it is bound to the obligations in the treaty provisions because of a rule of customary international law – *pacta sunt servanda* – that requires all States to honor their treaties. That is why treaties are more accurately described as sources of obligations under international law.[1818]

For the governance of the global environmental commons, including climate change, the standard treaty is the multilateral environmental agreement (MEA) adopted by several nation-States due to the nature of the global environmental commons problem. In general, the international community does not yet have strong evidences of right action with multilateral environmental agreements (MEAs).

One very good indicator of the difficulties the international community is having with the implementation of MEAs is the steep drop in the number of MEAs and Protocols established since their peak periods in the 1990s. Based on data from the International Environmental Agreements Database Project (Version 2017.1),[1819] the peak period for the establishment of MEAs by the international community took place during the 4 years from 1990-1994 with close to 90 MEAs. Ten years later, the number of MEAs adopted had dropped to less than 30 during the period 2005-2009. After 20 years, the number of MEAs adopted had dropped to below 3 during the 2014-2016 period.

Meanwhile, the peak period for the establishment of Protocols to the MEAs took place

[1818] Christopher Greenwood (2008) supra note 290, p. 2.

[1819] Ronald B. Mitchell (2018) supra note 846.

during the 4 years after the peak period for establishment of MEAs from 1995-1999 with more than 30 Protocols. Ten years later, the number of Protocols adopted had dropped to less than 15 during the period 2010-2014. After 20 years, there had been no Protocol adopted during the 2014-2016 period.

It is possible that the trend in the quantitative data on MEAs points to the successful adoption and implementation of MEAs and that there are currently no outstanding global environmental commons problems to be solved by the international community. Rather the diametrically opposite view is closer to the truth – it has become very difficult for the international community to forge a MEA or establish a new Protocol in the current international political climate. The trend in qualitative data on MEAs clearly points to intractable problems with the implementation of these MEAs, which is inhibiting further attempts by the international community to resolve complex global environmental issues via multilateral environmental agreements.

5.1.2.1. Equivocal Legal Status of Trail Smelter Arbitration

For instance, as late as 2006, John H. Knox[1820] criticized the Trail Smelter Arbitration of 1938 as the "Wrong Tribunal, the Wrong Parties and the Wrong Law" and Stephen C. McCaffrey[1821] highlighted that the United States, which was awarded the damages by the Tribunal, has been equivocal as to the legal status of the fundamental principle on which the Tribunal's award was based.

5.1.2.2. Non-Implementation of ASEAN Agreement on Transboundary Haze

Not long after the successful negotiation and adoption of the Convention on Long-range Transboundary Air Pollution in Europe, the Environment Ministers from the Association of Southeast Asian Nations (ASEAN) adopted on 19 June 1990 the Kuala Lumpur Accord on Environment and Development to address transboundary pollution prevention and abatement.[1822] It was followed by a series of declarations and resolutions, culminating in the ASEAN Agreement on Transboundary Haze Pollution, signed on 10

[1820] John H. Knox (2006) The Flawed Trail Smelter Procedure: The Wrong Tribunal, the Wrong Parties, and the Wrong Law. In: Transboundary Harm in International Law: Lessons from the Trail Smelter Arbitration [Rebecca M. Bratspies and Russel A. Miller (eds.)]. Cambridge University Press, Cambridge, 347 pp, pp. 66-78.

[1821] Stephen C. McCaffrey (2006) supra note 872, p. 35.

[1822] ASEAN (1990) Kuala Lumpur Accord on Environment and Development, Association of South East Asian Nations, 19 June 1990.

June 2002 in Kuala Lumpur,[1823] which identified actions to prevent forest fire and restrict burning of biomass during the dry seasons. It also included actions to establish mechanisms to help prevent long-range transport of haze pollution.

However, neither specific standard nor binding obligation was established in the ASEAN Agreement, and Indonesia, which is the largest country in ASEAN both in terms of population size and GDP, and the primary source of the transboundary haze pollution, only ratified the agreement on 20 January 2015.[1824] Unlike the Convention on Long-range Transboundary Air Pollution in Europe, which was legally binding onto the Conference of the Parties (COP), the ASEAN Agreement on Transboundary Haze Pollution was not even legally binding, yet it still took Indonesia some 13 years to ratify the Agreement. No specific Protocol has been established since then. Although the negotiation of the ASEAN Agreement on Transboundary Haze Pollution was successfully carried out through consensus, yet the adoption was much delayed, and its implementation still faces insurmountable obstacles. In its current manifestation, it is considered as completely toothless. The Indonesian haze is enveloping Singapore as I write my thesis.[1825] Meanwhile, enormous fires are raging in the Amazon forests of South American countries for exactly the same reasons. The highly economical "slash and burn" method is being used to clear forested areas for the planting of commercially valuable crops and mining.[1826]

5.1.2.3. Uncertain Future of the Montreal Protocol

The international community's quick and universal response to eliminate the ozone-depleting substances as embodied in the Montreal Protocol has been widely regarded as the most successful international environmental protection agreement ever reached.[1827]

[1823] ASEAN (2002) Agreement on Transboundary Haze Pollution, Association of South East Asian Nations, 10 June 2002.

[1824] ASEAN (2015) Status of ratification of the 2002 Agreement on Transboundary Haze Pollution as of 20 January 2015, Association of South East Asian Nations. Accessed on 29 April 2016 at: http://haze.asean.org/status-of-ratification/

[1825] Straits Times (2019) Toxic air from fires in Indonesia putting 10m kids at risk: UN, The Straits Times online, 25 September 2019. Accessed on 25 September 2019 at: https://www.straitstimes.com/asia/se-asia/toxic-air-from-fires-in-indonesia-putting-10m-kids-at-risk-un

[1826] Straits Times (2019) Firefighters in Bolivia lose hope of taming blazes as burned area doubles, The Straits Times online, 24 September 2019. Accessed on 25 September 2019 at: https://www.straitstimes.com/world/americas/firefighters-in-bolivia-lose-hope-of-taming-blazes-as-burned-area-doubles

[1827] EPA (2017) International Actions - The Montreal Protocol on Substances that Deplete the Ozone Layer, United States Environmental Protection Agency. Accessed on 13 MKay 2018 at:

More importantly, the implementation of the Montreal Protocol seemed to have progressed well in both the developed and developing countries. In view of the steady progress made under the Protocol, the former United Nations Secretary-General Kofi Annan had already stated in 2003 that, "perhaps the single most successful international agreement to date has been the Montreal Protocol".[1828]

5.1.2.3.1. Recovery of the Stratospheric Ozone Layer

Yet despite all efforts to eliminate the ozone-depleting substances, the ozone hole over the Antarctic in October 2006 was the largest ever recorded, 17 years after the Protocol entered into force.[1829] It is only today, after 30 years, that there is finally some good news that the healing of the Antarctic ozone hole has started, according to the latest report published in *Science* on 30 June 2016.[1830] The Protocol has achieved much but there is clearly no room for complacency. In fact, there is an urgent need for renewed international negotiations to ensure the international community continues to implement the commitments already agreed upon as well as to address upcoming challenges.

5.1.2.3.2. Areas of Great Concern

One area of great concern is that some ozone-depleting substances are still used widely as they (e.g. methyl bromide use for quarantine and pre-shipment) are not covered by the phase-out schedules contained in the Protocol.[1831] Progress must be made soon to reduce exemptions for such ozone-depleting substances.

Another area of great concern is sulphur hexafluoride (SF_6). It is a cheap and non-flammable gas, which makes it a highly effective insulating material for medium and high-voltage electrical installations. It is widely used across the industry, from large power stations to wind turbines to electrical sub-stations in towns and cities to prevent

https://www.epa.gov/ozone-layer-protection/international-actions-montreal-protocol-substances-deplete-ozone-layer

[1828] Kofi Annan (2003) supra note 19.

[1829] European Commission (2007) The Montreal Protocol, Luxembourg: Office for Official Publications of the European Communities. Accessed on 16 July 2016 at: https://ec.europa.eu/clima/sites/clima/files/docs/montreal_prot_en.pdf

[1830] Susan Solomon, Diane J. Ivy, Doug Kinnison, Michael J. Mills, Ryan R. Neely III and Anja Schmidt (2016) Emergence of healing in the Antarctic ozone layer, Science, Volume 353, Issue 6296, 15 July 2016, pp. 269-274.

[1831] UNEP (2018b) Methyl Bromide, Ozone Action, United Nations Environmental Programme (UNEP). Accessed on 15 May 2018 at: http://web.unep.org/ozonaction/what-we-do/methyl-bromide

electrical fires. Sulphur hexafluoride has the highest GWP of any known substance. It is 23,500 times more warming than carbon dioxide. Hence, leaks of this little known gas may be the unintended negative consequence of the extensive electrification programme towards a low-carbon economy.[1832]

However, the area of greatest concern is the illegal production of these prohibited substances, and there is growing evidence of significant illegal trade in these prohibited substances as a result of such production.[1833] It reflects the difficulty that governments in open societies faced when trying to regulate illicit substances, e.g. drugs.[1834]

5.1.2.3.3. Slowdown in the Rate of Decline in Atmospheric CFC-11

A significant slowdown in the rate of decline of atmospheric concentrations of trichlorofluoromethane (CFC-11) has recently been reported.[1835] The rate of decline in the atmospheric CFC-11 concentrations observed at remote measurement sites, which was constant from 2002 to 2012, has slowed by about 50 per cent after 2012. As the reduction of atmospheric CFC-11 is the second largest contributor to the decline in the total atmospheric concentration of ozone-depleting chlorine since the prohibition of CFCs in the 1990s, the timely recovery of the stratospheric ozone layer is significantly dependent on a sustained rate of decline in the atmospheric CFC-11 concentrations.

This slowdown in CFC-11 emissions appears unrelated to past production as reported production is close to zero since 2006. This finding suggests that unreported new production, which is a violation of the Montreal Protocol agreement to phase out global CFC production by 2010, is the source of the new emissions. The source of these new emissions has been tracked to East Asia. However, to determine its precise location will require further investigation.[1836]

[1832] Matt McGrath (2019) Climate change: Electrical industry's 'dirty secret' boosts warming, BBC News online, 13 September 2019. Accessed on 25 September 2019 at: https://www.bbc.com/news/science-environment-49567197

[1833] Duncan Black (1996) International Trade and the Montreal Protocol, 1 June 1996, Brookings Institute Press, Washington, DC, USA, 118 pp, pp. 105-114.

[1834] UNODC (2017) World Drug Report 2017, United Nations Office on Drugs and Crime (UNODC), Vienna, Austria.

[1835] Stephen A. Montzka, Geoff S. Dutton, Pengfei Yu, Eric Ray, Robert W. Portmann, John S. Daniel, Lambert Kuijpers, Brad D. Hall, Debra Mondeel, Carolina Siso, J. David Nance, Matt Rigby, Alistair J. Manning, Lei Hu, Fred Moore, Ben R. Miller & James W. Elkins (2018) An unexpected and persistent increase in global emissions of ozone-depleting CFC-11, Nature, Volume 557, 16 May 2018, pp. 413-417.

[1836] Damian Carrington (2018) Mysterious rise in banned ozone-destroying chemical shock scientists, The Guardian, 16 May 2018. Accessed on 17 May 2018 at:

These findings clearly highlight that self-reporting is not enough to ensure compliance in MEAs and that strict implementation of monitoring, reporting, and verification (MRV) schemes are required to ensure compliance in environmental regulations.

5.1.2.3.4. New Challenges with Replacement HCFCs and HFOs

Meanwhile, the transitional solutions put in place via the Montreal Protocol have posed new challenges. Hydrochloroflourocarbons (HCFCs), which replaced CFCs, have been found to deplete ozone as well, albeit at a significantly lower rate than CFCs. Although it is now illegal to use newly manufactured HCFCs in the developed countries, its use is still allowed in the developing countries. In fact, its use in the developing countries is growing at such a rapid rate, concomitant with their rapid economic growth rate, that the eventual release of the used HCFCs into the atmosphere may well jeopardize the recovery of the ozone layer.[1837] To compound the problem, the HCFCs and their replacements as substitute refrigerants, the hydroflourocarbons (HFCs), are also powerful greenhouse gases.[1838] Hence, the availability of more environmental-friendly alternatives, e.g. hydrofluoroolefins (HFOs), has become an urgent issue for the international community in the Anthropocene.

5.1.2.3.5. Kigali Amendment to the Montreal Protocol

The Kigali Amendment to the Montreal Protocol was adopted at the 28th Meeting of the Parties to the Montreal Protocol on 15 October 2016 in Kigali, Rwanda. The threshold for the agreement to enter into force was met on 17 November 2017, when 20 parties ratified the agreement, and the Amendment will enter into force on 1 January 2019.[1839] The Amendment calls upon all countries to gradually phase down HFCs by more than 80% over the next 30 years and replace them with more environmental-friendly

https://www.theguardian.com/environment/2018/may/16/mysterious-rise-in-banned-ozone-destroying-chemical-shocks-scientists

[1837] European Commission (2007) supra note 1829, p.10.

[1838] Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D.W. Fahey, J. Haywood, J. Lean, D.C. Lowe, G. Myhre, J. Nganga, R. Prinn, G. Raga, M. Schulz and R. Van Dorland (2007) Changes in Atmospheric Constituents and in Radiative Forcing. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[1839] Ozone Secretariat (2018) Kigali Amendment: Thirty Five Parties to the Montreal Protocol have Ratified, Ozone Secretariat, UNEP. Accessed on 8 May 2018 at: http://ozone.unep.org/en/focus

alternatives. The developed countries will have to start reducing HFCs as early as 2019, while developing countries will start later.

Phasing down HFCs under the Kigali Amendment is expected to contribute to keeping the global mean surface temperature rise to less than 0.5°C rise from the Montreal Protocol gases by the end of this century while continuing to protect the stratospheric ozone layer. With the Kigali Amendment, the objectives of the ozone layer governance have overlapped with the objectives of climate change governance.

The Parties to the Montreal Protocol will now have to grapple with some similar difficulties faced by policymakers addressing climate change, especially the high cost of eliminating the atmospheric pollutants. In trying to phase down the high-GWP[1840] HFCs, the Parties will find that substituting HFCs with HFOs will result in a significant increase in the cost of deployment. Hence, developing countries in the tropic and sub-tropical regions with some of the hottest climates on planet Earth, e.g. India, will be quite reluctant to crack down on HFCs too aggressively as it would be a substantial addition to their economic burden.[1841] In fact, in 1990, a coalition led by India refused to agree to strengthen the Protocol unless a compensation fund was established.[1842] Hence, one of the main reasons for the success of the Montreal Protocol has been the Multilateral Fund (MLF), which had distributed nearly US$1 billion before the end of the century to compensate the developing countries for the cost of phasing out the CFCs.[1843] Once again, success with phasing out the HFCs will very much dependent on the ability of the MLF to continue compensating the developing countries.

5.1.2.4. Poor Implementation of International Climate Change Governance

Some scholars, especially those with experience in policymaking[1844] or legislation,[1845]

[1840] The Global Warming Potential (GWP) of a greenhouse gas incorporates two fundamental physical properties of a greenhouse gas, first the molecule must be able to absorb infrared radiation via one or more of its vibration modes in the infrared range of 5μm-25μm and, second, it should have a relatively long lifetime in the Earth's atmosphere. It is the radiative efficiency of the greenhouse gas as compared to that of carbon dioxide over a specified period of time, whose GWP value is set as 1.

[1841] Brad Plumer (2016) 197 countries just agreed to phase out HFCs — a potent greenhouse gas in air conditioners, Vox, 15 October 2016. Accessed on 8 May 2018 at: https://www.vox.com/2016/10/15/13292878/montreal-protocol-cut-hfcs

[1842] Elizabeth R. Desombre & Joanne Kauffman (1996) The Montreal Protocol Multilateral Fund: Partial Success Story. In Institutions for Environmental Aid: Pitfall and Promises [Robert O. Keohane and Marc A. Levy (eds.)], MIT Press, Cambridge, USA, pp. 94-96.

[1843] Id., p. 89.

[1844] Marshall Geck, Xiaoxue Weng, Caitlin Bent, Chukwumerjie Okereke, Taylor Murray and Kirsty

assumed that the right view and right intent were in operation during the successful negotiation and adoption of the MEAs of climate change governance by the international community. Therefore, these same scholars recommend that the policymakers and legislators should just focused on understanding what are the immediate causes of poor implementation of these the climate change agreements and work out corrective measures to improve their implementation.

5.1.2.4.1. Fine-Tuning of UNFCCC and Kyoto Protocol

For instance, scholars have specifically proposed replacing the current annexes under the UNFCCC (Annex I and Annex II) with two new annexes that will incorporate a larger number of nations. Emissions targets, financial obligations, and access to different market mechanisms in the Kyoto Protocol are then differentiated according to this new system of annexes, reflecting still the principle of Common But Differentiated Responsibilities (CBDR) as defined in the UNFCCC.[1846]

However, the probability of political agreement for amendments to the current annexes under the UNFCCC is very small. Amendments to the UNFCCC, and the adoption of annexes or their amendments would require a consensus or a three-fourths majority vote in the absence of a consensus. The Kyoto Protocol to the UNFCCC essentially follows the same rules.[1847] Although such amendments are still possible, it will be very difficult to get the necessary consensus or three-fourths majority vote for adoption of the amendments, and the process of ratification has proven to be a very lengthy process before the amendments can gain entry into force. For example, the Doha Amendment to the Kyoto Protocol was adopted in 2012, but to date it still does not have the necessary ratifications for the Doha Amendment to gain entry into force.[1848]

Besides, the international community has moved on to replace the top-down approach of the Kyoto Protocol with the bottom-up approach of the Paris Agreement. Hence, any serious attempt by policymakers and negotiators to fine-tune the UNFCCC and its Kyoto Protocol as suggested by these scholars is futile.

Wilson (2013) Breaking the impasse: towards a new regime for international environmental governance, Climate Policy, Volume 13, Number 6, pp. 777-784.

[1845] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, p. 17.

[1846] Marshall Geck, Xiaoxue Weng, Caitlin Bent, Chukwumerjie Okereke, Taylor Murray and Kirsty Wilson (2013) supra note 1844, p. 778.

[1847] United Nations (1992a) supra note 16, Article 15.

[1848] UNFCCC (2012) supra note 837.

5.1.2.4.2. Overlapping of Different Specific Governances of Climate Change

It has also been suggested that while the negotiation and adoption of the climate change agreements themselves might not have present a problem but when it comes down to the implementation of these agreements, because climate change touches upon so many different areas of law, the overlapping of climate change governance with other regulatory governances may give rise to divergent objectives, incompatible principles, conflicting norms, opposing economic incentives for encouraging participation and implementation, and different impediments in diffusion and learning, giving rise to poor implementation of the climate change agreements.[1849]

The key related international governances include the substances depleting the stratospheric ozone layer, the international aviation,[1850] and the international shipping[1851] regimes. The most effective method to resolve these conflicts among the climate, ozone layer, international aviation and international shipping governances, is to draft a new comprehensive climate change treaty to integrate all these other key related treaties on climate change clarifying the objectives, the principles, and the measures to regulate the non-carbon dioxide gases with high GWP and the IBF emissions[1852], or to amend the existing provisions in the Kyoto Protocol so as to avoid the incompatible principles, conflicting norms and opposing incentives among the different regimes.[1853]

For the same reasons articulated in the proposal to replace the current annexes under the UNFCCC with two new annexes as discussed in Section 5.1.2.4.1, the political resolve to draft a completely new treaty to integrate all the different but related climate change governances is infinitesimally small, and the political agreement to amend the

[1849] Harro van Asselt (2014) The Fragmentation of Global Climate Governance: Consequences and Management of Regime Interactions, Edward Elgar, Cheltenham, pp. 52-55.

[1850] The International Civil Aviation Organization (ICAO) is a United Nations specialized agency, established by States in 1944 to manage the administration and governance of the Convention on International Civil Aviation, also known as the Chicago Convention. Accessed on 11 September 2018 at: https://www.icao.int/about-icao/Pages/default.aspx

[1851] The International Maritime Organization (IMO) is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships. Accessed on 11 September 2018 at: http://www.imo.org/en/About/Pages/Default.aspx

[1852] United Nations (1998) supra note 17, Article 2.2. The Parties included in Annex I shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization and the International Maritime Organization, respectively.

[1853] Beatriz Martinez Romera (2017) supra note 860, p. 230.

UNFCCC or its Kyoto Protocol is currently non-existent.

5.1.2.4.3. Easy Withdrawal during the Implementation Phase

When commitments are ratcheted up in subsequent negotiations, a nation-State unable to fulfil the more stringent commitments proposed would withdraw from the MEA because flouting it would be seen as undermining the basis of international law.

The United States and Australia both withdrew from the Kyoto Protocol despite having ratified the UNFCCC and adopted its Kyoto Protocol.[1854] Both nation States were not penalized. Canada took a similar route and withdrew from the Kyoto Protocol in 2011, after having ratified it, when Canada realised that it was not able to fulfil its commitments to reduce emissions as specified in terms of target and timetable in the Protocol. Canada was also not punished for its withdrawal.[1855]

5.1.2.5. Wrong Strategic Approach for MEAs

Since there is still no strong evidence of right action by international community in the implementation of many of the MEAs, especially the climate change agreements, other scholars, with experience in international relations,[1856] which is intertwined with international law,[1857] had started to question the assumption that the international community had the right view and right intent when negotiating and adopting these MEAs, especially the climate change agreements.

After all, it is reasonable to expect that the right action should follow without too much adjustment if the right view and right intent had been put in place during the negotiation and adoption of these climate change agreements. Hence, some key criticisms of the current strategic approach include the following:

5.1.2.5.1. Ineffectiveness of Multilateral Legislative Processes

[1854] Cass R. Sunstein (2006) Montreal versus Kyoto: A Tale of Two Protocols, AEI-Brookings Joint Center for Regulatory Studies, Working Paper No. 06-17, 45 pp, p. 23.

[1855] Helga Jónsdóttir (2013) The Kyoto Protocol Compliance System: Is the System effective Enough to Ensure Compliance, LL.M. in Environmental Law, Spring Semester 2013, Stockholm Universitet, Stockholm, p. 35.

[1856] David G. Victor (2011) supra note 1633.

[1857] Kenneth W. Abbott (1989) Modern International Relations Theory: A Prospectus for International Lawyers, Yale Journal of International Law, Volume 14, pp. 335-412.

For instance, there were serious questions raise as to whether the current multilateral negotiation process, based on consensus decision-making, can be effective to promote environmental protection.[1858] The global climate change negotiations take place within the United Nations (UN) system. The United Nations' legitimacy is based in part on the principle of universality. Hence nearly all the UN institutions, except the Security Council, are open to all members. Within the UN system there exists the conventional wisdom that greater participation in the negotiations would lead to fairer, more inclusive, more legitimate, and more effective outcomes.[1859]

The multilateral legislative process may be fairer, more inclusive and more legitimate, but it has been known for a long time that it is mostly non-effective. Detractors often call the United Nations a "talking shop" of 193 nations where, it has memorably been said, "no issue is too small to be debated endlessly."[1860]

5.1.2.5.2. Logic of Collective Action in Large Groups

As early as 1965, Mancur Olson, an economist, in studying the structural logic of collective action in large groups on public goods, e.g. greenhouse gas emissions reduction, had verified that if the members of a group, e.g. Parties to the Kyoto Protocol, "rationally seek to maximize their personal welfare, they will not act to advance their common or group objectives, unless there is coercion to force them to do so, or unless some separate incentive, distinct from the achievement of the common or group interest, is offered to the members of the group individually on the condition that they help bear the costs or burdens involved in the achievement of the group objectives." These conclusions hold true even when there is unanimous agreement in the group about the common goods and the methods of achieving it.[1861]

Although a highly complex compliance mechanism was established for the Kyoto Protocol it was found to be ineffective.[1862] The Kyoto Protocol also specified the transfer of financial resources from Annex II Parties to developing countries to address climate change and adapt to its adverse effects. Yet by 2009 the world's richest

[1858] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) supra note 354, p. 16.

[1859] David G. Victor (2011) supra note 1633, p. 211.

[1860] UN Secretary General (2008) More than just talk, International Herald Tribune (France), 17 June 2008. Accessed on 4 October 2018 at: https://www.un.org/sg/en/content/sg/articles/2008-06-17/more-just-talk

[1861] Mancur Olson (1965) supra note 216, p. 2.

[1862] Louise Fournier (2017) Compliance Mechanism under the Kyoto Protocol: Lessons for Paris, Edinburgh Law School, University of Edinburgh, DOI: 10.13140/RG.2.2.13842.66240, p. 12.

countries have disbursed to the poorer countries less than US$1 billion of the US$18 billion pledged thus far.[1863] Meanwhile, pledges made under the 2015 Paris Agreement for a year 2020 target of US$100 billion a year has fallen short by 50%.[1864]

5.1.2.5.3. Law of Least Ambitious Program

The climate change problem is intimately entanglement with economic growth through the common underlying independent variable of fossil fuel combustion. One could therefore view the climate change problem as the flip side of the resource management problem. In the 1970s, Arild Underdal puzzled over why the fish stock in the Northeast Atlantic kept declining although there was no shortage of fisheries agreements. He found that the main reason for the ineffectiveness in curbing the decline in fish stock was the application of the rule of unanimous consent in these fisheries agreements.

The rule of unanimous consent was termed by experts as the "unit veto" system of decision-making because one significant dissident can block agreement by the whole group. As a result, consensus was obtained based on the weakest of the proposals. Underdal called it the 'law of the least ambitious program'.[1865]

5.1.2.5.4. Shallowness of Multilateral Environmental Agreements

Empirical evidence of the few international environmental agreements that had been examined closely broadly supports the view that the cooperation required in the international agreements is shallow.[1866] A seemingly high rate of compliance with these international agreements is often the result of nation States formulating agreement that require them to do little more than they would have done in the absence of the agreement.[1867] In other words, commitments reflect what countries are already doing

[1863] John Vidal (2009b) Rich nations failing to meet climate aid pledges, The Guardian, 20 February 2009. Accessed on 13 May 2018 at: https://www.theguardian.com/environment/2009/feb/20/climate-funds-developing-nations

[1864] Fiona Harvey (2018) Climate change aid to poor nations lags behind Paris pledges, The Guardian, 3 May 2018. Accessed on 13 May 2018 at: https://www.theguardian.com/environment/2018/may/03/climate-change-aid-poor-nations-paris-cop21-oxfam

[1865] Arild Underdal (1980) supra note 1226.

[1866] David Victor (1999) Enforcing International Law: Implications for an Effective Global Warming Regime, Duke Environmental Law and Policy Forum, Duke University, Volume 10, Number 1, Fall 1999, pp. 151-153.

[1867] George W. Downs, David M. Rocke and Peter N. Barsoom (1996) Is the Good News About Compliance Good News About Cooperation? International Organization, Volume 50, Issue 3, p. 379-406.

rather than what is needed to address the problem at hand. Hence, although scores of agreements are in force, few of the issues on the environmental agenda seem to be solved.[1868] In cases where noncompliance does occur, e.g. global climate change agreements, both self-interest and enforcement play significant roles.[1869]

If the negotiation process were focused on establishing agreements to solve the environmental problems at hand, the number of international agreements would have been very few. International environmental cooperation that focused on collaboration will require sophisticated agreements and powerful institutions for enforcement. Hence, achieving consensus is difficult. However, because the willingness of the nation States to pay is often low when negotiations begin, the negotiators frame the environmental problem as that requiring harmonisation or simple coordination in order to reach fast agreement. Hence, agreement is reached quickly and participation in the agreement is high because the substantive part of the agreement is based on the 'law of least ambitious program'.[1870]

In fact, from the 1972 Stockholm Conference to the present, the efficiency of the search by policymakers and negotiators for shallowness of the international environmental agreement has seemed to increase, as reflected by the relatively constant and short time of about 3 years from the start of formal negotiations to adopt of the agreement despite the increasing complexity of the environmental issues involved. Policymakers and negotiators have learned how to agree on formats and language by adapting from the scores of precedents. Institutionalization thus facilitates further institutionalization.[1871]

The contrast to the Law of the Sea, comprising of some 320 Articles and 9 Annexes, which took more than 14 years to complete,[1872] and to the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), comprising a package of 22 agreements on a wide range of topics, including enforcement and the creation of the World Trade Organization (WTO), which required 8 years of almost constant negotiation sessions to complete, is striking.[1873]

[1868] David Victor (1999) supra note 1866, p. 153.

[1869] George W. Downs, David M. Rocke and Peter N. Barsoom (1996) supra note 1867, p. 379.

[1870] David Victor (1999) supra note 1866, pp. 155-156.

[1871] Id., p. 156.

[1872] United Nations (1982) supra note 785.

[1873] GATT (1994) General Agreements on Tariffs and Trade 1994, Legal texts: the WTO agreements, World Trade Organization. Accessed on 14 May 2018 at: https://www.wto.org/english/docs_e/legal_e/ursum_e.htm#General

5.1.2.6. Compliance and Enforcement Issues in MEAs

Most of the multilateral environmental agreements (MEA) are intended to protect the global commons, e.g. global climate change, there has to be 100% participation by all significant parties for the agreement to be effective.[1874] Non-compliance by one significant party to the agreement would harm everyone, and for the other parties to reciprocate by suspending their compliance will only make the environmental damage much worse. Because non-compliant reciprocity means greater environmental damage, the role of the MEA must be in the first instance to strive to foster compliance.[1875]

Hence, the essence of the modern non-compliance approach in many MEAs, including the UNFCCC and its Kyoto Protocol, is actually to address compliance instead of non-compliance in a proactive, non-confrontational and preventive way.[1876]

5.1.2.6.1. Shallow Commitments to Ensure Compliance during Implementation

Since the essence of the modern non-compliance approach is actually to address compliance instead of non-compliance in a proactive, non-confrontational and preventive way when coupled with the general presumption underpinning international law in that nation-States would not negotiate, adopt and ratify an international agreement unless they intend to fulfill their commitments,[1877] the ambition of the policymakers and negotiators is set very low, and the environmental issue is framed as one that requires only harmonisation or simple coordination, resulting in shallow commitments to the agreement.[1878]

The 'standard model' for negotiating such a MEA, of which the Montreal Protocol is a good example,[1879] is for negotiators to reach agreement on a specific framework agreement with objectives, general principles and rules on largely procedural matters while setting provisions for future protocols to deal with the substantive regulations.

5.1.2.6.2. Types of Compliance Mechanisms Used in MEA

[1874] Mancur Olson (1965) supra note 216, p. 41.

[1875] Xueman Wang and Glenn Wiser (2002) The Implementation and Compliance Regimes under the Climate Change Convention and its Kyoto Protocol, RECIEL, Volume 11, Number 2, p. 182.

[1876] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 378.

[1877] Michael Grubb, Christian Vrolijk and Duncan Brack (1999) supra note 1061, pp. 146-147.

[1878] David Victor (1999) supra note 1866, pp. 155-156.

[1879] UNEP (1987) supra note 896.

To ensure compliance with multilateral environmental agreements (MEA), the approaches could range from soft management to hard enforcement.

The soft management approaches are based on the presumption that, in general, nation States are willing to comply with the agreements they have adopted and ratified, and that non-compliance stems is unintentional due to the lack of capacity or because of uncontrollable circumstances or ambiguity in the terms of an obligation. In the case of the Kyoto Protocol, which has legally binding targets and timelines, citing the lack of capacity or because of uncontrollable circumstances or ambiguity in the terms of an obligation may be valid for the developing countries but these reasons cannot be valid for the developed countries. Hence, the "procedures and mechanisms relating to compliance under the Kyoto Protocol" annexed to Decision 24/CP.7[1880] were the strongest and institutionally most sophisticated non-compliance procedures adopted by MEA to date.[1881] Although the Protocol is stringent on the assessment of compliance, it is typically still very weak on enforcement.[1882]

The hard enforcement approaches presume, on the other hand, that a nation State will, if given the opportunity, not comply with an international agreement, unless it is more costly for a nation State not to comply.[1883]

Advocates for the hard enforcement approach argue that if levels of compliance with the MEA appear to be high, it is because of the shallowness of these agreements that demand little more action than states would have carried out in their absence. When more stringent commitments are introduced in subsequent protocols, harder enforcement measures are required.

The declaration by the Trail Smelter Arbitration Tribunal[1884] that "under principles of international law … no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by

[1880] UNFCCC (2002) supra note 1395, p. 64.

[1881] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 386.

[1882] Michael Grubb, Christian Vrolijk & Duncan Brack (1999) supra note 1061, p. 142.

[1883] Larry MacFaul (2006) Developing the climate change regime: the role of verification. In Verifying Treaty Compliance: Limiting Weapons of Mass Destruction and Monitoring the Kyoto Protocol Provisions [Rudolf Avenhaus, Nicolas Kyriakopoulus, Michel Richard and Gotthard Stein (eds.)], Springer, Berlin, p. 183.

[1884] Stephen C. McCaffrey (2006) supra note 872, p. 35.

clear and convincing evidence" in deciding on the limits of the sovereignty of States and the application of international law on State liability for cross-border damage caused by transboundary air pollution had been enshrined in subsequent international environmental agreements, including the UNFCCC.[1885]

However, this mechanism of traditional dispute settlement utilized in the Trail Smelter Arbitration case in which one State takes adversarial legal proceedings against another State, either in court or tribunal, has never been used in a multilateral environmental agreement to enforce compliance, including the UNFCCC and its legally binding Kyoto Protocol.[1886] The two main obstacles in the use of this traditional dispute settlement mechanism are, first, the breached obligation in a multilateral environmental agreement is not owed to a single state but to the whole international community, and second, the difficulty in attributing clear cause-effect, especially in the case of climate change.

There is also the difficulty in assessing the nature of the damages as well as the appropriate compensations that might be awarded for climate change liability. In any case, compensatory payments may not make good the damage that has already occurred due to climate change because such damages may turned out to be irreversible or the impact is primarily on the well-being of future generations.[1887]

5.1.2.7. Too Early to Declare Success in MEA Implementation

While it is true that many regional and international environmental agreements were successfully adopted and ratified by the international community, which indicates right view and right intent, it is, however, still too early to conclude that these multilateral environmental agreements on the atmospheric global commons have been successfully implemented. The jury is still out on the effectiveness of these MEAs, whether based on the criteria of its internal legal architecture, the transfer of authority, the change of state behavior, solving the problem in terms of the achievement of technical and social goals, or a fundamental change of the system itself.

5.2. LIMITATIONS OF INTERNATIONAL POLITICS

[1885] United Nations (1992a) supra note 16, Preamble.

[1886] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 378.

[1887] Id., pp. 379-380.

As discussed earlier, the struggle of modern legal doctrines against international politics had offered only partial solutions.[1888] It has driven many modern international lawyers, since the last two decades of the 20th century, to support views that point beyond liberal doctrines. Two new legal doctrines, the Chicago school of law and economics and the Harvard school of critical legal studies (CLS) have emerged. Both share a critical view of modern liberalism and consider law to be politics by other means. The CLS movement, however, has yet to climb down and spread beyond the ivy towers of academic institutions while the Chicago school of law and economics through its neoliberal economic and political ideology had transformed the world's political economy from predominantly State-centred to predominantly Market-centred.[1889] Hence, it is right view to understand the impact and limitations of neoliberalism.

Another school of political thought critical of modern liberalism is the classical realism of Hans Morgenthau.[1890] However, Morgenthau was also critical about the limitations of the current state of international politics, he declared that "no attempt to solve the problem of international peace [and order] by limiting the national aspirations for power has succeeded, and none could have succeeded under the conditions of the modern state system."[1891] He then argued, based on the political doctrine of Hobbes,[1892] that "without a state national societies would resemble the international scene". From this premise, Morgenthau logically concluded that peace and order among nations would be secure only within a world state comprising all nations of the earth."[1893] He then went on to elaborate that "[t]he experience of two world wars within a quarter of a century and the prospects of a third one to be fought with nuclear weapons have imparted to the idea of a world state an unprecedented urgency."[1894] Today, with the additional existential threat of systemic climate change, the notion of global governance through the formation of a world state deserves to be heard.

The 5th and final chapter will analyse the impact and limitations of neoliberal economic and political ideology and Morgenthau's perspective of the world state. It will also propose the introduction of global climate change constitutionalism to address the global climate change commons. It requires diplomatic efforts at the international level

[1888] Martti Koskenniemi (2005) supra note 295, p. 219.

[1889] Jonathan D. Ostry, Prakash Loungani and David Furceri (2016) Neoliberalism: Oversold? Finance and Development, Volume 53, Number 2 (June 2016), p. 38.

[1890] Hans Morgenthau (1985) supra note 62, p. 3.

[1891] Id., p. 505.

[1892] Thomas Hobbes (1651) supra note 191.

[1893] Hans Morgenthau (1985) supra note 62, p. 505.

[1894] Id., p. 505.

to initiate political negotiations as soon as it is feasible to establish a world political and legal authority as the long-term solution to achieve the ultimate objective of "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system" and balancing economic, environmental and social needs of contemporary society in order to ensure sustainable development for current and future generations.

5.2.1. Limitations of Neoliberalism

The 'negative' impact of neoliberal ideology first surfaced on the international scene, when the US, after nearly two decades of support for the 'common heritage of mankind' principle in the Law of the Sea (LoS) Convention, rejected it in 1982. In defending the non-signing of the Convention, the US ambassador to the United Nations Conference on the Law of the Sea (UNCLOS III) declared: "[T]he political, economic and ideological assumptions which underlay the treaty are essentially antithetical to American values [and promote] a thinly disguised world collectivism."[1895]

5.2.1.1. Key Characteristics of Neoliberalism

The neoliberal economic and political ideology was essentially about competitive free market economics, relying solely on the 'market' solution and minimizing the role of the 'state'.[1896] In the economic sphere, the ideal domestic or international political system should just provide a fixed, neutral, universal legal framework within which market forces operate spontaneously. The price system of the Market is not only efficient but is also seen as maximising individual liberty as well, or at least the opportunity for men and women to make free choices about their own lives. In the political sphere, unlike the classical liberals were not against state-led welfare programmes and moderate taxation, the neoliberals only wants to dismantle state welfare systems so as to enable private capital to flow freely globally. They are not as concerned about individual liberty as they are about the existence of free competitive markets without barriers. In the social sphere, unlike the classical liberals who consider mutual tolerance, free and open discussion, and the freedom for the individual to act as long as nobody else is harmed in the process as virtues to be cultivated in human society, neoliberalism sees competition as the

[1895] Cited in D. Brian Hufford (1983) supra note 795, p. 127. Remarks of James Malone, Assistant Secretary of State and the United States Representative to UNCLOS under Reagan, quoted by Curtis, Sign the Sea-Law Treaty, N.Y. Times, Feb. 21, 1983, at A17, Col. 4.

[1896] John Vogler (2000) supra note 185, p. 64.

defining characteristic of human interactions. It re-defines individuals as mere consumers, whose democratic choices are best exercised by buying and selling, an exchange process that rewards merit and punishes inefficiency. "Inequality is recast as virtuous. The market ensures that everyone gets what they deserve."[1897]

5.2.1.2. Evolution of Neoliberalism

In the 1980s, the major conservative political parties in USA and UK enthusiastically embraced the ideology of neoliberalism.[1898] The neoliberal ideology associated with the administrations of President Ronald Reagan (1981-1989) and Prime Minister Margaret Thatcher (1979-1990) became entrenched in both the US and the UK as both held power in the US and UK for a long time respectively.[1899]

The neoliberal economic policies produced a boom in the US in the 1990s even though the relatively full employment achieved was at low rates of pay under conditions of diminishing social protections. The flexibility in labour markets and reductions in welfare provision through Clinton's draconian overhaul of the welfare system began to pay off for the US and put competitive pressures on the more rigid labour markets that prevailed in most of Europe and Japan.[1900]

The global diffusion of the new monetarist and neoliberal economic orthodoxy exerted an even more powerful ideological influence. Keynes economics has been replaced by neoliberal economics in IMF and the World Bank. The financial complex of Wall Street–International Monetary Fund (IMF)–US Treasury dominated economic policy during the Clinton administration. It was able to persuade, cajole, and on the back of structural adjustment programmes administered by the IMF, coerce many developing countries to take the neoliberal road. The US also used the carrot of preferential access to its huge consumer market to persuade these countries to reform their economies along neoliberal lines, sometimes through bilateral trade agreements. Considerable pressure was put first on Japan and Europe and later on the rest of the world to take the neoliberal road. The formation of the World Trade Organization (WTO) was the high point of the international neoliberal regime. The WTO set neoliberal standards and rules for interactions among its member-States in the global economy.

[1897] George Monbiot (2016) supra note 371.
[1898] Peter Evans and William H. Sewell, Jr. (2013) supra note 466, p. 44.
[1899] Id., pp. 44-46.
[1900] David Harvey (2005) supra note 467, pp. 92-93.

However, most nation-States that took the neoliberal turn generally did so partially, e.g. continental Europe combined neoliberal practices with social democratic institutions[1901] while China has its market economy with Chinese characteristics.[1902] Even in the wake of crises, e.g. the collapse of the Soviet Union, it has been followed by slow reversals as the unpalatable aspects of neoliberalism become more evident.[1903]

5.2.1.3. Benefits of Neoliberalism

Jonathan D. Ostry, Prakash Loungani and David Furceri from the IMF Research Department recounted the benefits of neoliberalism[1904] as follow:

(1) The expansion of global trade has rescued millions from abject poverty.
(2) Foreign direct investment has often been a way to transfer technology and know-how to developing economies.
(3) Privatization of state-owned enterprises has, in many instances, led to more efficient provision of services and lowered the fiscal burden on governments.

5.2.1.4. Limitations from the Political Economy Perspective

The IMF authors then turned their attention to areas where the expected benefits have not materialized, particularly in terms of removing restrictions on the movement of capital across a country's borders (capital account liberalization); and fiscal consolidation or "austerity", which is shorthand for policies to reduce fiscal deficits and debt levels. An assessment of these specific policies rather than the broad neoliberal agenda reached the following disquieting conclusions,[1905] namely:

(1) The benefits in terms of increased growth seem fairly difficult to establish when looking at a broad group of countries.
(2) The costs in terms of increased inequality are prominent. Such costs epitomize the trade-off between the growth and equity effects of some aspects of the neoliberal agenda.
(3) Increased inequality in turn hurts the level and sustainability of growth. Even if growth is the sole or main purpose of the neoliberal agenda, advocates of that

[1901] Peter Evans and William H. Sewell, Jr. (2013) supra note 466, p. 52.
[1902] David Harvey (2005) supra note 467, pp. 120-151.
[1903] Id., p. 87.
[1904] Jonathan D. Ostry, Prakash Loungani and David Furceri (2016) supra note 1889, p. 38.
[1905] Id., pp. 38-39.

agenda still need to pay attention to the distributional effects.

The limitations of neoliberalism from a political economy perspective were first exposed during the Asian financial crisis. The crisis began in Thailand in 1997 and spread to the Asian countries of Indonesia, Malaysia, and the Philippines, and second to Hong Kong, Taiwan, Singapore, and South Korea. Estonia and Russia in Europe were then hit hard, followed shortly afterwards by the South American countries of Brazil and Argentina, which was badly affected with serious and long-lasting consequences. Even Australia, New Zealand, and Turkey were affected by the crisis. The social effects of the financial crisis were devastating. As the crisis progressed, GDP plummeted, unemployment soared, and banks closed. By 1998, the GDP in Indonesia had fallen by 13.1% and almost 15% of males working in 1997 had lost their jobs by August 1998. As GDP fell and unemployment soared, the IMF stepped in and mandated austerity by abolishing subsidies on food and kerosene in Indonesia in return for financial aid. The riots and violence that followed tore apart the country's social fabric.[1906] IMF/US Treasury recommended further neoliberalization policies with disastrous consequences. It was the push to liberalize the economy that resulted in impetuous financial deregulation and the failure to construct adequate regulatory controls over unruly and speculative portfolio investments in these developing countries. Those Asian countries that had not liberated their financial markets, including Singapore, Taiwan and China, were far less affected than those countries, such as Thailand, Indonesia, Malaysia, and the Philippines, that had liberated their financial markets.[1907]

Jonathan D. Ostry, Prakash Loungani and David Furceri from the IMF Research Department mentioned that although Chile's pioneering experience in the 1970s received high praise from one of the two founders of neoliberalism, Nobel Laureate Milton Friedman, many economists now have now accept the more nuanced view expressed by Nobel Laureate Joseph Stiglitz that Chile "is an example of a success of combining markets with appropriate regulation". Stiglitz noted that Chile then did impose "controls on the inflows of capital, so they wouldn't be inundated," unlike the first Asian-crisis country, Thailand, a decade and a half later.[1908]

Neoliberal globalisation seems now to be on the back foot, both in the US under President Donald Trump, and also in Europe with the emergence of the alternate right

[1906] David Harvey (2005) supra note 467, p. 96.

[1907] Id., p. 97.

[1908] Joseph Stiglitz (2002) The Chilean Miracle: Combining Markets with Appropriate Reform, Commanding Heights Interview, Public Boardcasting Service, Arlington, VA, USA.

with Marie Le Pen in France, Geert Wilders in the Netherlands, Nigel Farage in UK, Heinz-Christian Strache in Austria, and the Vlaams Belang Party in Belgium, to name a but a few. The negative effects of neoliberalism have spawned the rise of authoritarian populism, which is clearly anti-liberal. Rightwing populism is also fiercely anti-immigration and anti-integration. It assumes a kind of authoritarianism stance towards rights. Although it appeals to the 'common man', it does not subscribe to the practice of equality. There is also a strong tendency toward protectionism in economic policy and an isolationism in foreign policy.[1909]

5.2.1.5. Limitations from the Climate Change Governance Perspective

The turn in US political history from classical liberalism to neoliberalism[1910] was responsible for the three obstacles encountered in the evolutionary path of international climate change governance namely:

(1) US-Europe political divide
(2) North-South economic divide
(3) Conceding national sovereignty and power to a supranational authority

The notion of using market-based mechanisms, at the insistence of the US delegation, to solve the climate change problem, introduced into the 1997 Kyoto Protocol, was also the influence of neoliberal ideology. It was accepted by the international community to enable the Annex I countries to meet their commitments under the Protocol by purchasing or acquiring credits of GHG emissions reduction that had or are taking place in other countries.[1911] The rationale advanced by proponents of the market-based mechanisms of international transfer was that the geographical location of climate change mitigation is largely irrelevant as it is perfectly acceptable from a cost-effectiveness perspective to carry out the mitigation project where it is the cheapest option regardless of the location.[1912] If the location happened to be in a developing country there was also the additional benefit of fund transfer and possibly technology transfer as well. However, the provision of these market-based mechanisms was partly responsible for the failure of the Kyoto Protocol.[1913]

[1909] Michael A. Peters (2018) The end of neoliberal globalisation and the rise of authoritarian populism, Educational Philosophy and Theory, Volume 50, Number 4, p. 324.
[1910] Roderick Ogley (1984) supra note 794.
[1911] Philippe Sands, Jacqueline Peel, Adriana Fabra and Ruth Mackenzie (2018) supra note 354, p. 310.
[1912] Farhana Yamin and Joanna Depledge (2004) supra note 374, p. 136.
[1913] Amanda M. Rosen (2015) supra note 382, p. 32.

With the rise of authoritarian populism in the international political system, the turn to polycentric governance of climate change may well be the only choice left for the international community in the short-term to do something to avert the Earth's climate from tipping over into catastrophic disruptions for humankind as the ball is now in the court of national societies to restrain the profligate use of fossil fuels by individuals, families, communities, corporations, local, regional and national governments for power generation, industry, agriculture, transportation, heating and cooling, and regulate the transition to a low-carbon economy.

5.2.2. Morgenthau's Perspective on International Politics

To save the world from self-destruction by nuclear war or climate change, from Morgenthau's perspective, is not limitations of the exercise of national sovereignty through international obligations and international institutions, e.g. nuclear arms treaties and UNFCCC, but the "transference of sovereignties over the individual nations to a world authority, which would be sovereign over the individual nations as the individual nations are sovereign within their respective territories. Reforms within the international society have failed and were bound to fail. What is needed, then is a radical transformation of the existing international society of sovereign nations into a supranational community of individuals"[1914] – a World State.

5.2.2.1. Necessary Conditions for Peaceful Change

The struggle of modern legal doctrines against international politics had failed to offer satisfactory solutions,[1915] prompting many modern international lawyers to look beyond the liberal principles of freedom, equality and the Rule of Law, and back to the notion of justice. But we have started our quest for the right legal doctrine with the simple denial of the existence of principles of natural justice or of our human capacity to know them.[1916] Hence, what notion of non-natural justice will satisfy the expectation of the nation-States for justice to all in a World State?

5.2.2.1.1. Expectation of Justice for All

[1914] Hans Morgenthau (1985) supra note 62, pp. 505-506.
[1915] Martti Koskenniemi (2005) supra note 295, p. 219.
[1916] Martti Koskenniemi (1990) supra note 1699, p. 5.

According to Morgenthau, it will be analogous to the way national societies create the expectation of justice on the part of hostile social groups within it such that none of their claims of justice will be completely ignored while all groups shall have the opportunity for at least partial satisfaction.[1917]

The intricate mechanisms of peaceful change, which includes the legislative, judiciary and executive functions, come into play, giving all [nation-States] a chance to submit their claims for justice to the arbitrament of public opinion, of elections, of parliamentary votes, of examination boards, and the like. These mechanisms, analogous to their domestic counterparts, guide the conflicting claims of nation-States into peaceful channels by giving them a chance to make themselves heard and to compete with each other for recognition according to procedural rules binding upon all. Because these mechanisms will be of fixed duration, no nation-State can be sure to prevail over the long term unless it is able to win over the majority of public opinion in every election or parliamentary vote while all nations will always have the opportunity at one time or another to work towards the attainment of their own notion of justice.[1918]

5.2.2.1.2. Peaceful Channeling of Public Opinion

Whether in the domestic or international sphere, tension, including the different notions of justice held by the different social groups, is an omnipresent phenomenon of social life. In the domestic sphere, a given status quo is stabilized and perpetuated by its domestic legal system. The judiciary function acts as the agent of the status quo while the legislative function acts as the agent of change. According to Morgenthau, three factors made this peaceful change possible:[1919]

(1) Public opinion has the freedom to express itself.
(2) Ability of institutions to absorb the pressure of public opinion.
(3) Ability of the State to protect the status quo against violent change.

The public expressed their desire for change through the spoken and written word, through organized efforts and spontaneous responses. Responding to the impact of these manifold expressions, the moral climate of domestic society changed, enhancing the desire for change and depreciating the current status quo. No social or political

[1917] Hans Morgenthau (1985) supra note 62, p. 508.
[1918] Id., p. 509.
[1919] Id., p. 455.

institutions could escape the pervading heat of this moral climate. It is the intangible transformation of moral values that society finds the most potent force promoting the transformation of the status quo.[1920]

"It is the all-pervading of public opinion that determines the moral values and legal decisions of legislative agencies, as it does in the long run of courts and of executive power. Legislative, judicial and executive agencies are instruments of public opinion They all fulfill the same function for public opinion [by providing the means for the] peaceful and orderly channeling for the presentation and scrutiny of its demands, for their evaluation in the light of generally shared principles of justice, and for the transformation into reality of those that have been recognized as legitimate." These domestic institutions make it possible for tensions to be giving expression in public debates, the electoral process, parliamentary consultations, and governmental dilemmas instead of in violent conflagrations. In fact, if these domestic processes do not operate or operate badly, the domestic scene will resemble the international scene.[1921]

The important insight is that the vital function of peaceful change within the nation-State is performed not by any particular agency acting in isolation but by all these domestic legal institutions as an integrated whole. In the same way, the establishment of the legislative, judiciary and executive functions at the world level as an integrated whole is necessary to perform the vital function of peaceful change with the World State. If any of these essential functions are weak or non-existent, as discussed in Section 5.1.2 with respect to the multilateral environmental agreements, the whole system of peaceful change will fail.

5.2.2.1.3. Supranational Loyalty and Epochal Consciousness

After the peaceful change to a new status quo, maintaining the peace among the nation-States in the World State is predicated upon dual foundations:[1922]

(1) Disinclination of the individual human being to break the peace.
(2) Inability of the member-States to break the peace.

The latter is based on the response of overwhelming power making the attempt by any member-State to break the peace a hopeless undertaking. The former, however, is

[1920] Id., p. 456.
[1921] Id., pp. 456-457.
[1922] Id., p. 506

dependent on the education of each and every human being, not the member-State, to regard loyalty to our planetary home as superior to loyalty to any part of it.

We now turn to the unprecedented climate change phenomenon that is shaping the Anthropocene, which is a thing that human beings never had to face in recorded or remembered history. Humankind had faced local and regional climate changes and other environmental problems but something is profoundly different about current times. The timescale of human history has now collided with the timescales of two other histories, both deep time, the time of evolution of life on the planet, and geological time.[1923]

The historical narratives, of human motives and aspirations, psychological emotions and passions, and the social-economic-political institutions that make up our social lives, were all constructed on the assumption that geological and evolutionary developments were mere backdrop on the stage in which our human dramas unfolded. Occasionally, earthscale phenomena, e.g. earthquakes eruptions, enter into our narratives, but they provided, for the most part, a background to our actions.[1924]

In our own lifetime, we have become aware that human development has merged with geological and evolutionary developments and all three are now in the foreground of the planetary drama. Human activities are now contributing to the loss of biodiversity that may become the Sixth Great Extinction Event,[1925] and at the same time a geophysical force, changing the climate and the geology for the planet for millennia to come. This collapsing of human and geological chronologies has not gone unnoticed by scientists. A recent publication by the geologist Jan Zalasiewicz and his collaborators, who have been working to substantiate and formalize the name of the epoch of the Anthropocene, cite a series of worldwide and synchronic stratigraphic signals enabling them to suggest with confidence that "the Anthropocene . . . be defined to begin historically at the moment of the detonation of the Trinity A-bomb at Alamogordo, New Mexico, . . . [on] July 16, 1945." The date thus combines both an important event of the atomic test explosion in human history and "the source of a chemostratigraphic [global] signal."[1926]

[1923] Dipesh Chakrabarty (2015) The Human condition in the Anthropocene, Lecture II, The Tanner Lectures in Human Values (18-19 February 2015), Yale University, New Haven, CT, USA, p. 179.

[1924] Id., p. 179.

[1925] Damian Carrington (2017) Earth's sixth mass extinction event under way, scientists warn, The Guardian, 10 July 2017. Accessed on 25 Septmeber 2019 at: https://www.theguardian.com/environment/2017/jul/10/earths-sixth-mass-extinction-event-already-underway-scientists-warn

[1926] Jan Zalasiewicz, Colin N. Waters, Mark Williams, Anthony D. Barnosky, Alejandro Cearreta, Paul Crutzen, Erle Ellis, Michael A. Ellis, Ian J. Fairchild, Jacques Grinevald, Peter K. Haff, Irka Hajdas,

If the Anthropocene were to be formalized by the International Union of Geologists, it will mean that long after fossil fuel-based civilizations are gone, the Earth will still bear in its rocks the signs of human beings having been here.

Epochal consciousness is the thinking needed for the age of the Anthropocene as it decenters the human by subordinating human history to the geological and evolutionary histories of the planet. However, as Karl Jaspers remarked, epochal consciousness "[is] granted to man without giving him the rest of a conclusion."[1927] In the meantime, human beings are already very familiar with the consciousness of national identity. The middle path then is to extend the logic of Morgenthau for national consciousness to world consciousness.

The loyalties, with which the individuals cling to the World State, are more than mere repayment of a debt of gratitude for benefits received. These loyalties are the very conditions of those benefits. It is only by being faithful to the World State, by adhering to it as the fountainhead of all material goods, by identifying oneself with it that one will experience as one's own the security of belonging.[1928] Hence, interests and loyalties that might not be compatible with the central concern for the unity of the world must yield to that concern. Hence, this concern imposes an ever-present limitation upon the kind of issues that will be allow to separate the individuals and places ever-present restraints upon the methods by which the individuals could iron out these issues. It is the limiting and restraining influence of supranational loyalties that constitutes one of three factors that can make peaceful change for the world.[1929]

5.2.2.1.4. Overwhelming Force

The last factor in maintaining peace within national societies is the overwhelming force with which the national government can nip in the bud all attempts by individuals to disturb the peace.[1930] The situation, however, is far more complex for the World State to nip in the bud all attempts by nation-States to disturb the peace. Regardless whether it on the national or world arena, there are two different processes involved in order to

Reinhold Leinfelder, John McNeil, Eric O. Odada, Clément Poirier, Daniel Richter, Will Steffen, Colin Summerhayes, James P. M. Syvitski, Davor Vidas, Michael Wagreich, Scott L. Wing, Alexander P. Wolfe, ZhiSheng An and Naomi Oreskes (2015) supra note 101.

[1927] Karl Jaspers (1958) Die Atombombe und die Zukunft des Menschen [The Future of Mankind translated by E. B. Ashton], The University of Chicago Press (1961), Chicago, IL, USA, p. 12.

[1928] Hans Morgenthau (1985) supra note 62, p. 508.

[1929] Id., p. 508.

[1930] Id., p. 509.

create the right conditions for the use of overwhelming force to maintain peace:

(1) General disarmament of subordinate entities
(2) Creation of neutral police force under command of State

Both processes will probably need to be carried out simultaneously. In the case of the first process, there are many examples, including in the US, where the disarmament process has been difficult to carry out successfully even in the national arena. Although in the case of the second process of creating a neutral force under the command of State, it had been much easier to achieve and are generally successful in the national arena.

On the world arena, the powerful nation-States are already armed to the teeth with nuclear weapons that can vaporize the world and those nation-States without nuclear weapons are trying desperately to acquire them. In fact, even small groups of extremists are hell bent on acquiring nuclear weapons. Even if all the nation-States were to decide to establish a World State tomorrow, the powerful nation-States are very unlikely to give up their nuclear weapons. The only possible scenario is one in which all the nation-States disarmed at once. Even if there were an international agreement adopted to pursue such a step today, the practical aspects of supervising such a transformation would overwhelm the agency responsible for the exercise, especially the necessity for strict monitoring, verification and reporting of the general disarmament process to guarantee that there is no cheating. The human and other resources needed to carry out such a task will be enormous. Nevertheless, these costs pale into insignificance when compared with the costs and risks of nuclear rearmament.[1931]

Meanwhile, every nation-State, powerful or otherwise, has accumulated a large arsenal of conventional weapons. The general disarmament of the conventional weapons of all the 193 nation-States of the world simultaneously will be at least as daunting a task as that for nuclear weapons. The difficulty in general disarmament is further compounded today by the use of artificial intelligence in drones and robots as killing machines. For the monitoring, verification and reporting of the disarmament process of such 'weapons' will require not only examining the individual 'weapons' which are easily disguised but also the sophisticated AI system behind these 'weapons'.

[1931] Susan Willett (2003) Costs of Disarmament – Disarming the Costs: Nuclear Arms Control and Nuclear Rearmament, United Nations Institute for Disarmament Research (UNIDIR), Geneva, Switzerland, p. xiii.

If the general disarmament process were not carried out successfully, the difficulty in creating a police force under the command of the State increases proportionally. A general rule of thumb in combat is that the attack force should have a 3:1 ratio as compared to the defense force for a reasonable successful strike.[1932] If such, the human and other resources needed to create an overwhelming force under the command of the World State will be astronomical.

According to Morgenthau, "the history of the attempts at disarmament is a story of many failures and few successes."[1933] "The only successful disarmament treaty of the 19th century is the Rush-Bagot Agreement of 1817 concerning the frontier between the United States and Canada." It was revised in the Second World War and has remained in force to this day.[1934] The success of the Rush-Bagot Agreement is first because it is under conditions of local disarmament and second because "[i]n the relations between the two countries there is virtually no chance for a competition for power that might transform itself into an armed quest for each other's territory", making the 3,800 miles of Canadian-American frontier the longest unarmed frontier of the world.[1935]

Disarmament is an indispensable step in a general settlement of international conflicts but it cannot be the first factor to pursue. Efforts to establish the legislative, judicial and executive agencies for the peaceful and orderly channeling of public opinion for presentation and scrutiny of its demands, for their evaluation in the light of generally shared principles of justice, and for the transformation into reality of those that have been recognized as legitimate on the world stage, together with the education of world consciousness in every individual human beings, must come first. Once, the nation-States have agreed upon a mutually satisfactory distribution of power among themselves, they can then afford to reduce and limit their armaments. Disarmament, in turn, will contribute greatly to the general pacification. The measure of the political understanding and will of the nation-States to form a World State is the degree to which the nation-States are able to settle the issue of disarmament.[1936]

5.2.2.2. Model for the World State

[1932] M. Kress and I. Talmor (1999) A new look at the 3:1 rule of combat through Markov stochastic Lancaster models, Journal of the Operation Research Society, Volume 50, Number 7 (July 1999), pp. 733-744.

[1933] Hans Morgenthau (1985) supra note 62, p. 403.

[1934] Id., p. 407.

[1935] Id., p. 409.

[1936] Id., pp. 422-423.

The "two conflicting theories" of political institutions are those John Stuart Mill found to be the basis for his analysis of which model of government to choose in the first chapter of his book, "Considerations on Representative Government",[1937] are also the basis for the thesis's analysis of the best model for the World State.

One school of thought conceives government as strictly a practical art. It is regarded as wholly an affair of invention and contrivance. Being made by man, it is assumed that man has the choice either to make it or not, and how or what pattern it shall be made. Hence, to find the best model of government is, first, to persuade others that the selected form is the best, and, second, to stir the others to insist on having it, is the order of thought in the minds of those who adopt this conception of political philosophy. The other school of thought considers government to be the science of a branch of natural history. Hence, the model of government is not a matter of choice. It is not constructed by pre-meditated design. The political institutions of a people are the products of organic growth from the nature and life of that people. The will of the people plays no part in their construction, as they are the evolving products of meeting the necessities of the moment by the contrivances of the moment by the people.[1938]

Mill took a middle stand between the two extreme political doctrines, as there is some truth in either. Taking such a stand means that 'the model of government intended for the people, which has evolved from the nature and life of the people, must first be accepted by the people.' Second the people must be willing and able to do what is necessary to keep it going. Third, the people must be willing and able to do what is required of them to enable it to fulfill its purposes. All three conditions are necessary and sufficient for any model of government to work, and the failure of any of these three conditions will render the whole process a failure.[1939] The same conditions apply to the establishment of a World State to solve the climate change problem.

5.2.2.3. World Community Antedates World State

Morgenthau had already came to the conclusion that world peace cannot be permanent without a World State and that a World State cannot be established under the current

[1937] John Stuart Mill (1861) Chapter I, Considerations on Representative Government, Parket, Son and Bourn, London, UK [Pennsylvania State University, Electronic Classics Series, Jim Manis (ed.), Hazleton, PA, USA, pp. 5-15].

[1938] Id., pp. 5-6.

[1939] Hans Morgenthau (1985) supra note 62, pp. 513-514.

moral, social and political conditions of the world.[1940] In the same breath, he had also concluded that there is no period of "modern history was civilization more in need of permanent peace and, hence, of a world state, and that in no period of modern history were the moral, social and political conditions of the world less favorable for the establishment of a world state."[1941]

He then admitted that with regards to the conditions needed for the establishment of a World State, based on the understanding of John Stuart Mill, there would be no World State without a world community willing and able to support it. Any successful movement away from a society of nation-States must be preceded by a transformation at the level of the world community. It is a necessary precondition, although not sufficient by itself, for the establishment of a World State that individuals must have shifted their primary allegiance from their national community to a world community. Thus, a world community must antedate a World State.[1942]

Morgenthau then cited two international efforts to create such a world community through the United Nations Educational, Scientific, and Cultural Organization (UNESCO)[1943] and the other specialized agencies of the United Nations[1944] respectively.

He was of the strong opinion that the philosophy of UNESCO on the use of education, cultural exchange and communication to increase contacts among members of different nation-States and facilitate understanding of one another cannot contribute significantly to the creation of a world community and the maintenance of peace for implicit in the assumption is that the nations are nationalistic and go to war because they do not know

[1940] Id., pp. 505-506.

[1941] Id., p. 516.

[1942] Id., p. 521.

[1943] UNESCO is the United Nations Educational, Scientific and Cultural Organization. It seeks to build peace through international cooperation in Education, the Sciences and Culture. It has a unique role to play in strengthening the foundations of lasting peace and equitable and sustainable development. Advancing cooperation in education, the sciences, culture, communication and information holds strategic stakes at a time when societies across the world face the rising pressures of change and the international community faces new challenges. Its programmes contribute to the achievement of the Sustainable Development Goals defined in Agenda 2030, adopted by the UN General Assembly in 2015. Accessed on 26 September 2019 at: https://en.unesco.org/about-us/introducing-unesco

[1944] Specialized Agencies are legally independent international organizations with their own rules, membership, organs and financial resources, were brought into relationship with the United Nations through negotiated agreements. Some of the agencies existed before the First World War, some were associated with the League of Nations, others were created almost simultaneously with the United Nations and yet others were created by the United Nations itself to meet emerging needs. Accessed on 26 September 2019 at: https://www.unsystem.org/members/specialized-agencies

one another well enough and they operate on different levels of education and culture. He argued that both assumptions are erroneous based on evidences in human history that education and culture and the nationalistic mindset and warlike tendencies are not only not cause-and-effect but they are not highly correlated as well. Hence, the creation of a world community does not hinge on the knowledge of and the creation and appreciation of different cultural values, but upon a moral and political transformation of unprecedented dimensions.[1945]

Morgenthau was, however, more enthusiastic about the work of the specialized agencies in pointing the way to the creation of a world community. Professor David Mitrany explained the philosophy of such an approach:

"If the evil of conflict and war springs from the division of the world into detached and competing political units, will it be exorcised simply by changing or reducing the lines of divisions? Any political reorganization into separate units must, sooner or later, produce the same effects; any international system that is to usher in a new world must produce the opposite effect of subduing political divisions. As far as one can see, there are only two ways of achieving that end. One would be through a world state which would wipe out political divisions forcibly; the other is the way ... which would rather overlay political divisions with a spreading web of international activities and agencies, in which and through which the interests and life of all the nations would be gradually integrated."[1946] Hence, according to Mitrany, a world community must grow on the satisfaction of common needs shared by members of all the different nations. The specialized agencies of the United Nations in serving peoples from all over the world regardless of national boundaries could create through their performance a sense of supranational identity. If these specialized agencies were numerous enough and served the most important needs of the peoples of the earth, the loyalties of the peoples to these institutions and to the world community of which they are the agencies would supersede the loyalties to the separate nation-States and their respective institutions.[1947]

Morgenthau, however, found that the shifting of the primary allegiance of individuals from their national community to a world community was a very difficult process under the current moral, social and political conditions. First, in peacetime, the benefits

[1945] Hans Morgenthau (1985) supra note 62, pp. 522-523.

[1946] David Mitrany (1946) A Working Peace System, 4th Edition, The Royal Institute of International Affairs, London, UK, pp. 14-15.

[1947] Hans Morgenthau (1985) supra note 62, p. 528.

offered by the nation to the individual far outweigh the benefits offered by the specialized agencies. Second, the benefits from the specialized agencies are offered through the intermediary of the national agencies such that its international origins are hard to trace. It is always the last mile that matters most to the consumer. Thus the significant contributions made by the specialized agencies to the wellbeing of the members of all nations fade into the background. Third, Morgenthau found that in practice the transfer of national loyalties to these specialized agencies is actually made even more difficult by the standard procedures that these specialized agencies had to follow. For instance, these agencies give aid generally only on the request of individual governments. Furthermore, the purpose of assistance, the kind of aid, and modalities of its execution are subject to the agreement between the agency and the recipient government. Under these conditions, the receiving individuals probably see the specialized agency as an agent of their respective government.[1948]

5.2.2.4. Rudimentary World Community

Hence, although Morgenthau believed that if humankind is to survive it is essential in the long run for a world government to be established to eliminate the potential existential threat of nuclear war and, perhaps, that of systemic climate change as well, which did not surface in his lifetime, he found that it was already very difficult to create a world community, which has to antedate a World State, in the current moral, social and political conditions. However, Morgenthau did provide the necessary organizational principles for the establishment of a World State and pointed the way for the creation of a world community.

Today, there are evidences of such a rudimentary world community established under the difficult moral, social and political conditions of present-day society. The worldwide Baha'i community has already been established in more than 100,000 localities in virtually every country and territory around the world.[1949] In April 2018, the national delegates from 166 countries elected the Universal House of Justice, the global supreme governing body of the worldwide Baha'i community, for another five-year term.[1950]

This worldwide community comprises the members of the Baha'i Faith, a religion

[1948] Id., pp. 528 & 536.

[1949] BIC (2019a) A Global Community: Websites and contact information, Baha'i International Community (BIC). Accessed on 26 September 2019 at: https://www.bahai.org/national-communities/

[1950] BWNS (2019) Universal House of Justice elected, 30 April 2018, Baha'i World News Service (BWNS). Accessed on 26 September 2019 at: https://news.bahai.org/story/1258/

whose followers claimed to be the latest revelation from God, which include in the past both the Abrahamaic line of religions from those of Abraham to Moses to Christ and Muhammad as well as the Aryanic line of religions, which included those of Krishna, Buddha and Zoroaster. The three basic tenets of the Baha'i Faith are the oneness of God, the progressive nature of religious revelations, and the essential unity of humankind.[1951] Its social goals are the establishment of world order[1952] and the promulgation of universal peace on planet Earth.[1953] The Baha'i organizational principles for the world order hews closely to those espoused by Morgenthau. First, it has already established the Baha'i Administrative Order of legislative, judiciary and executive functions at the local, national and global levels, with the legislative function operating only at the global level and the other two functions operative at all levels based on the principle of subsidiarity, which is "not only as the nucleus but the very pattern of the New World Order destined to embrace in the fullness of time the whole of mankind".[1954] Second, because one of the basic tenets of the Baha'i Faith is the essential unity of humankind, the inculcation of world consciousness and its corollary principles of the lack of prejudices, the equality of man and woman, the harmony of science and religion, the elimination of the extremes of wealth and poverty, the need for a universal auxiliary language and compulsory education, and the independent investigation of truth, form the core syllabus of the education of its followers and of interested local communities where the Baha'is are residing.[1955] Third, Baha'u'llah, the Prophet-Founder, had already called for the general disarmament of the power nation-States in Europe and the Middle East during his lifetime in the mid-19th century, counseling them to "[b]e reconciled among yourselves, that ye may need no more armaments save in a measure to safeguard your territories and dominions."[1956]

Today, the worldwide Baha'i community is pursuing both educational as well as social-economic strategies from a bottom-up approach to extend the core tenets as well as the organizational principles of the Baha'i Faith to create eventually a world community.

[1951] BIC (2019b) What Baha'is Believe, Baha'i International Community (BIC). Accessed on 26 September 2019 at: https://www.bahai.org/beliefs/

[1952] Shoghi Effendi (1938) The World Order of Baha'u'llah: Selected Letters [2nd Revised Edition published by the National Spiritual Assembly of the Baha'is of the United States, Baha'i Publishing Trust (1974), Wilmette, IL, USA.]

[1953] Abdu'l-Baha (1912) Promulgation of Universal Peace: Talks Delivered by Abdu'l-Baha during His Visit to United States and Canada in 1912 [Compiled by Howard McNutt and published by Baha'i Publishing Trust (2008), Wilmette, IL, USA].

[1954] Shoghi Effendi (1938) supra note 2385, p. 144 [2nd Revised Edition (1974)].

[1955] BIC (2019b) supra note 1949.

[1956] Baha'i World Centre (2002) The Summons of the Lord of Hosts: Tablets of Baha'u'llah, Baha'i Publishing Trust, New Delhi, India, p. 93.

5.3. GLOBAL ENVIRONMENTAL CONSTITUTIONALISM

On a broad front, climate change, population growth, economic growth and energy resources are already directly shaping planet Earth in the Anthropocene. The future of modern humankind began to be a subject of heated debate during the 1960s, when the peoples for the world began to recover from the horrors of world wars, and started to consider the consequences of that recovery. Now half a century later, there are real concerns about a "classical endogenous Mathusian overload: by one estimate the earth was 30 percent overpopulated in the year 2000".[1957]

5.3.1. The Future Climate Change

If you were to compare humankind current atmospheric impacts with those from other forces that have occurred in geological times, they, perhaps, pale in comparison. Besides, when left alone to its systemic processes, the atmospheric conditions would revert to reasonably 'normal' circumstances in a few millennia. But if a ten billion human population aspires for a seemingly more secure and gratifying life grounded on an energy-intensive fossil fuel-based economy, then the margin for civilization error will have seriously narrowed.[1958] More importantly, if the atmospheric GHG concentrations reach or exceed the levels of the mid-Miocene epoch (400~500ppm),[1959] millions of years ago, the latent change built into the new atmospheric system would put the planetary system on a fundamental different reality.[1960]

The immediate impact will be the increase in the frequency of extreme weather

[1957] John L. Brooke (2014) Climate Change and the Course of Global History: A Rough Journey, Cambridge University Press, Cambridge, UK, pp. 560-561.

[1958] Johan Rockström, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin, III, Eric F. Lambin, Timothy M. Lenton, Marten Scheffer, Carl Folke, Hans Joachim Schellnhuber, Björn Nykvist, Cynthia A. de Wit, Terry Hughes, Sander van der Leeuw, Henning Rodhe, Sverker Sörlin, Peter K. Snyder, Robert Costanza1, Uno Svedin, Malin Falkenmark, Louise Karlberg, Robert W. Corell, Victoria J. Fabry, James Hansen, Brian Walker, Diana Liverman, Katherine Richardson, Paul Crutzen and Jonathan A. Foley (2009) Planetary Boundaries: Exploring the Safe Operating Space for Humanity, Ecology and Society, Volume 14, Number 2, Article 32.

[1959] Yi Ge Zhang, Mark Pagani, Zhonghui Liu, Steven M. Bohaty and Robert DeConto (2013) A 40-million-year history of atmospheric CO_2, Philosophical Transactions of the Royal Society A, 371: 20130096.

[1960] John L. Brooke (2014) supra note 1957, p. 558.

events.[1961] The most pervasive and serious of the impacts of climate change of either gradual or abrupt climate change in the coming decades will involve the rising of sea levels as well as changes in the patterns of precipitation and water distribution. Highly populated coastal cities and districts around the world will be directly impacted by rising sea levels. Economies and peoples who are directly and primarily dependent on rain- or glacial-fed agriculture will suffer greatly from drought and water shortage.[1962] The United Nations had already classified 32 countries as suffering from water scarcity or water stress. By 2050 this number will rise to 60, encompassing nearly one-half of the world's population.[1963] The warming temperatures will make new and established diseases, often tropical in origin, much more pervasive. [1964]

Climate change is already impacting various regions of the planet and falling disproportionately on peoples who had little role in its cause while those who collectively have been most responsible for it, and who have the capacity to rectify it, will suffer the least impact. The next several decades will see large populations coming of age in impoverished economies with limited prospects. Their circumstances will have some resemblance to those during the breaks in the history of the Old World after the mid-Holocene and the rise of the state after 3,000 BC, which were associated with long-term climate changes towards drought, often abrupt, contributing to failing economies, starvation, epidemics, and falling states, and thereby setting the stage for migrations, civil violence, and war.[1965]

Humankind may find itself at another "bottleneck" of a sharp reduction in the size of the total human population in the next several decades, equivalent to the Late Pleistocene epoch.[1966] Answer to this critical issue leads into the domain of politics and governance.

[1961] EASAS (2018) New data confirm increased frequency of extreme weather events, European national science academies urge further action on climate change adaptation, European Academies Science Advisory Council, 21 March 2018. Accessed on 26 September 2019 at: https://easac.eu/press-releases/details/new-data-confirm-increased-frequency-of-extreme-weather-events-european-national-science-academies/

[1962] IPCC (2019) Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]. In press.

[1963] James Hansen, Makiko Sato and Reto Ruedy (2012) Perception of Climate Change, Proceedings of the National Academy of Sciences, Volume 109, Number 37 (6 August 2012), E2415-E2423.

[1964] John L. Brooke (2014) supra note 1957, p. 566.

[1965] Id., p. 569.

[1966] Stanley H. Ambrose (1998) Late Pleistocene human population bottlenecks, volcanic winter, and the differentiation of modern humans, Journal of Human Evolution, Volume 34, pp. 623-651.

5.3.2. Global Environmental Constitutionalism

There is now mounting evidence that planetary systems are on the brink of human-induced ecological disaster that could change life on Earth, as we know it. Hence, besides the scientific consideration of its use as a geological epoch beyond the Holocene, the term 'Anthropocene' is transcending its initial use as a mere rhetorical device, permitting deeper epistemological and ontological enquiries into regulatory intervention to mediate the human-environment interface. There is a proportional awareness that existing legal and political governance systems cannot continue to rely on the assumption, which had never been questioned, that the current stable conditions of the Holocene would last indefinitely. While the current moral, social and political conditions are far from ideal for the development of a world order with a world government, humankind in the current moral, social and political conditions should be prepared to start a conversation about the type of legal and political governance interventions capable of responding to the exigencies and complexities of a new and urgent social-ecological reality.[1967]

5.3.2.1. Principles of Environmental Law and Governance in the Anthropocene

The concept of sustainable development as the overarching lead principle is well suited towards a holistic, planetary approach. This cooperation principle requires all actors, including non-state actors, to work together, first, with the aim to prevent the Earth system from tipping over in the short-term and, second, to restore the health of the Earth system in the long-term.[1968]

Second, the precautionary principle is a vital principle for the Anthropocene because the complexity, uncertainty and element of surprise associated with an Earth system approach with a focus on planetary boundaries, require decision-makers to be much more aware of humanity's limitations and, thus, exercise precaution. The very notion of the Anthropocene also implies that humankind is capable not only of preventing, restoring but also enhancing the Earth system, which technological innovations can help

[1967] Louis J. Kotze (2017) Preface: Discomforting Conversations in the Anthropocene. In: Environmental Law and Governance for the Anthropocene [Louis J. Kotze (ed.)], Hart Publishing, Oxford, UK, pp. vii-viii.

[1968] Jonathan Verschuuren (2017) The Role of Sustainable Development and the Associated Principles of Environmental Law and Governance in the Anthropocene. In: Environmental Law and Governance for the Anthropocene [Louis J. Kotze (ed.)], Hart Publishing, Oxford, UK, p. 28.

humankind to achieve.[1969] But just as the large-scale technological innovation and utilization of fossil fuel energy had helped humankind to vastly grow its population and wealth in the last quarter of a century, it had also caused global warming and resultant climate change. These technological innovations for preventing and restoring the Earth system, if necessary, and for enhancing the Earth system are associated with great uncertainty and risks, and will require risk assessment and management at all levels, which shows the vital importance of the precautionary principle.

Third, the integration principle, which is closely linked to, and to some extent, forms part of the concept of sustainable development, must be included as soon as possible as humankind needs to integrate environmental consideration into all relevant decision-making processes at all levels immediately, particularly those aimed at socio-economic development, thus enabling humankind to remain within the planetary boundaries.[1970]

Analogous to the situation faced by Mill in deciding on the form of government, these three principles must first be accepted by the people. Second, the people must be willing and able to do what is necessary to keep these principles alive. Third, the people must be willing and able to do what is required of them to enable it to fulfill their purposes. As Morgenthau has articulated with respect to the establishment of the World State, all these three conditions are necessary and sufficient in order for the principles to take effect, and failure in any of these conditions will render the whole process a failure.[1971]

If is therefore necessary that radically stronger normative force be coupled to these three principles, and that they are safeguarded by all legal institutions at all levels of government. International law as it is practiced currently will also have to be radically reformed beyond that of a mere coordination role, as humankind will be dealing with planetary processes that will impact the whole human race. It is impossible at the local and national levels to assess if the other decision-makers have the right view and the right intent, and to coordinate what all other decision-makers around the world have decided upon.[1972]

It also means that the civic education of the whole human race on the Earth system and the social-ecological interactions and implications of the Anthropocene will have to proceed soonest possible. UNESCO has a vital role to play in this worldwide effort. It

[1969] Id., pp. 28-29.
[1970] Id., pp. 28-29.
[1971] Hans Morgenthau (1985) supra note 62, pp. 513-514.
[1972] Jonathan Verschuuren (2017) supra note 1968, p. 29.

will need the approval of and the material support from all the nation-States to significantly enlarge its existing programme of strengthening the foundations of lasting peace and equitable and sustainable development. “For those who wish the twenty-first century to be one of peace, we need to translate our research findings on collective action into materials written for high school and undergraduate students ... It is the ordinary persons and citizens who craft and sustain the workability of the institutions of everyday life. We owe an obligation to the next generation to carry forward the best of our knowledge about how individuals solve the multiplicity of social dilemmas”.[1973]

The next step at the international step is for the United Nations General Assembly to call for a Summit of all nation-States and non-state actors to start the process of global civic education of the whole human race, under the auspices of UNESCO, as the process of education not only take much resources, it will also take much time to pervade every strata of global society.

It should then be followed immediately, as soon as the implementation of the Paris Agreement has stabilized, for the international community to begin political negotiations to establish global environmental constitutionalism as part of the long-term solution. The nation-States will still be relevant for most human affairs, e.g. security, foreign policy, however, on matters concerning the planetary environment, a direct connection is needed between human beings and planet Earth.

5.3.2.2. Legal Constitutionalism

Constitutionalism is essentially a legal theory that seeks to guarantee the liberty and rights of individuals under a limited government at the national or global level. It may include a written constitution or it may not. A country without a written constitution may nevertheless adhere to constitutionalism, e.g. United Kingdom. In other words, what matters is the substantive intent of constitutionalism and not its procedural aspects. As a matter of substance, constitutionalism is made of two fundamental principles: first, all powers derive from the people, and second, all people are endowed with fundamental human rights. However, there is no such thing as a 'one size fits all' in constitutional law. Constitutional rules have to be tailored to each country. However, regardless of the necessary adjustments, one should never forget that the fabric of constitutionalism is always the same. Constitutionalism has been devised for the good and the right of humankind. As globalization of markets may put globalization of

[1973] Elinor Ostrom (1998) supra note 55, p. 18.

constitutional law at risk because of its huge social costs, we must never forget that the starting point and the end result of constitutionalism is indeed the human being.[1974]

First, global legal constitutionalism fosters the progressive social ordering from an international anarchical system to a world system with "an apex form of law to improve a legal and political order for the common good" addressing the issue of fragmentation highlighted by the International Law Commission.[1975] Second, it provides a stable and legitimate framework to facilitate positive interactions among its world citizens to address the global challenges of carbon emissions, population growth, nuclear weapons and energy, and resource depletion.[1976] Third, "as part of its elevated relative juridical position," global constitutionalism "provides guarantees of individual freedoms, democracy, representation, rights and participation, among others."[1977] Fourth, it has also been argued that "[i]n the background, if not even at the foundations, of any constitutional system are reflections upon the very notion of morality."[1978]

Hence, in all these aspects, global legal constitutionalism transcends the limitations of international law and politics. While there is still little consensus about the meaning and approach to global constitutionalism, it is clear that the paradigm shift will be from a state-centric to a geo- or eco-centric perspective [space] and from a short-term to a long-term approach [time]. It should have a global constitution, in which fundamental norm/s is/are enshrined.[1979] There will be separation of global governance powers, i.e., legislative, executive, and judiciary.[1980] The law-making process will take place only at the world level but the administrative, executive and adjudicative processes will adhere to the principle of subsidiarity.[1981]

5.3.2.3. Elements of Global Environmental Constitutionalism

[1974] Elisabeth Zoller (1996) Southey Memorial Lecture: Constitutionalism in the Global Era, Paper 579, Maurer School of Law, Indiana University, Bloomington, IN, USA, pp. 1143-1151.

[1975] ILC (2006) supra note 48.

[1976] Richard A. Falk (2012) supra note 22, p. 12.

[1977] Louis J. Kotze (2017) supra note 39, p. 191.

[1978] G. Anastaplo (2003) supra note 69, p. 738.

[1979] Klaus Bosselmann (2017) The Imperative of Ecological Integrity: Conceptualising a Fundamental Legal Norm for a New 'World System' in the Anthropocene. In: Environmental Law and Governance for the Anthropocene [Louis J. Kotze (ed.)], Hart Publishing Co., Oxford, UK, pp. 241-265.

[1980] Louis J. Kotze (2017) supra note 39, pp. 205-207.

[1981] Eur-Lex (2019) Subsidiarity, Glossaries of Summaries, Summaries of EU Legislation, Access to European Union Law. Accessed on 11 August 2019 at: https://eur-lex.europa.eu/summary/glossary/subsidiarity.html

There is currently little consensus about the meaning of global environmental constitutionalism. The complexity and controversy that permeate the global constitutionalism debate are immense. Different approaches to global constitutionalism already have been identified and systemized by other scholars,[1982] including:

(1) The Internationalist Approach
(2) The Regionalist Approach
(3) The International Environmental Regulatory Regime Approach
(4) Global Civil Society Environmental Constitutionalism
(5) Transnational Comparative Environmental Constitutionalism

There are seven common elements of environmental constitutionalism currently manifest in the global regulatory domain within the context of the different approaches to global environmental constitutionalism. Although the seven elements analyzed herein are neither the final typology nor topography of global environmental constitutionalism, they, however, could serve as the framework elements for the evaluation of the emergence of the governance process of global environmental constitutionalism.[1983] Similarly, it is neither expected that the same elements would have the same weightage in the development of global environmental constitutionalism nor that some other new elements would not be included in the final topography.

5.3.2.3.1. Global Environment Constitution

According to Daniel Bodansky, there does not exist an International Environmental Constitution [1984] while others have assessed that "[t]he prospect of a global environmental constitution may not be realistic for many years to come."[1985] One obvious reason for the absence of such a constitution and the doubt that it will emerge anytime soon is because the nation-States had not agreed to the creation of a strong, centralized international environmental organization. For instance, the proposal to strengthen the UNEP has met with strong resistance.[1986]

[1982] Louis J. Kotze (2017) supra note 39, pp. 193-202.

[1983] Id., p. 202.

[1984] Daniel Bodansky (2009) Is There an International Environmental Constitution? Indiana Journal of Global Legal Studies, Volume 16, Issue 2, Article 8, pp. 565-584.

[1985] Klaus Bosselmann (2015) Global Environmental Constitutionalism; Mapping the Terrain, Widener Law Review, Volume 21, p. 182.

[1986] Faye Leone (2019) UNEP Reports on Strengthening and Upgrading Process Since 2012, International Institute for Sustainable Development (IISD), 7 March 2019 at: https://sdg.iisd.org/news/unep-reports-on-agencys-strengthening-and-upgrading-process-since-2012/

However, there are two reasons to be optimistic. First, the evolution of international climate change effectively transit from a monocentric to a polycentric approach, the involvement of all actors, both state ad non-state, would provide people to learn through experience what is necessary to keep the notion of global environmental constitutionalism alive and what is required of them to enable it to fulfill its purposes. Second, if the social-ecological system should decline globally soon, there should be, in theory, even greater motivation for the nation-States (through diplomatic negotiations) and global civic society (though civic education) to embark on paradigm-shifting reforms of global environmental law, governance and its institutions.[1987]

5.3.2.3.2. Global Environmental Rule of Law

Lon Fuller in his book on "The Morality of Law" determined that the essential elements for the rule of law are that the law must be general and publicly promulgated, clear, not demand something impossible, prospective in effect (as opposed to being retrospective), understandable, consistent and constant by applying equally to all cases, non-contradictory, and relatively stable and congruent.[1988] A modern restatement of the essential elements would be that "the rule of law is that it provides certainty in a legal order, it prevents the entrenchment of power, and it plays a more-then-symbolic role in the constitutional state in that it offers a normative justification and foundation for the entrenchment of procedural and substantive mechanisms to prescribe and proscribe power. Whereas the formal/procedural aspects of the rule of law provide for and determine those elements that are necessary to establish and maintain a governance order on the basis of positive law, the material/substantive aspects of the rule of law bind those that exercise governance power to substantive standards."[1989]

One essential element in Fuller's list of the rule of law that it should be prospective in effect, as opposed to being retrospective, has significant implication for the interpretation of the principle of CBDR-RC in climate change law and governance.

The principle of CBDR-RC was the outcome of the hotly contested debate by the

[1987] Louis J. Kotze (2017) supra note 39, p. 202.

[1988] Lon L. Fuller (1964) The Morality of Law, Yale University Press, New Haven CT, USA, pp. 33-94.

[1989] Birgit Enzmann (2014) Der Demokartische Verfassungsstaat: Entstehung, Elemente, Herausforderungen, Springer, Wisebaden, Germany, pp. 43-163. Cited in Louis J. Kotze (2017) supra note 39, p. 202.

countries of the North-South economic divide in climate change negotiations in which the Parties of the UNFCCC acknowledged the present capabilities of the nation-States and the notion of historical responsibility in the application of equity in the climate change context. This principle of CBDR-RC was enshrined in Article 3.1 of the UNFCCC [1990], which has legally binding implications, while the principle of the 'common concern of humankind was stated in the Preamble, which informs and guides the interpretation of the treaty. Hence, the Parties have to take into consideration this principle of CBDR-RC when provisions on targets and timetables for the reduction of GHG emissions were established in future Protocols. This central principle in the climate change regime paved the way for the divide of the world into Annex I and non-Annex I Parties. Similar to the Montreal Protocol, the CBDR-RC served as the guiding principle during the negotiation on commitment targets and timetables of the Kyoto Protocol. However, unlike the Montreal Protocol, which only grant the developing countries a 10-year grace period and after which the same commitments (obligations) would kick in for the developing countries,[1991] the legally binding commitments in the Kyoto Protocol to reduce GHG emissions apply only to the developed countries listed in Annex I of the UNFCCC with the quantifiable emission limitations specified in Annex B of the Protocol.[1992] The developed countries were the OECD countries, which comprised of Western Europe, the United States, Canada, Japan, Australia, and New Zealand, and the EIT countries, which comprised mostly the countries in Eastern Europe and the former Soviet Union. China, India, Brazil, South Korea, and other fast growing developing countries were not included in the Annex I Parties. More importantly, there was no provision in the Kyoto Protocol for the eventual inclusion of these developing countries in similar legally binding commitments.

Hence, to reach agreement on the Kyoto Protocol, it was necessary for the developed countries of the North to sacrifice the fair burden sharing by all parties in order to appease the developing countries of the South into signing the agreement. In return, the developed countries were able to have several 'flexible mechanisms', including emissions trading and joint implementation among developed countries as well as a 'Clean Development Mechanism' (CDM) for emission reduction projects in developing countries, incorporated into the Kyoto Protocol to supplement domestic action.[1993]

However, the differences in perspectives of the countries from the North-South

[1990] United Nations (1992a) supra note 16, Article 3.1.
[1991] Europa (2008) supra note 1314.
[1992] United Nations (1998) supra note 17, p. 20.
[1993] Daniel Bodansky (2001) supra note 907, p. 36.

economic divide when applying the principle of equity to solving the climate change problem continued unabated after the signing of the Kyoto Protocol. First, there is the perception among some of the developed countries that rapidly industrialized countries, e.g. China, Brazil and India, will be able to free ride on the sacrifices made by Annex 1 countries. Second, there is also the related concern among the some of the developed countries that the energy-intensive manufacturing industries will uproot and relocate to the developing countries not covered by the provisions of the Kyoto Protocol resulting in 'carbon leakage'.[1994] Third, even the innovative introduction of 'flexible mechanisms' into the Kyoto Protocol was criticized by some developing countries as "carbon colonialism" as the developing countries are being reconstituted as sinks for GHG emissions from the developed countries.[1995]

This decision to sacrifice the critical success factor of 'fair burden-sharing by all' became a source of contention immediately after the adoption of the Kyoto Protocol. Just before the adoption of the Kyoto Protocol, the US Senate, in its 105th Congress session in July 1997, had unanimously voted by 95-0 for the bipartisan (Senators Byrd and Hagel) Senate Resolution 98 that "declares that the United States should not be a signatory to any protocol to, or other agreement regarding, the United Nations Framework Convention on Climate Change of 1992, at negotiations in Kyoto in December 1997 or thereafter which would: (1) mandate new commitments to limit or reduce greenhouse gas emissions for the Annex 1 Parties, unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period; or (2) result in serious harm to the U.S. economy."[1996]

The issue of 'fair burden sharing by all' was certainly one of the main drivers for the failure of the United States to ratify the Kyoto Protocol. In 2001, President Bush, in a letter to members of the US Senate, described the Kyoto Protocol as "fatally flawed" and "effectively dead," and stated that the non-participation of developing countries was one of the two main reasons for the withdrawal of the United States from the Kyoto Protocol. President Bush wrote that he "oppose the Kyoto Protocol because it exempts 80 percent of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the U.S. economy."[1997]

[1994] Harriet Buckeley and Peter Newell (2015) supra note 1317, p. 39.
[1995] Heidi Bachram (2004) supra note 1318, pp. 5-20.
[1996] US Senate (1997) supra note 1091.
[1997] George W. Bush (2001) supra note 1093.

In Article 2.2 and Articles 4.3 & 4.4 of the Paris Agreement, the principle of common but differentiated responsibilities and respective capabilities, however, has been modified to reflect "the light of different national circumstances".[1998] This modification is necessary to align the principle of CBDR-RC to the use of voluntary nationally determined contributions (NDCs) to curb GHG emissions as the primary means to achieve the temperature goals of "[h]olding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels."[1999]

The focus has shifted with the latest revision from the retrospective of historical responsibility to the prospective of what nation-States can do under current conditions to curb GHG emissions and to ratchet up ambitions to further curb GHG emissions in the future and follow the GHG emission pathway to carbon neutrality in 2050.[2000]

5.3.2.3.3. Separation of Global Environmental Governance Powers

The separation of powers doctrine entails that the global authority to govern should be divided among the different government powers, i.e. the legislative, the judiciary, and the executive powers. It follows from Immanuel Kant's first definitive article, from a domestic perspective, that "[t]he civil constitution of very nation should be republican",[2001] i.e. each state should embrace a republican form of government in which legislative power and executive power are separated.

Related to the formal aspects of the rule of law, this doctrine seeks to counter the hazards of excessive centralization and abuse of authority to ensure accountability. More importantly, there has been ample experience among the nation-States with the republican form of government from the domestic sphere.

5.3.2.3.4. The Global Environmental Judiciary

Much as there is no strong centralized international environmental organization, there is no established international jurisdiction, and global environmental dispute settlement remains a fragmented affair. This insight is particularly important for global environmental constitutionalism. While there are concerns about the fragmented nature

[1998] United Nations (2015a) supra note 18, Article 2.2 and Articles 4.3 & 4.4, pp. 22-24.
[1999] Id., Article 2.1(a), p. 22.
[2000] Id., Article 4.1, p. 22.
[2001] Immanuel Kant (1795) supra note 492, p. 112.

of global environmental judiciary, the current set-up does provide the means for judicial bodies to extend their influence into the numerous governance spaces at various geographical sites and levels where environmental issues might arise. Over time, it would be necessary, however, to create judicial bodies where they do not exist or strengthen existing ones; expand the jurisdictions of these judicial bodies, and create specialized units within each jurisdiction to deal with the highly technical and specialized environmental issues, which will arise increasingly in the Anthropocene.[2002]

5.3.2.3.5. Global Environmental Democracy

Democracy serves as an enabler of constitutionalism. Democracy is more difficult to discern from a global level than it is at the domestic level. However, based on an "enlarged notion of 'international community', comprising of state and non-state actors, an aggregated constituent power should be enabled to drive participative, representative, inclusive, and transparent modes of global environmental governance in the spaces where states and their citizens, international organizations as global representatives of the states, and global civic society operate."[2003] Outside of the more formal state-driven law and governance arena, global civic society will be able to assert themselves as observers during global environmental conferences and, more importantly, to cooperate more closely with states to achieve global governance objectives, which they will be doing with the implementation of polycentric governance.

5.3.2.3.6. Global Environmental Constitutional Supremacy

The concept of constitutional supremacy asserts that there is no higher juridical norm in a state than the constitution and its provisions.[2004] This creates a normative and institutional hierarchy such that all laws, decisions, and acts of government are subject to evaluation in the light of the constitution, in terms of whether these laws, decisions and acts could be declared unconstitutional and invalid.[2005]

In the domestic arena, such norms are usually encapsulated within human or citizen rights in the constitution, and it is the judiciary that will play a key role in upholding and protecting these constitutional rights. In the global arena, constitutional supremacy,

[2002] Louis J. Kotze (2017) supra note 39, pp. 209-210.

[2003] Id., p. 210.

[2004] Jutta Limbach (2001) The Concept of the Supremacy of the Constitution, Modern Law Review, Volume 64, Number 1 (January 2001), pp. 1-10.

[2005] Louis J. Kotze (2017) supra note 39, pp. 212-213.

however, is best understood by determining whether a normative hierarchy exists in terms of which higher-order non-derogable norms supersede other norms and which bind states to the extent that their free sovereign will is limited.[2006] In the absence of a global constitution to determine such a hierarchy, such norms would likely be found in *jus cogens* norms[2007] and customary international law with *erga omnes* obligations,[2008] and international human rights instruments, such as the following:

(1) Universal Declaration of Human Rights[2009]
(2) International Covenant on Economic, Social and Cultural Rights[2010]
(3) International Covenant on Civil and Political Rights[2011]

5.3.2.3.7. Global Environmental Rights

There is neither a universally applicable global treaty that explicitly provides for an environmental right, nor has such a right been accepted into the corpus of customary international law.[2012] However, with the need for high-order regulatory norms and international institutions in the Anthropocene to be ecocentric, it will be crucial to commence global discussions about creating such an environmental right, either in a future global environmental constitution or as an element of an existing or new global human rights instrument. It will be the ultimate expression of constitutionalism.

In fact, the Bolivian government has proposed to the United Nations an ecocentric rights reformulation in terms of the Universal Declaration of Rights of Mother Earth.

[2006] Erika de Wet and Jure Vidmar (2012) Introduction. In: Hierarchy in International Law: The Place of Human Rights [E de Wet and J Vidmar (eds.)], Oxford University Press, Oxford, UK, pp.1-2.

[2007] *Jus cogens* [peremptory] norms refer to certain fundamental, overriding principles of international law. There is near-universal agreement for the existence of a category of *jus cogens* norms, and its existence is memorialized in Article 53 of the VCLT: "[A] treaty is void if, at the time of its conclusion, it conflicts with a peremptory norm of general international law."

[2008] Maurizio Ragazzi (2000) The Concept of International Obligations Erga Omnes, Oxford Univeristy Press, Oxford, UK. In an obiter dictum in its 1970 judgment in the Barcelona Traction case, the International Court of Justice identified a category of international obligations called erga omnes, namely obligations owed by states to the international community as a whole, intended to protect and promote the basic values and common interests of all.

[2009] UNGA (1948) Universal Declaration of Human Rights, General Assembly Resolution 217A (III), 183rd Plenary Meeting, UN Doc A/810 at 71 (1948).

[2010] UNGA (1966a) International Covenant on Economic, Social and Cultural Rights, General Assembly Resolution 2200A (XXI) of 16 December 1966, 993 UNTS 3.6 ILM 360.

[2011] UNGA (1966b) International Covenant on Civil and Political Rights, General Assembly Resolution 2200A (XXI) of 16 December 1966, 999 UNTS 171, 6 ILM 368.

[2012] Louis J. Kotze (2017) supra note 39, p. 216.

The proposed Declaration in essence and in detail recognizes that the Earth is a living entity and as a result 'Mother Earth' could lay claim to the full range of fundamental rights normally attribute to humans.[2013] Considering the legal fraternity's continued apprehension about such an ecological apprehension and its possible legal and governance implications, as well as the prevailing strong political resistance to such a drastic proposal, it is understandably unlikely that it will gain any credence soon. The important point, from a global environmental constitutionalism perspective, is that the debate has been initiated in the international political arena.

In advocating for an environmental right to be established in this thesis does not mean that the thesis is advocating that this right should be refocused away from serving human needs and toards the limits of Earth's life supporting system and the rights of non-humans. The thesis is advocating that the social-ecological interactions and its implications must be respected. This right is to ensure the sustainable wellbeing of humankind and that the each member of the current cohort of humans should do its very best in concerted collective action to solve the climate change problem.

5.3.2.4. Motivation for Pursuing Global Environmental Constitutionalism

Global environmental constitutionalism is already considered, in the current moral, social and political environment, to be a radical juridical intervention to address a critical systemic climate change problem. The Parties to the Paris Agreement are expected to ensure that each successive NDC is the Party's highest possible level of ambition and is a progression from the previous NDC. Meanwhile, the Parties expect that Article 13, which set out the "transparency framework' of self-reporting and international review and the binding obligations of conduct to communicate existing or successive NDCs every 5 years[2014] will enhance the intent of the Parties and their ratcheting up of ambition. However, neither the transparency framework nor the global stock-take have the mandate to assess whether a Party's NDC has been designed "with a view to achieving the purpose of the Agreement as set out in Article 2".[2015]

In essence, it is for each Party to determine nationally the level and progression of its ambition, including the extent to which its GHG emissions reduction pathways implied

[2013] See World's People's Conference on Climate Change and the Rights of Mother Earth, Proposed Universal Declaration of the Rights of Mother Earth. Accessed on 26 Sepember 2019 at: http://pwccc.wordpress.com/progama/

[2014] United Nations (2015a) supra note 18, Article 4.9, p. 23.

[2015] Lavanya Rajamani and Jacob Werksman (2018) supra note 1534, p. 7.

by its NDC will be a credible contribution to achieving the temperature goal of the Paris Agreement. Hence, as soon as the implementation of the Paris Agreement has stabilized, the international community has to begin political negotiations to establish global environmental constitutionalism with strong normative and institutional force to ensure that each Party's action plan is pitched at the highest possible level of ambition and is a progression from the previous NDC to curb GHG emissions.

There are two plausible reasons that the international community might be motivated enough then to pursue global environmental constitutionalism. First, the evolution of international climate change effectively transit from a monocentric to a polycentric approach, the involvement of all actors, both state and non-state, would provide people to learn through experience what is necessary to keep the notion of global environmental constitutionalism alive and what is required of them to enable it to fulfill its purposes. Second, if the social-ecological system should decline globally soon, there should be, in theory, even greater motivation for the nation-States (through diplomatic negotiations) and global civic society (though civic education) to embark on the radical juridical intervention to reform environmental law, governance and its institutions.[2016]

5.3.3. Concluding Remarks

The solution to the climate change problem will require a change in human values or ideas of morality. If the human being does not subdue his acquisitive nature, does not value affluence over abundance and shunt the acquisition of relative needs, does not devote his time and energies to non-economic purposes once his absolute needs are satisfied, whatever technical solution found will be rendered ineffective. If the leaders of the nation-States and policymakers in international organizations do not have the long-term perspective, do not uphold the principles of justice and equality and shunt the corrosive effects of party or national politics respectively, and continue with just paying lip service to the process of climate change governance, then there will be no right action plan to execute. It the leaders and the policymakers do not have the moral courage to risk their careers or personal ambitions by making hard commitments for the common good and co-operate with his or her fellow-leaders to find viable solutions, then the wise citizens of the world must step forward and lead the way.

[2016] Louis J. Kotze (2017) supra note 39, p. 202.

BIBLIOGRAPHY

Books

Abdu'l-Baha (1912) Promulgation of Universal Peace: Talks Delivered by Abdu'l-Baha during His Visit to United States and Canada in 1912 [Compiled by Howard McNutt and published by Baha'i Publishing Trust (2008), Wilmette, IL, USA].

Abeyratne, Ruwantissa (2014) Aviation and Climate Change: In Search of a Global Market Based Measure, Springer, Cham, Switzerland.

Alvarez, Alejandro (1959) Le droit international nouveau dans ses rapports avec la view actuelle des peoples, Lebraire Pedone, Paris, France.

Aristotle (350 BCE) Nicomachean Ethics [Translated by W. D. Ross], Internet Classic Archives.

Aristotle (350 BCE) Politics [Translated by Benjamin Jowett], Internet Classic Archives.

Aron, Raymond (1962) Paix et guerre entre les nations, Calmann-Levy, Paris, France.

Asselt, Harro van (2014) The Fragmentation of Global Climate Governance: Consequences and Management of Regime Interactions, Edward Elgar, Cheltenham, UK.

Axelrod, Robert M. (1984) The Evolution of Cooperation, Basic Books Publishers, New York, NY, USA.

Baha'i World Centre (2002) The Summons of the Lord of Hosts: Tablets of Baha'u'llah, Baha'i Publishing Trust, New Delhi, India.

Baslar, Kemal (1998) The Concept of the Common Heritage of Mankind in International Law, Martinus Nijhoff Publishers, The Hague, The Netherlands.

Birnie, Patricia, Alan Boyle and Catherine Redgwell (2009) International Law and the Environment, 3rd Edition, Oxford Univeristy Press, Oxford, UK.

Black, Duncan (1996) International Trade and the Montreal Protocol, 1 June 1996, Brookings Institute Press, Washington, DC, USA.

Bolin, Bert (2007) A History of the Science and Politics of Climate Change: The Role of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK.

Boulding, Kenneth E. (1985) The World as a Total System, Sage Publications, Newbury Park, CA, USA.

Broekman, Jan M. and Larry Catà Backer (2013) Lawyers Making Meaning: The Semiotics of Law in Legal Education II, Springer, Dordrecht, Germany.

Brooke, John L. (2014) Climate Change and the Course of Global History: A Rough Journey, Cambridge University Press, Cambridge, UK.

Brownlie, Ian (2003) Principles of Public International Law, 6th Edition, Oxford Unversity Press, Oxford, UK.

Bulkeley, Harriet and Peter Newell (2010) Governing Climate Change, Routledge, London, UK.

Burke, Lauretta, Kathleen Reythar, Mark Spalding and Alison Perry (2011) Reefs at Risk Revisited, World Research Institute, Washington, DC, USA.

Carr, Edward Hallett (1939) The Twenty Years Crisis: 1919-1939, [1964 Edition], Harper Perennial, New York, NY, USA.

Climate Leadership Council (2018) Exceeding Paris: How the Baker-Shultz Carbon Dividends Plan Would Significantly Exceed U.S. Paris Commitment, Climate Leadership Council, Washington, DC, USA.

Commission on Global Governance (1995) Our Global Neighbourhood: The Report of the Commission on Global Governance, Reprint 2005 [Ingvar Carlsson and Shridath Ramphal (co-chair)], Oxford University Press, Oxford, UK.

D'Amato, Anthony (1984) Jurisprudence: A Descriptive and Normative Analysis of Law, Kluwer Academic Publishers, Dordrecht, The Netherlands.

DeCanio, Stephen J. (2003) Economic Models of Climate Change: A Critique, Palgrave Macmillan, Basingstoke, UK.

Deming, W. Edwards (1993) The New Economics, MIT Press, Cambridge, MA, USA.

Dickinson, Henry Winram (1939) A Short History of the Steam Engine, Cambridge University Press, Cambridge, republished on 17 February 2011, UK.

Edwards, Paul N. (2010) A Vast Machine: Computer Models, Climate Data and the Politics of Global Warming, MIT Press, Cambridge, MA, USA.

Effendi, Shoghi (1938) The World Order of Baha'u'llah: Selected Letters [2nd Revised Edition published by the National Spiritual Assembly of the Baha'is of the United States, Baha'i Publishing Trust (1974), Wilmette, IL, USA.]

Ekins, Richard (2012) The Nature of Legislative Intent, Oxford University Press, Oxford, UK.

Enzmann, Birgit (2014) Der Demokartische Verfassungsstaat: Entstehung, Elemente, Herausforderungen, Springer, Wisebaden, Germany.

Foster, John Bellamy (2000) Marx's Ecology: Materialism and Nature, Monthly Review Press, New York, NY, USA.

Foster, John Bellamy, C. Clarke and R. York (2010) The Ecological Rift: Capitalism's War on the Earth, Monthly Review Press, New York, NY, USA.

Franck, Thomas M. (1995) Fairness in International Law and Institutions, Oxford University Press, Oxford, UK.

Friedman, Milton (1962) Capitalism and Freedom, University of Chicago Press, Chicago, IL, USA.

Fuller, Lon L. (1964) The Morality of Law, Yale University Press, New Haven CT, USA.

Gillespie, Alexander (2006) Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries with Policy and Science Considerations, Martinus Nijhoff Publishers, Leiden, The Netherlands.

Goldsmith, Jack L. and Eric A. Posner (2005) The Limits of International Law, Oxford University Press, Oxford, UK.

Goodman, Nelson (1984) Ways of Worldmaking, Hackett Publishing Company, Indianapolis, IN, USA.

Grotius, Hugo (1609) The Free Sea, Elzevier, Leiden, Holland [Translated by Richard Hakluyt and republished by Liberty Fund, Indianapolis, IN, USA].

Grubb, Michael, Christian Vrolijk & Duncan Brack (1999) The Kyoto Protocol: A Guide and Assessment [Additional contributions from Tim Forsyth, John Lanchbery and Fanny Missfeldt], the Royal Institute of International Affairs, London, UK.

Hall, Nina (2016) Displacement, Development and Climate Change: International Organizations Moving Beyond Their Mandates, Routledge, London, UK.

Hansen, James (2009) Storms of My Grandchildren: The Truth about the Coming Climate Catastrophe and Our Last Chance to Save Humanity, Bloomsbury, New York, USA.

Hart, H.L.A. (1961) The Concept of Law, Clarendon Press, Oxford, UK.

Hartmann, Dennis L. (2016) Global Physical Climatology, 2nd Edition, Elsevier, Amsterdam, The Netherlands.

Harvey, David (2005) A Brief History of Neoliberalism, Oxford University Press, Oxford, UK.

Hayek, Friedrich A. (1944) The Road to Serfdom, Routledge Press, Abingdon, UK.

Heal, Geoffrey (2007) Endangered Economies: How Neglect of Nature Threatens Our Prosperity, Columbia University Press, New York, NY, USA.

Hinsley, F. H. (1962) Power and the Pursuit of Peace: Theory and Practice in the Relations between States, Cambridge Universitry Press, Cambridge, UK.

Hobbes, Thomas (1651) Leviathan or The Matter, Forme and Power of a Common-Wealth Ecclesiasticall and Civil [Oxford World's Classics Edition (1996)], Oxford University Press, Oxford, UK.

Howe, Joshua P. (2014) Behind the Curve, University of Washington Press, Seattle, USA.

Hulme, Mike (2009) Why We Disagree About Climate Change, Cambridge University Press, Cambridge, UK.

Hume, David (1739) Section VII: On the Origin of Government. In A Treatise on Human Nature: Being an Attempt to introduce experimental Method into Moral Subjects, eBook@Adelaide.

Hurrell, Andrew (1992) International Politics of the Environment, Clarendon Press, Oxford, UK.

ICSU (2015) The International Council for Science and Climate Change: 60 Years of Facilitating Climate Change Research and Informing Policy, International Council for Science (ICSU), Paris, France.

Jaspers, Karl (1958) Die Atombombe und die Zukunft des Menschen [The Future of Mankind translated by E. B. Ashton], The University of Chicago Press (1961), Chicago, IL, USA.

Jenks, Wilfred C. (1958) The Common Law of Mankind, Stevens & Sons, Ltd., London, UK.

Jervois, Robert (1997) System Effects: Complexity in Political and Social Life, Princeton University Press, Princeton, NJ, USA.

Johnson, Stanley (2012) UNEP The First 40 Years: A Narrative, United Nations Environmental Programme, Nairobi, Kenya.

Kant, Immanuel (1795) Zum ewigen Frieden: ein philosophischer Entwurf [Perpetual Peace: A Philosophical Sketch], Friedrich Nicolovius, Konisberg, Germany [Perpetual Peace and Other Essays,

translated by Ted Humphrey, Hackett Classics, 1st Edition, 1983, Hackett Publishing Company, Indianapolis, IN, USA].

Kaul, Inge (2004) Providing Global Public Goods: Managing Globalization, Oxford University Press, Oxford, UK.

Kirton, John J. and Ella Kokotsis (2015) The Global Governance of Climate: G7, G20, and UN Leadership, Ashgate Publishing, Aldershot, UK.

Koskenniemi, Martti (2001) The Gentle Civilizer of Nations: The Rise and Fall of International Law 1870-1960, Cambridge University Press, Camridge, UK.

Koskenniemi, Martti (2005) From Apology to Utopia: The Structure of International Legal Argument [Reissue with a new Epilogue], Cambridge University Press, Cambridge, UK.

Koskenniemi, Martti (2011) The Politics of International Law, Hart Publishing Ltd, Oxford, UK.

Kovell, Joel (2007) The Enemy of Nature: The End of Capitalism or the End of the World? 2nd Edition, Zed Books, New York, NY, USA.

Lam Wai Fung (1998) Governing Irrigation Systems in Nepal: Institutions, Infrastructure, and Collective Action, ICS Press, Oakland, CA, USA.

Lauterpacht, Hersch (1948) Recognition in International Law, Cambridge University Press, Cambridge, UK.

Locke, John (1690) Two Treatise on Government: In the former, the false principles, and foundation of Sir Robert Filmer, and his followers, are detected and overthrown; the latter is an essay concerning the true original, extent, and end of civil government, Awnsham Churchill, London, UK.

Lodge, Michael W., David Anderson, Terje Løbach, Gordon Munro, Keith Sainsbury and Anna Willock (2007) Recommended Best Practices for Regional Fisheries Management Organizations, The Royal Institute of International Affairs, Chatham House, London, UK.

Lyotard, Jean-Francois (1979) The Post Modern Condition: A Report on Knowledge [Translation from the French by Geoff Bennington and Brian Massumi, Manchester University Press, Manchester, UK (1984)].

Lyster, S. (1985) International Wildlife Law: An Analysis of International Treaties Concerned with the Conservation of Wildlife, Grotius Publications, Cambridge, UK.

Maddison, Angus (2003) The World Economy: Historical Statistics, Development Centre Studies, OECD, Paris, France.

McDougal, Myres S., Harold D. Lasswell and Lung-Chu Chen (1980) Human Rights and World Public Order: The Basic Policies of an International Law of Human Dignity, Yale University Press, New Haven, CT, USA.

Melieres, Maria-Antoinette and Chloe Marechal (2015) Climate Change: Past, Present and Future, translated by Eric Gressler, Wiley-Blackwell, Chichester, UK.

Merchant, Carolyn (2008) Ecology, 2nd Edition, Promotheus Books, Amherst, NY, USA.

Miller, Gary J. (1992) Managerial Dilemmas: The Political Economy of Hierarchy, Cambridge University Press, Cambridge, UK.

Mill, John Stuart (1861) Chapter I, Considerations on Representative Government, Parket, Son and Bourn, London, UK [Pennsylvania State University, Electronic Classics Series, Jim Manis (ed.), Hazleton, PA, USA].

Mitrany, David (1946) A Working Peace System, 4th Edition, The Royal Institute of International Affairs, London, UK.

Morgenthau, Hans (1985) Politics Among Nations: The Struggle for Power and Peace, 6th Edition, [revised by Kenneth W. Thompson], McGraw-Hill, New York, NY, USA.

National Academies of Sciences, Engineering, and Medicine (2016) Attribution of Extreme Weather Events in the Context of Climate Change, Committee on Extreme Weather Events and Climate Change Attribution, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies, United States National Academies of Sciences, Engineering, and Medicine, The National Academies Press, Washington, DC, USA.

National Research Council (2011) Understanding Earth's Deep Past: Lessons for Our Climate Future, National Academy of Sciences, USA, National Academic Press, Washington, DC, USA.

North, Douglass (2005) Understanding the Process of Institutional Change, Princeton University Press, Princeton, NJ, USA.

Oberthur, Sebastian (1993) Politik im Treibhaus: Die Entstehung des internationalen Klimaschutzregimes, Sigma, Berlin, Germany.

Oberthur, Sebastian and Hermann E. Ott (1999) The Kyoto Protocol: International Climate Policy for the 21st Century, Springer Verlag, Berlin, Germany.

Ogley, Roderick (1984) Internationalizing the Seabed, Gower Publishing Co., Aldershot, UK.

Olson, Mancur (1965) The Logic of Collective Action: Public Goods and the Theory of Groups, Harvard University Press, Cambridge, MA, USA.

Ostrom, Elinor (1990) Governing the Commons: The evolution of institutions for collective action, Cambridge Univeristy Press, Cambridge, UK.

Ostrom, Elinor (2005) Understanding Institutional Diversity, Princeton University Press, Princeton, NJ, USA.

Ostrom, Elinor, Roy Gardner and James Walker (1994) Rules, Games, and Common-Pool Resources, University of Michigan Press, Ann Arbor, MI, USA.

Paterson, Matthew (1996) Global Warming and Global Politics, Routledge, London, UK.

Pepper, David (1993) Eco-Socialism: From Deep Ecology to Social Justice, Routledge, London, UK.

Pigou, A. C. (1932) The Economics of Welfare, 4th Edition, MacMillan & Co. Ltd., London, UK.

Pilkey, Orring H. and Rob Young (2009) The Rising Sea, Island Press, Washington, DC, USA.

Polanyi, Michael (1951) The Logic of Liberty: Reflections and Rejoinders [First Edition (US) First Printing Edition (May 1, 1998), Routledge, Abingdon, UK], Liberty Fund, Inc., Indianapolis, IN, USA.

Ragazzi, Maurizio (2000) The Concept of International Obligations Erga Omnes, Oxford Univeristy Press, Oxford, UK.

Rawls, John (1999) A Theory of Justice, Revised Edition, Belknap Press, Cambridge, MA, USA.

Romera, Beatriz Martinez (2017) Regime Interaction and Climate Change: The Case of International Aviation and Maritime Transport, Routledge, London, UK.

Rousseau, Jean-Jacques (1762) *Du contrat social; ou Principes du droit politique* [The Social Contract, translated with an introduction by Maurice Cranston (1968), Penguin, London, UK, p. 32.]

Sabel, Robbie (1997) Procedure at International Conferences: A Study of the Rules of Procedure of International Inter-governmental Conferences, Cambridge University Press, Cambridge, UK.

Sands, Philippe (2003) Principles of International Environmental Law, 2nd Edition, Cambridge University Press, Cambridge, UK.

Sands, Philippe, Jacqueline Peel, Adriana Fabra and Ruth MacKenzie (2018) Principles of International Environmental Law, 4th Edition, Cambridge University Press, Cambridge, UK.

SCAR (2017) The Antarctic Treaty System, Scientific Committee on Antarctic Research (SCAR), Committee of International Science Council, Cambridge, UK.

Schiele, Simone (2014) Evolution of International Environmental Regimes, Cambridge Univeristy Press, Cambridge, UK.

Schwarzenberger, Georg (1949) International Law, Volume 1, Stevens & Sons, Ltd., London, UK.

Schwarzenberger, Georg (1962) The Frontiers of International Law, Stevens & Sons, Ltd., London, UK.

Schwarzenberger, Georg (1964) Power Politics: A Study of World Society, 3rd Edition, Stevens & Sons, Ltd., London, UK.

Schwarzenberger, Georg (1965) The Inductive Approach to International Law, Stevens & Sons, Ltd., London, UK.

Schwarzenberger, Georg (1971) International Law and Order, Stevens & Sons, Ltd., London, UK.

Schwarzenberger, Georg and E. D. Brown (1976) A Manual of International Law, 6th Edition, Professional Books, Milton, UK.

Selden, John (1652) Mare Clausum of the Dominion, Or, Ownership of the Sea, William Du-Gard, London, UK.

Sen, Amartya (1970) Collective Choice and Social Welfare, Holden Day, San Francisco, CA, USA.

Shaw, Malcolm N. (2008) International Law, 6th Edition, Cambridge University Press, Cambridge, UK.

Shiekh, Ahmed (1974) International law and National Behaviour: A Behavioral Interpretation of Contemporary International Law and Politics, Wiley, New York, NY, USA.

Silver, Nate (2012) The Signal and the Noise: Why so Many Predictions Fail – But Some Don't, The Penguin Press, New York, NY, USA.

Smil, Vaclav (2010) Energy Transitions: History, Requirements, Prospects, Praeger, Santa Barbara, CA, USA.

Smith, Adam (1761) The Theory of Moral Sentiments, 2nd Edition, A. Millar, Strand, London, UK.

Smith, Adam (1776) An Enquiry into the Nature and Caufes of the Wealth of Nations, Volume 1 [in Two Volumes], W. Strahan, London, UK.

Spencer, Roy W. (2010) The Great Global Warming Blunder: How Mother Nature Fooled the World's

Top Climate Scientists, Encounter Broadsides, New York, NY, USA.

Stern, Nicolas (2006) The Economics of Climate Change: The Stern Review, 1st Edition, [15 January 2007] Cambridge University Press, Cambridge, UK.

Suzman, James (2017) Affluence without Abundance: The Disappearing World of the Bushmen, Bloomsbury, New Ork, NY, USA.

Thaler, Richard H. (2015) Misbehaving: the making of behavioral economics, W. W. Norton & Company, New York, NY, USA.

Underdal, Arild (1980) The Politics of International Fisheries Management: The Case of the Northeast Atlantic, Olso University Press, Oslo, Norway.

Vick, Brian E. (2014) The Congress of Vienna: Power and Politics after Napoleon, Harvard University Press, Cambridge, MA, USA.

Victor, David G. (2001) The Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming, Princeton University Press, Princeton, NJ, USA.

Victor, David G. (2011) Global Warming Gridlock: Creating More Effective Strategies for Protecting the Planet, Cambridge University Press, Cambridge, UK.

Vogler, John (2000) The Global Commons: Environmental and Technological Goverannce, 2nd Edition, John Wiley & Sons, Ltd., Chichester, UK.

Walker, Gabrielle and Sir David King (2008) The Hot Topic: How to Tackle Global Warming and Still Keep the Lights On, Bloomsbury, London, UK.

Waltz, Kenneth N. (1979) Theory of International Politics, Reissued by Waveland Press (2010), Waveland Press, Long Grove, IL, USA.

Weiss, Edith Brown (1989) In Fairness to Future Generations: International Law, Common Property and Intergenerational Equity, Transnational Publishers, New York, NY, USA.

Wells, H. G. (1898) Wars of the World, 1st Edition, William Heinemann, London, UK.

Wheaton, Henry (1855) Elements of International Law [6th Edition by William Beach Lawrence], Little, Brown and Company, Boston, MA, USA.

Willett, Susan (2003) Costs of Disarmament – Disarming the Costs: Nuclear Arms Control and Nuclear Rearmament, United Nations Institute for Disarmament Research (UNIDIR), Geneva, Switzerland.

Woolsey, Theodore D. (1879) Introduction to the Study of International Law Designed as an Aid in Teaching, and in Historical Studies, 5th Edition, Scribner, Armstrong & Co., New York, NY, USA.

World Bank (2014) Turn Down the Heat: Confronting the New Climate Normal, World Bank Group, Washington, DC, USA.

Xue Hanqin (2003) Transboundary Damage in International Law, Cambridge University Press, Cambridge, UK.

Yamin, Farhana and Joanna Depledge (2004) The International Climate Change Regime: A Guide to Rules, Institutions and Procedures, Cambridge University Press, Cambridge, UK.

Book Chapters

Abi-Saab, Georges (1981) The concept of international organization: a synthesis. In: The Concept of International Organization [Georges Ab-Saab (ed.)], United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris, France.

Arrigo, Kevin R., Thomas Mock and Michael P. Lizotte (2010) Primary Producers and Sea Ice. In: Sea Ice, 2nd Edition [David N. Thomas and Gerhad S. Dieckmann (eds.)], Wiley-Blackwell, Chichester, UK.

Bamber, Jonathan (2016) Land Ice: Indicator and Integrator of Climate Change. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, The Netherlands.

Barnes, Gary M. (2017) Meteorological Hazards in the Tropics: Severe Convective Storms and Flash Floods. In: Tropical Meteorology, Encyclopedia of Life Support Systems, UNESCO-EOLSS.

Black, Brian C. and David M. Hassenzahl (2013) Global Atmospheric Research Programme. In: Climate Change: An Encyclopedia of Science and History, Volume 1: A-D [Black, B. C., D. M. Hassenzahl, J. C. Stephens, G. Wiesel, and N. Gift (eds.)], ABC-CLIO, Santa Barbara, CA, USA.

Bodansky, Daniel (1994) Prologue to the Climate Change Convention. In: Negotiating Climate Change: The Inside Story of the Rio Convention [Irving M Mintzer and J Amber Leonard (eds.)], Cambridge University Press, Cambridge, UK.

Bodansky, Daniel (1997) The History and Legal Structure of the Global Climate Change Regime. In: International Relations and Global Climate Change [Detlef Sprinz and Urs Luterbacher (eds.)], PIK Report No. 21, Potsdam Institute for Climate Impact Research, Potsdam, Germany.

Bodansky, Daniel (2001) The History of the Global Climate Change Regime. In: International Relations and Global Climate Change, [Urs Luterbacher and Detlef F. Sprinz (eds.)], MIT Press, Cambridge, MA, USA.

Bodansky, Daniel, Jutta Brunee and Ellen Hey (2007) International environmental law: mapping the field. In: The Oxford Handbook of Envrionmental Law [Daniel Bodansky, Jutta Brunee and Ellen Hey (eds.)], Oxford University Press, Oxford, UK.

Bosselmann, Klaus (2017) The Imperative of Ecological Integrity: Conceptualising a Fundamental Legal Norm for a New 'World System' in the Anthropocene. In: Environmental Law and Governance for the Anthropocene [Louis J. Kotze (ed.)], Hart Publishing Co., Oxford, UK.

Campbell, Richmond (1985) Background for the Uninitiated. In: Paradoxes of Rationality and Cooperation [Richmond Campbell and Lanning Sowden (eds.)], University of British Columbia Press, Vancouver, Canada.

Carlarne, Cinnamon P., Kevin R. Gray and Richard G. Tarasofsky (2016) International Climate Change Law: Mapping the Field. In: The Oxford Handbook of International Climate Change Law [Cinnamon P. Carlarne, Kevin R. Gray and Richard G. Tarasofsky (eds.)], Oxford University Press, Oxford, UK.

Cass, Loren R. (2015) Air pollution and acid rain. In: Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, UK.

D'Amato, Anthony and John Lawrence Hargrove (1975) Who Protects the Ocean? Environment and the Development of the Law of the Sea [John Lawrence Hargrove (ed.)], The American Society fo International Law, West Publishing Co., St Paul, MINN, USA.

Derrida, Jacques (2012) Avowing – the impossible: "Retuns", repentance, and reconcilation: A lesson. In: Living Together: Jacques Derrida Communities of Violence and Peace [Elisabeth Weber (ed.)], Fordham Scholarship (online).

Desombre, Elizabeth R. & Joanne Kauffman (1996) The Montreal Protocol Multilateral Fund: Partial Success Story. In: Institutions for Environmental Aid: Pitfall and Promises [Robert O. Keohane and Marc A. Levy (eds.)], MIT Press, Cambridge, MA, USA.

Dovland, Harald, Richard Ballaman and Jan Thompson (2004) Introduction. In: Clearing the Air: 25 years of the Convention on Long-range Transboundary Air Pollution [Johan Sliggers and Willem Kakebeeke (eds.)], United Nations Economic Commission on Europe, Geneva, Switzerland.

Downie, Christine (2015) Nongovernmental organizations, civil society and individuals. In: Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, UK.

Downie, David Leonard (2014) International Environmental Regimes and the Success of Global Ozone Policy. In: The Global Environment: Institutions, Law and Policy, 4th Edition [Regina S. Axelrod and Stacy D. VanDeveer (eds.)], CQ Press, Thousand Oaks, California, USA.

Dryzek, John S., Richard B. Norgaard and David Schlosberg (2013) Climate Change and Society: Approaches and Responses. In: The Oxford Handbook on Climate Change and Society [John S. Dryzek, Richard B. Norgaard and David Schlosberg (eds.)], Oxford University Press, Oxford, UK.

Edwards, Martin (2016) Sea Life (Pelagic Ecosystems). In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, The Netherlands.

Estrada-Oyuela, Raul (1998) First Approaches and Unanswered Questions. In: Issues and Options: The Clean Development Mechanism [J. Goldenberg (ed.)], UNDP, New York, NY, USA.

Evans, Peter and William H. Sewell, Jr. (2013) Neoliberalism. In: Social Resilience in the Neo-Liberal Era [Peter A. Hall and Michele Lamont (eds.)], Cambridge University Press, Cambridge, UK.

Falk, Richard (1976) The Role of Law in World Society. In: Towards World Order and Human Dignity: Essays in Honor of Myres S. McDougal [W. Michael Reisman and Burns H. Weston (eds)], Free Press (1 October 1976), New York, NY, USA.

Faure, Michael and Marjan Peeters (2011) Part I: Introduction. In: Climate Change Liability, [Michael Faure and Marjan Peeters (eds)], Edward Elgar Publishing Ltd, Cheltenham, UK.

Frischmann, Brett M., Michael J. Madison and Katherine J. Strandburg (2014) Governing Knowledge Commons. In: Governing Knowledge Commons [Brett M. Frischmann, Michael J. Madison and Katherine J. Strandburg (eds.)], Oxford University Press, Oxford, UK.

Gehrels, Roland (2016) Rising Sea Levels. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, The Netherlands.

Gehring, Thomas (2007) Treaty-making and treaty evolution. In: The Oxford Handbook of

Envrionmental Law [Daniel Bodansky, Jutta Brunee and Ellen Hey (eds.)], Oxford University Press, Oxford, UK.

Gottlieb, Gideon (1982) Global Bargaining: The legal and diplomatic framework. In: Lawmaking in the Global Community [Nicholas Greenwood Onuf (ed.)], Carolina Academic Press, Durham, NC, USA.

Harwell, Mark A. and Christine C. Harwell (1986) The Nuclear Famine: The Indirect Effects of Nuclear War. In: The Medical Implications of Nuclear War [Fred Solomon and Robert Q. Marston (eds.)], Institute of Medicine, National Academy of Sciences, National Academy Press, Washingtion, DC, USA.

Held, David and Augus Hervey (2011) Democracy, Climae Change and Global Governance: Demoncratic Agency and the Policy Menu Ahead. In: The Governance of Climate Change: Science, Economics, Politics & Ethics [David Held, Augus Hervey and Marika Theors (eds.)], Polity Press, Cornwall, UK.

Higgins, Rosalyn (1982) The Identity of International Law. In: International Law: Teaching and Practice [Bin Cheng (ed.)], Stevens & Sons, Ltd., London, UK.

Institute of Medicine (1986) Preface. In: The Medical Implications of Nuclear War [Fred Solomon and Robert Q. Marston (eds.)], Institute of Medicine, National Academy of Sciences, National Academy Press, Washingtion, DC, USA.

Jacobson, Harold K. and Edith Brown Weiss (1998) A Framework for Analysis. In: Engaging Countries: Strengthening Compliance with International Environmental Accords [Edith Brown Weiss and Harold K. Jacobson (eds.)], MIT Press, Cambridge, MA, USA.

Johnson, Tana and Andrew Heiss (2018) Liberal Institutionalism. In: International Orgnaiztion and Global Governance, 2nd Edition [Thomas g. Weiss and Rorden Wilkinson (eds.)], Routledge, London, UK.

Jordan, Andrew, Dave Huitema, Jonas Schoenefeld, Harro van Asselt and Johanna Forster (2018) Governing Climate Change Polycentrically: Setting the Scene. In: Governing Climate Change: Polycentricity in Action [Andrew Jordan, Dave Huitema, Harro van Asselt and Johanna Forster (eds.)], Cambridge University Press, Cambridge, UK.

Joshi, Shangrila (2015) North-South relations: colonialism, empire and international order. In: Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, UK.

Jouannet, Emmanuelle (2011) Koskenniemi: A Critical Introduction [Martti Koskenniemi commenting at a Conference at the Law Faculty of the Sorbonne, February 2004.] In: Martti Koskenniemi: The Politics of International Law, Hart Publishing, Oxford, UK.

Knox, John H. (2006) The Flawed Trail Smelter Procedure: The Wrong Tribunal, the Wrong Parties, and the Wrong Law. In: Transboundary Harm in International Law: Lessons from the Trail Smelter Arbitration [Rebecca M. Bratspies and Russel A. Miller (eds.)], Cambridge University Press, Cambridge, UK.

Koskenniemi, Martti (2011) The Function of Law in the International Community: Introduction. In: Sir Hersch Lauterpacht (1933) The Function of Law in the International Community. Oxford Univeristy Press, Oxford, UK.

Kotze, Louis J. (2017) Global Environmental Consittutionalism in the Anthropocene. In: Environmental

Law and Governance for the Anthropocene [Louis J. Kotze (ed.)], Hart Publishing Co., Oxford, UK.

Kotze, Louis J. (2017) Preface: Discomforting Conversations in the Anthropocene. In: Environmental Law and Governance for the Anthropocene [Louis J. Kotze (ed.)], Hart Publishing, Oxford, UK.

Kulovesi, Kati (2013) Exploring the Landscape of Climate Law and Scholarship: Two Emerging Trends. In: Climate Change and Law [Erkki J. Hollo, Kati Kulovesi and Michael Mehling (eds.)], Springer, Dordrecht, The Netherlands.

Lanchberry, John and David Victor (1995) The Role of Science in the Global Climate Negotiations. In: Green Globe Yearbook of International Cooperation on Environment and Development [Helge Bergesen and Georg Parmann (eds.)], Oxford University Press, Oxford, UK.

Levy, Marc A. (1993) European Acid Rain: Tote-Board Diplomacy. In: Institutions for the Earth: Sources of Effective International Environmental Protection [Peter M. Haas, Robert O. Keohane and Marc A. Levy (eds.)], MIT Press, Cambridge, MA, USA.

Levy, Marc A. (1995) International Cooperation to Combat Acid Rain. In: Green Globe Yearbook of International Cooperation on Environment and Development [Helge Ole Bergesen, Georg Parmann, and Øystein B. Thommessen (eds.)], Oxford University Press, Oxford, UK.

McCaffrey, Stephen C. (2006) Of Paradoxes, Precedents, and Progeny: The Trail Smelter arbitration 65 Years Later. In: Transboundary Harm in International Law: Lessons from the Trail Smelter Arbitration [Rebecca M. Bratspies and Russel A. Miller (eds.)], Cambridge University Press, Cambridge, UK.

McDougal, Myres (1953) International Law, Power and Policy: A Contemporary Conception, Volume 082. In: Collected Course of the Hague Academy of International Law, The Hague, The Netherlands.

McFaul, Larry (2006) Developing the climate change regime: the role of verification. In: Verifying Treaty Compliance: Limiting Weapons of Mass Destruction and Monitoring the Kyoto Protocol Provisions [Rudolf Avenhaus, Nicolas Kyriakopoulus, Michel Richard and Gotthard Stein (eds.)], Springer, Berlin, Germany.

Nordberg, Lars, Keith Bull, Radovan Chrast, Oddmund Graham, Andrzej Jagusiewicz, Peter H. Sand, Arne Tollan and Henning Wuester (2004) Chapter 7: The role of the secretariat: building the protocol tree. In: Clearing the Air: 25 Years of the Convention on the Long-range Transboundary Air Pollution [Johan Sliggers and Willem Kakebeeke (eds.)], United Nations Publications, New York, NY, USA.

Olmstead, Sheila M. and Robert N. Stavins (2007) A Meaningful Second Commitment Period for the Kyoto Protocol. In: The Economists' Voice: Top Economists Take on Today's Problems [J. Stiglitz, A. Edlin, B. Delong (eds.)], Columbia University Press, New York, USA.

O'Neill, Kate (2015) International Organizations: Global and regional environmental cooperation. In: Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, UK.

Ostrom, Elinor (2008) Developing a Method for Analyzing Institutional Change. In: Alternative Institutional Structures: Evolution and Impact [Sandra Batie and Nicholas Mercuro (eds.)], Routledge, London, UK.

Ostrom, Elinor (2012) Challenges for Achieving Conservation and Development. In: Annual Proceedings

of the Wealth and Well-Being of Nations [Jennifer Kodl and Emily Chamlee-Wright (eds.)], Beloit College Press, Beloit, WI, USA.

Ostrom, Vincent (2014) (1991) Polycentricity: The Structural Basis of Self-Governing Systems. In: Choice, Rules and Collective Action: The Ostroms on the Study of Institutions and Governance [Paul Dragos Aligica and Filippe Sabetti (eds.)], ECPR Press, Colchester, UK.

Ostrom, Vincent and Elinor Ostrom (1977) Public Goods and Public Choices. In: Alternatives for Delivering Public Services [E. S. Sava (ed.)], Westview Press, Boulder, CO, USA.

Peel, Jacqueline (2014) International Law and the Protection of the Global Environment. In: The Global Environment: Institutions, Law and Policy, 4th Edition [Regina S. Axelrod and Stacy D. VanDeveer (eds.)], CQ Press, Thousand Oaks, California, USA.

Puchala, Donald J. and Raymond F. Hopkins (1983) International regimes: lessons from inductive analysis. In: International Regimes [Stephen d. Krasner (ed.)], Cornell University Press, Ithaca, NY, USA.

Rayner, Steve, Elizabeth L. Malone and Michael Thompson (1999) Equity Issues and Integrated Assessment. In: Fair Weather – Equity Concerns in Climate Change [Ferenc L. Toth (ed.)], Earthscan, London, UK.

Redgwell, Catherine (2000) Multilateral environmental treaty-making. In: Multilateral treaty-making: the current status of challenges to and reforms needed in the international legislative process [V Gowland-Debbas (ed.)], Nijhoff Law Specials, Martinus Nijhoff, The Hague, The Netherlands.

Reichler, Thomas (2016) Poleward Expansion of the Atmospheric Circulation. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, The Netherlands.

Rupert, Mark (2007) Marxism. In: International Relations Theory for the Twenty-First Century: An Introduction [Martin Griffiths (ed.)], Routledge, London, UK.

Sand, Peter H. (2007) The Evolution of Environmental Law. In: The Oxford Handbook of Envrionmental Law [Daniel Bodansky, Jutta Brunee and Ellen Hey (Eds.)], Oxford University Press, Oxford, UK.

Schachter, Oscar (1982) International Law in Theory and Practice: General Courses in Public International Law, Volume 178. In: Collected Course of the Hague Academy of International Law, The Hague, The Netherlands.

Schnieder, Toni and Jurgen Schneider (2004) Chapter 3: EMEP – Backbone of the Convention. In Clearing the Air: 25 Years of the Convention on the Long-range Transboundary Air Pollution [Johan Sliggers and Willem Kakebeeke (eds.)], United Nations Publications, New York, NY, USA.

Slouka, Zdenek (1982) International Law-Making: A view from technology. In: Lawmaking in the Global Community [Nicholas Greenwood Onuf (ed.)], Carolina Academic Press, Durham, NC, USA.

Sokolovsky, Valentin (2004) Fruits of the Cold War. In: Clearing the Air: 25 years of the Convention on Long-range Transboundary Air Pollution [Johan Sliggers and Willem Kakebeeke (eds.)], United Nations Economic Commission on Europe, New York, Geneva, Switzerland.

Soltau, Friedrich (2016) Common Concern of Humankind. In: The Oxford Handbook of International Climate Law [Cinnamon P. Carlarne, Kevin R. Gray and Richard G. Tarasofsky (eds.)], Oxford

University Press, Oxford, UK.

Steiner, Achim (2015) Foreword. In: The Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme Ozone Secretariat, Nairobi, Kenya.

Stevenson, Hayley (2015) Alternative theories: Constructivism, Marxism and other critical approaches. In: Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, UK.

Tuckett, Richard P. (2016) The Role of Atmospheric Gases. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, The Netherlands.

Turco, Richard P. (1986) Recent Assessments of the Environmental Consequences of Nuclear War. In: The Medical Implications of Nuclear War [Fred Solomon and Robert Q. Marston (eds.)], Institute of Medicine, National Academy of Sciences, National Academy Press, Washingtion, DC, USA.

Turley, Carol and Helen S. Findlay (2016) Ocean Acidification. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, The Netherlands.

Verschuuren, Jonathan (2017) The Role of Sustainable Development and the Associated Principles of Environmental Law and Governance in the Anthropocene. In: Environmental Law and Governance for the Anthropocene [Louis J. Kotze (ed.)], Hart Publishing, Oxford, UK.

Vogler, John (2015) Mainstream theories: Realism, rationalism and revolutionism. In: Routledge Handbook of Global Environmental Politics [Paul G. Harris (ed.)], Routledge, London, UK.

Wadhams, Peter (2016) Antarctic Sea Ice Changes and Their Implications. In: Climate Change: Observed Impacts on Planet Earth, 2nd Edition [Trevor M. Letcher (ed.)], Elsevier, Amsterdam, The Netherlands.

Wet, Erika de and Jure Vidmar (2012) Introduction. In: Hierarchy in International Law: The Place of Human Rights [E de Wet and J Vidmar (eds.)], Oxford University Press, Oxford, UK.

Wright, Martin (1966) Western Values in International Relations. In: Diplomatic Investigations: Essays in the Theory of International Politics [Herbert Butterfield (ed.)], Allen and Unwin, London, UK.

Journal Articles

Abbott, Kenneth W. (1989) Modern International Relations Theory: A Prospectus for International Lawyers, Yale Journal of International Law, Volume 14, pp. 335-412.

Abbott, Kenneth W. and Duncan Snidal (1998) Why States Act Through International Organizations, Journal of Conflict Resolution, Volume 42, Number 1, February 1998, p. 9.

Agrawala, Shardul (1998) Context and Early Origins of the Intergovernmental Panel on Climate Change, Climate Change, Volume 39, Issue 4 (August 1998), p. 610.

Aligica, Paul D. and Vlad Tarko (2012) Polycentricity: from Polanyi to Ostrom, and beyond, Governance, Volume 25, Issue 2 (April 2012), pp. 237-238.

Allen, Robert J., Joel R, Norris, Mahesh Kovilakam (2014) Influence of anthropogenic aerosols and the Pacific Decadal Oscillation on tropical belt width, Nature Geoscience, Volume 7, 16 March 2014, pp. 270-274.

Ambrose, Stanley H. (1998) Late Pleistocene human population bottlenecks, volcanic winter, and the

differentiation of modern humans, Journal of Human Evolution, Volume 34, pp. 623-651.

Anastaplo, G. (2003) Constitutionalism and the Good: Explorations, Tennessee Law Review, Volume 70, p. 738.

Andersen, D. H. (1995) Legal Implications of the Entry into Force of the UN Convention on the Law of the Sea, International and Comparative Law Quarterly, Volume 44, Issue 2 (April 1995), pp. 313-326.

Andresen, Steinar and Ellen Hey (2005) The effectivness and legitimacy of international environmental institutions, International Environmental Agreements: Politics, Law and Economics, Volume 5, Issue 3 (September 2005), p. 220.

Archer, David (2005) Fate of fossil fuel CO_2 in geologic time, Geophysical Research Letters, Volume 110, 21 September 2005, C09S05.

Arrow, Kenneth and Gerald Debreu (1954) Existence of an Equilibrium for a Competitive Economy, Econometrica, Volume 22, Number 3 (July 1954), pp. 265-290.

Atkinson, D. and R. M. Sibly (1997) Why are organisms usually bigger in colder environments? Making sense of a life history puzzle, Trends in Ecological Evolution, Volume 12, Issue 6, pp. 235-239.

Avnery, S., D.L. Mauzerall, J. Liu and L.W. Horowitz (2011) Global crop yield reductions due to surface ozone exposure: 1. Year 2000 crop production losses and economic damage, Atmospheric Environment, Volume 45, Issue 13, pp. 2284-2296.

Avnery, S., D.L. Mauzerall, J. Liu and L.W. Horowitz (2011) Global crop yield reductions due to surface ozone exposure: 2. Year 2030 potential crop production losses and economic damage under two scenarios of O_3 pollution, Atmospheric Environment, Volume 45, Issue 13, pp. 2296-2309.

Bachram, Heidi (2004) Climate Fraud and Carbon Colonialism: The New Trade in Greenhouse Gases, Capitalism Nature Socialism, Volume 15, Issue 4, pp. 5-20.

Baldwin, David A. (1996) Security Studies and the End of the Cold War, World Politics, Volume 48, Issue 1 (October 1995), pp. 117-141.

Bilder, Richard B. (1981) International Law and Natural Resources Policy, Natural Resource Journal, Volume 20, pp. 451-486.

Bodansky, Daniel (1993) The United Nations Framework Convention on Climate Change: A Commentary, Yale Journal of International Law, Volume 18, p. 468.

Bodansky, Daniel (2009) Is There an International Environmental Constitution? Indiana Journal of Global Legal Studies, Volume 16, Issue 2, Article 8, pp. 565-584.

Bodansky, Daniel (2016) The Legal Character of the Paris Agreement, RECIEL, Volume 25, Issue 2, pp. 142.

Bolstad, Erika (2016) Seas Rising but Florida Keeps Building on the Coast: Sea level rise as a result of global warming is not stopping developers of Florida's coast, Scientific American, 20 June 2016.

Bostrom, Nick (2002) Existential risks: analyzing human extinction scenarios and related hazards, Journal of Evolution and Technology, Volume 9, Number 1, pp. 1-22.

Brenner, Neil, Jamie Peck and Nik Theodore (2010) Variegated Neoliberalism: Geographies, Modalities, Pathways, Global Networks, Volume 10, Issue 2 (April 2010), pp. 182-222

Buchanan, James M. (1965) "An Economic Theory of Clubs", Economica, New Series, Volume 32, Number 125, pp. 1-14.

Buldyrev, Sergey V., Roni Parshani, Gerald Paul, H. Eugene Stanley and Shlomo Havlin (2010) Catastrophic cascades of failures in interdependent networks, Nature, Volume 464 (15 April 2010), pp. 1025-1028.

Bulletin of the Atomic Scientists (2017) It is Two and the Half Minutes to Midnight, 2017 Doomsday Clock Statement [John Mecklin (ed.)], Science and Security Board, Bulletin of the Atomic Scientists, USA, p. 8.

Bulletin of the Atomic Scientists (2019) A new abnormal: It is still 2 minutes to midnight, 2019 Doomsday Clock Statement [John Mecklin (ed.)], Science and Security Board, Bulletin of the Atomic Scientists, USA.

Caney, Simon and Derek Bell (2011) Morality and Climate Change, The Monist, Volume 94, Number 3, July 2011, pp. 305-309.

Chambers, W. Bradnee (2004) Towards an improved understanding of legal effectivenss of international environmental treaties, Georgetown International Environmental Law Review, Volume 16, Issue 3, p. 509.

Chao Chen, Enli Wang, Qiang Yu and Yongqiang Zhang (2010) Quantifying the effects of climate trends in the past 43 years (1961-2003) on crop growth and water demand in the North China Plain, Climatic Change, Volume 100, Issue 3-4, pp. 559-578.

Church, John A. and Neil J. White (2011) Sea-Level Rise from the Late 19th to the Early 21st Century, Surveys in Geophysics, Volume 32, Issue 4, September 2011, pp. 585-602.

Churchill, R. and G. Ulfstein (2000) Autonomous Institutional Arrangements in Multilateral Environmental Agreements: A Little-noticed Phenomenon in International Law, American Journal of International Law, Volume 94, Number 4, pp. 623-659.

Coase, R. H. (1937) The Nature of the Firm, Economica, Volume 4, Issue 16 (November 1937), pp. 386-405.

Coase, R. H. (1960) The Problem of Social Cost, Journal of Law and Economics, Volume III (October 1960), pp. 1-44.

Cosmides, Leda and John Tooby (1994) Better than Rational Evolutionary Psychology and the Invisible Hand, American Economic Review, Volume 84 (May 1994), pp. 327-332.

Cox, Michael, Gren Arnold and Sergio Villamayor Tomás (2010) A review of design principles for community-based natural resource management, Ecology and Society, Volume 15, Issue 4, Article 38.

Cox, Robert W. (1981) Social Forces, States and World Orders: Beyond International Relations, Millennium – Journal of International Studies, Volume 10, Number 2, pp. 126 – 155.

Craine, J.M., A.J. Elmore, K.C. Olson and D. Tolleson (2010) Climate change and cattle nutritional stress, Global Change Biology, Volume 16, Issue 10, pp. 2901-2911.

Crutzen, Paul J. and Eugene F. Stoermer (2000) The ‘‘Anthropocene’’, Global Change Newsletter, Volume 41, pp. 17–18.

Crutzen, Paul J. and John W. Birks (1982) Atmosphere after a Nuclear War: Twilight at Noon, Ambio, Volume 11, Numbers 2-3, pp. 114-125.

Cumberlege, S. (2009) Multilateral environmental regimes: from Montreal to Kyoto. A theoretical approach to an improved climate change regime, Denver Journal of International Law and Policy, Volume 37, p. 307.

Cvijanovic, Ivana and Ken Caldeira (2015) Atmospheric impacts of sea ice decline in CO_2-induced global warming, Climate Dynamics, Volume 44, Issue 5, pp. 1173-1186.

Dawes, R.M. (1973) The Commons Dilemma Game: An N-Person Mixed-Motive Game with a Dominating Strategy for Defection, Oregon Research Institute Research Bulletin, Volume 13, pp. 1-12.

Donat, M. G., L. V. Alexander, H. Yang, I. Durre, R. Vose, R. J. H. Dunn, K. M. Willett, E. Aguilar, M. Brunet, J. Caesar, B. Hewitson, C. Jack, A. M. G. K. Tank, A. C. Kruger, J. Marengo, T. C. Peterson, M. Renom, C. O. Rojas, M. Rusticucci, J. Salinger, A. S. Elrayah, S. S. Sekele, A. K. Srivastava, B. Trewin, C. Villarroel, L. A. Vincent, P. Zhai, X. Zhang and S. Kitching (2013) Updated analyses of temperature and precipitation extreme indices since the beginning of the twentieth century: The HadEX2 dataset, Journal of Geophysical Research-Atmospheres, Volume 118, Issue 5, pp. 2098-2118.

Dorsch, Marcel J. and Christian Flachsland (2017) A Polycentric Approach to Global Climate Governance, Global Environmental Politics, Volume 17, Issue 2 (May 2017), pp. 45-64.

Downs, George W., David M. Rocke and Peter N. Barsoom (1996) Is the Good News About Compliance Good News About Cooperation? International Organization, Volume 50, Issue 3, p. 379-406.

Duffield, John S. (2007) What are International Institutions? International Studies Review, Volume 9, Issue 1 (May 2007), pp. 7-8

Farman, J. C., B. G. Gardiner and J. D. Shanklin (1985) Large losses of total ozone in Antarctica reveal seasonal ClO_x/NO_x interaction, Nature, Volume 315, 16 May 1985, pp. 207-210.

Feldmann, Johannes and Anders Livermann (2015) Collapse of the West Antarctic Ice Sheet after local destabilization of the Amundsen Basin, Proceedings of the National Academy of Sciences for the United States of America, Volume 112, Number 46, 17 November 2015, pp. 14191-14196.

Fennell, Lee Anne and Richard H. McAdams (2017) Inverted Theories, Public Law and Legal Theory Working Papers, Chicago Unbound, 11 August 2017, Chicago Law School, Chicago, IL, USA, p. 1-2.

Fenney, David, Fikret Berkes, Bonnie McCay and James M. Acheson (1990). The Tragedy of the Commons: Twenty-two Years Later, Human Ecology, Volume 18, Number 1, pp. 1–19.

Figgis, J. Neville (1911) Respublica Christiana, Transactions of the Royal Historical Society, Volume 5 (December 1911), pp. 63-88.

Fishman, J., J.K. Creilson, P.A. Parker, E.A. Ainsworth, G.G. Vining, J. Szarka, F.L. Booker and X. Xu (2010) An Investigation of widespread ozone damage to the soybean crop in the upper Midwest determined from ground-based and satellite measurements, Atmospheric Environment, Volume 44, Issue 18, pp. 2248-2256.

Fitzpatrick, Sheila (2015) Impact of the Opening of Soviet Archives on Western Scholarship on Soviet Social History, Russian Review, Volume 74 (9 June 2015), pp. 377-400.

Forzieri G, Cescatti A, Silva FB, Feyen L (2017) Increasing risk over time of weather-related hazards to the European population: a data-driven prognostic study, Lancet Planet Health, Volume 1, pp. e200–208.

Frolicher, Thomas L., Jorge L. Sarmiento, David J. Paynter, John P. Dunne, John P. Krasting and Michael Winton (2014) Dominance of the southern ocean in anthropogenic carbon and heat uptake in CMIP5 models, Journal of Climate, Volume 28, 15 January 2015, pp. 862–886.

Fudenberg, Drew and Eric Maskin (1986) The Folk Theorem in Repeated Games with Discounting or with Incomplete Information, Economica, Volume 54, Number 3, pp. 533-554.

Fu, Qiang and Pu Lin (2011) Poleward shift of subtropical jets inferred from satellite-observed lower-stratospheric temperatures, Journal of Climate, Volume 24, Number 21, November 2011, pp. 5597-5603.

Gardner, Stephen M. (2004) Ethics and Global Climate Change, Ethics, Volume 114, Number 3 (April 2004), pp. 555-600.

Geck, Marshall, Xiaoxue Weng, Caitlin Bent, Chukwumerjie Okereke, Taylor Murray and Kirsty Wilson (2013) Breaking the impasse: towards a new regime for international environmental governance, Climate Policy, Volume 13, Number 6, pp. 777-784.

Gerten, Dieter, Wolfgang Lucht, Sebastian Ostberg, Jens Heinke, Martin Kowarsch, Holger Kreft, Zbigniew W Kundzewicz, Johann Rastgooy, Rachel Warren and Hans Joachim Schellnhuber (2013) Asynchronous exposure to global warming: freshwater resources and terrestrial ecosystems, Environmental Research Letters, Volume 8, 034032, p. 1.

Gillet, N. P., A. J. Weaver, F. W. Zwiers and M. D. Flannigan (2004) Detecting the effect of climate change on Canadian forest fires, Geophysical Research Letters, Volume 31, Issue 18, L18211, 4 pp.

Gordon, H. Scott (1954) The Economic Theory of a Common-Property Research: The Fishery, Journal of Political Economy, Volume 62 (April 1954), pp. 124-142.

Green, Bryan A. (2009) Lessons from the Montreal Protocol: Guidance for the Next International Climate Change Agreement, Environmental Law, Volume 39, p. 265.

Guis, H., C. Caminade, C. Calvete, A.P. Morse, A. Tran and B. Baylis (2012) Modelling the effects of past and future climate on the risk of bluetongue emergence in Europe, Journal of the Royal Society Interface, Volume 9, Number 67, pp. 339-350.

Haas, Peter (2004) Addressing the Global Governance Deficit, Global Environmental Politics, Volume 4, Issue 4, February 2004, p. 8.

Hansen, James, Inez Fung, Andrew Lacis, David Rind, Serjei Lebedeff, Reto Ruedy, Gary Russell and Peter Stone (1988) Global climate changes as forecast by Goddard Institute for Space Studies three-dimensional model, Journal of Geophysical Research, Volume 93, pp. 9341-9364.

Hansen, James, Makiko Sato and Reto Ruedy (2012) Perception of Climate Change, Proceedings of the National Academy of Sciences, Volume 109, Number 37 (6 August 2012), E2415-E2423.

Hardin, Garrett (1963) The Cybernetics of Competition: A Biologist's View of Society, Perspectives in Biology and Medicine, Volume 7 (Autumn 1963), p. 80.

Hardin, Garrett (1968) The Tragedy of the Commons, Science, Volume 162, Issue 3859 (13 December

1968), pp. 1243-1248.

Harris, Daniel C. (2010) Charles David Keeling and the Story of Atmospheric CO_2 Measurements, Analytical Chemistry, Volume 82, pp. 7865-7870.

Hatfield, J.L., K.J. Boote, B.A. Kimball, L.H. Ziska, R.C. Izaurralde, D. Ort, A.M. Thomson and D. Wolfe (2011) Climate impacts on agriculture: Implications for crop production, Agronomy Journal, Volume 103, Issue 2, pp. 351-370.

Hecht, Alan D. and Dennis Tirpak (1995) Framework Agreement on Climate Change: A Scientific and Policy History, Climate Change, Volume 29, pp. 371-402.

Held, Isaac M. (2005) The Gap between Simulation and Understanding in Climate Modeling, Bulletin of the American Meteorological Society, Volume 86, November 2015, pp. 1609–1614.

Hoegh-Guldberg, Ove (2011) Coral reef ecosystems and anthropogenic climate change, Regional Environmental Change, Volume 11, Supplement 1, pp. S215-S227.

Honda, Meiji, Jun Inoue and Shozo Yamane (2009) Influence of low Arctic sea-ice minima on anomalously cold Eurasian winters, Geophysical Research Letters, Volume 36, Issue 8, 28 April 2009, L08707.

Hönisch, Bärbel, Andy Ridgwell, Daniela N. Schmidt, Ellen Thomas, Samantha J. Gibbs, Appy Sluijs, Richard Zeebe, Lee Kump, Rowan C. Martindale, Sarah E. Greene, Wolfgang Kiessling, Justin Ries, James C. Zachos, Dana L. Royer, Stephen Barker, Thomas M. Marchitto Jr., Ryan Moyer, Carles Pelejero, Patrizia Ziveri, Gavin L. Foster, Branwen Williams (2012) The Geological Record of Ocean Acidification, Science, Volume 335, 2 March 2012, pp. 1058-1063.

Honjo, S., T.I. Eglinton, C.D. Taylor, K.M. Ulmer, S.M. Sievert, A. Bracher, C.R. German, V. Edgcomb, R. Francois, M.D. Iglesias-Rodriguez, B. van Mooy, and D.J. Repeta (2014) Understanding the role of the biological pump in the global carbon cycle: An imperative for ocean science, Oceanography, Volume 27, Number 3, pp. 10-16.

Hufford, D. Brian (1983) Ideological Rigidity vs. Political Reality: A Critique of Reagan 's Policy on the Law of the Sea, Yale Law and Policy Review, Volume 2, Issue 1, p. 127.

Huntingdon, T. G. (2008) Can we dismiss the effect of changes in land-based water storage on sea-level rise? Hydrological Processes, Volume 22, Issue 5, 29 February 2008, pp. 717-723.

Hutchinson, Allan C. and Patrick J. Monahan (1984) Law, Politics, and the Critical Legal Scholars: The Unfolding Drama of American Legal Thought, Stanford Law Review, Volume 36, Number 1/2, Critical Legal Studies Symposium (January 1984), pp. 213-215.

Jenks, C. Wilfred (1953) The Conflict of Law-Making Treaties, British Year Book of International Law (BYBIL), Volume 30, p. 403.

Jolly, W. Matt, Mark A. Cochrane, Patrick H. Freeborn, Zachary A. Holden, Timothy J. Brown, Grant J. Williamson & David M.J.S. Bowman (2015) Climate-induced variations in global wildfire danger from 1979 to 2013, Nature Communications, Volume 6, 7537.

Katz, Cheryl (2015) How Long Can Oceans Continue to Absorb Earth's Excess Heat? Yale Environment 360, Yale School of Forestry and Environmental Studies, 30 March 2015.

Kay, Jennifer E., Marika M. Holland and Alexandra Jahn (2011) Inter-annual to multi-decadal Arctic sea ice extent trends in a warming world, Geophysical Research Letters, Volume 38, Issue 15, 11 August 2011, L15708.

Keeling, Charles David (1998) Rewards and Penalties of Monitoring the Earth, Annual Review of Energy and the Environment, Volume 23, pp. 25–82.

Kellogg, William W. (1987) Mankind's Impact on Climate: The Evolution of an Awareness, Climate Change, Volume 10, p. 121.

Keynes, John Maynard (1926) The end of laissez-faire-II, New Republic, Volume 48 (1 September 1926), p. 37.

King, David A. (2004) Climate Change Science: Adapt, Mitigate, or Ignore? Science, Volume 303, Issue 5655, 9 January 2004, pp. 176-177.

Kinnard, Christophe, Christian M. Zdanowicz, David A. Fisher, Elisabeth Isaksson, Anne de Vernal and Lonnie G. Thompson (2011) Reconstructed changes in Arctic sea ice over the past 1,450 years, Nature, Volume 479, 24 November 2011, pp. 509-512.

Koskenniemi, Martti (1990) The Politics of International Law, International Journal of European Law, Volume 1, Issue 1 (1 February 1990), p. 6.

Krasner, Stephen (1982) Structural Causes and Regime Consequences: Regimes as Intervening Variables, International Orgnaizations, Volume 36, Number 2, International Regimes (Spring 1982), pp. 185-205.

Kratochwil, Friedrich (1983) Is International Law "Proper" Law? Archiv für Rechts- und Sozialphilosophie (ARSP) [Archives for Philosophy of Law and Social Philosophy], Volume 69, Number 1, pp. 33-34.

Kratochwil, F. and John G. Ruggie (1986) International organization: a state of the art on the state of the art, International Organizations, Volume 40, Number 4 (Autumn 1986), pp. 753-775.

Kress, M. and I. Talmor (1999) A new look at the 3:1 rule of combat through Markov stochastic Lancaster models, Journal of the Operation Research Society, Volume 50, Number 7 (July 1999), pp. 733-744.

Kushner, Paul J., Isaac M. Held and Thomas L. Delworth (2001) Southern hemisphere atmospheric circulation response to global warming, Journal of Climate, Volume 14, Number 10, 15 May 2001, pp. 2238-2249.

Levitus, S., J. I. Antonov, T. P. Boyer, O. K. Baranova, H. E. Garcia, R. A. Locarnini, A. V. Mishonov, J. R. Reagan, D. Seidov, E. S. Yarosh, and M. M. Zweng (2012) World ocean heat content and thermosteric sea level change (0–2000 m), 1955–2010, Geophysical Research Letters, Volume 39, 17 May 2012, L10603.

Levy, David L. and Peter J. Newell (2002) Business strategy and international environmental governance: towards a neo-Gramscian synthesis, Global Envionmental Politics, Volume 2, Issue 4, p. 86.

Limbach, Jutta (2001) The Concept of the Supremacy of the Constitution, Modern Law Review, Volume 64, Number 1 (January 2001), pp. 1-10.

Lobell, David B., Wolfram Schlenker and Justin Costa-Roberts (2011) Climate Trends and Global Crop Production since 1980, Science, Volume 333, Issue 6042, pp. 616-620.

Mace, M. J. and Roda Verheyen (2016) Loss, Damage and Responsibility after COP21: All Options Open for the Paris Agreement, Review of European Comparative and International Environmental Law, Volume 25 (27 July 2016), pp. 197-214.

Manabe, Syukuro and Richard T. Wethereld (1975) The Effects of Doubling the CO_2 Concentration on the Climate of a General Circulation Model, Journal of the Atmospheric Sciences, Volume 32, Number 1, pp. 3-15.

Masike, Sennye and Peter Urich (2008) Vulnerability of traditional beef sector to drought and the challenges of climate change: the case of Kgatleng District, Botswana, Journal of Geography and Regional Planning, Volume 1, Number 1, pp. 12-18.

Maslowski, Wieslaw, Jaclyn Clement Kinney, Matthew Higgins and Andrew Roberts (2012) The Future of Arctic Sea Ice, Annual Review of Earth and Planetary Sciences, Volume 40, May 2012, pp. 625-654.

Massom, Robert A., A. Barry Giles, Helen A. Fricker, Roland C. Warner, Benoit Legrésy, Glenn Hyland, Neal Young and Alexander D. Fraser (2010) Examining the interaction between multi-year landfast sea ice and the Mertz Glacier Tongue, East Antarctica: Another factor in ice sheet stability? Journal of Geophysical Research, Volume 115, C12027.

Massom, Robert A. and Sharon E. Stammerjoh (2010) Antarctic sea ice change and variability—physical and ecological implications, Polar Science, Volume 4, Issue 2, August 2010, pp. 149-186.

Matz-Luck, Nele (2009) Framework Conventions as a Regulatory Tool, Goettingen Journal of International Law, Volume 1, Issue 3, pp. 439-458.

McDougal, Myres S. (1956) Law as a Process of Decision: A Policy-Oriented Approach to Legal Study, Faculty Scholarship Series, Paper 2464, Yale Law School, New Haven, CT, USA, p. 56.

McGarth, Justine M. and David B. Lobell (2011) An independent method of deriving the carbon dioxide fertilization effect in dry conditions using historical yield data from wet and dry years, Global Change Biology, Volume 17, Issue 8, pp. 2689-2696.

McLachlan, Campbell (2005) The Principle of Systemic Integration and Article 31(3)(c) of the Vienna Convention, International and Comparative Law Quarterly, April 2005, pp. 279-319.

Merino, G., M. Barange, J.L. Blanchard, J. Harle, R. Holmes, I. Allen, E.H. Allison, M.C. Badjeck, N.K. Dulvy, J. Holt, S. Jennings, C. Mullon, and L.D. Rodwell (2012) Can marine fisheries and aquaculture meet fish demand from a growing human population in a changing climate? Global Environmental Change, Volume 22, pp. 795-806.

Mielke, Howard W. (1999) Lead in the inner cities: Policies to reduce children's exposure to lead may be overlooking a major source of lead in the environment, American Scientific, Volume 87, Issue 1 (Jan-Feb 1999), pp. 62-73.

Miles, Bertie W. J., Chris R. Stokes and Stewart S. R. Jamieson (2016) Pan–ice-sheet glacier terminus change in East Antarctica reveals sensitivity of Wilkes Land to sea-ice changes, Science Advances, Volume 2, May 2016, e1501350.

Miller, Laury and Bruce C. Douglas (2004) Mass and volume contributions to twentieth-century global sea level rise, Nature, Volume 428 (25 March 2004), pp. 406-409.

Molina, Mario J. and F. S. Rowland (1974) Stratospheric sink for chlorofluoromethanes: chlorine atom catalyzed destruction of ozone, Nature, Volume 249, Issue 5460, 28 June 1974, pp. 810-812.

Montzka, Stephen A., Geoff S. Dutton, Pengfei Yu, Eric Ray, Robert W. Portmann, John S. Daniel, Lambert Kuijpers, Brad D. Hall, Debra Mondeel, Carolina Siso, J. David Nance, Matt Rigby, Alistair J. Manning, Lei Hu, Fred Moore, Ben R. Miller & James W. Elkins (2018) An unexpected and persistent increase in global emissions of ozone-depleting CFC-11, Nature, Volume 557, 16 May 2018, pp. 413-417.

Mordfin, Robin I. and Marsha Ferziger Nagorsky (2011) Chicago and Law and Economics: A History, 11 October 2011, Chicago Law School, University of Chicago, Chicago, IL, USA.

Morgenthau, Hans J. (1940) Positivism, Functionalism, and International Law, American Journal of International Law, Volume 34, Issue 2 (April 1940), p. 265

Morgenthau, Hans (1948) The Twilight of International Morality, Ethics, Volume 58, Number 2 (Jan 1948), p. 87.

Moss, Richard H. (1995) Avoiding 'Dangerous' Interference with the Climate System: The Roles of Values, Science, and Policy, Global Environmental Change, Volume 5, Number 1, pp. 3-6.

Neumann, Barbara, Athanasios T. Vafeidis, Juliane Zimmermann and Robert J. Nicholls (2015) Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding - A Global Assessment, PLoS ONE, Volume 10, Number 3, 11 March 2015, e0118571, p. 2.

Newell, Peter J. (2011) The elephant in the room: capitalism and global environmental change, Global Environmental Change, Volume 21 (February 2011), pp. 4-6.

Notz, Dirk and Jochem Marotzke (2012) Observations reveal external driver for Arctic sea-ice retreat, Geophysical Research Letters, Volume 39, Issue 8, 20 April 2012, L051094.

Oberthur, Sebastian (1997) Montreal Protocol: 10 Years After, Environmental Policy and Law, Volume 27, Issue 6, pp. 432-440.

Orbach, Michael (2003) Beyond the Freedom of the Seas: Ocean Policy for the Third Millennium, Oceanography, Volume 16, Number 1, pp. 24-25.

Orr, James C., Victoria J. Fabry, Olivier Aumont, Laurent Bopp, Scott C. Doney, Richard M. Feely, Anand Gnanadesikan, Nicolas Gruber, Akio Ishida, Fortunat Joos, Robert M. Key, Keith Lindsay, Ernst Maier-Reimer, Richard Matear, Patrick Monfray, Anne Mouchet, Raymond G. Najjar, Gian-Kasper Plattner, Keith B. Rodgers, Christopher L. Sabine, Jorge L. Sarmiento, Reiner Schlitzer, Richard D. Slater, Ian J. Totterdell, Marie-France Weirig, Yasuhiro Yamanaka, and Andrew Yool (2005) Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms, Nature, Volume 437, pp. 681–686.

Ostrom, Elinor (1998) A Behavioral Approach to the Rational Choice Thoery of Collective Action, Presidential Address, American Political Science Association, 1997, American Political Science Review, Volume 92, Number 1 (March 1998), pp. 10-13.

Ostrom, Elinor (2000) Collective Action and the Evolution of Social Norms, The Journal of Economic Perspectives, Volume 14, Number 3, pp. 137-158.

Ostrom, Elinor (2010) Polycentric systems for coping with collective action and global environmental change, Global Environmental Change, Volume 20, pp. 550-557.

Ostrom, Elinor (2011) Background on the Institutional Analysis and Development Framework, Policy Studies Journal, Volume 39, Number 1, pp. 7-27.

Ostrom, Elinor (2012) Why do we need to protection institutional diversity? Keynote Lecture, European Political Science, Voume 11, pp. 137-139.

Ostrom, Vincent, Charles M. Tiebout and Robert Warren (1961) The Organization of Government in Metropolitan Areas: A Theoretical Enquiry, American Political Science Review, Volume 55, Issue 4 (December 1961), pp. 831-842.

Ostry, Jonathan D., Prakash Loungani and David Furceri (2016) Neoliberalism: Oversold? Finance and Development, Volume 53, Number 2 (June 2016), p. 38.

Ottar, Brynjulf (1976) Organization of long range transport of air pollution monitoring in Europe, Water, Air and Soil Pollution, Volume 6, Issues 2-4 (June 1972), pp. 219-229.

Page, William H. (1989) The Chicago School and the Evolution of Antitrust: Characterization, Antitrust Injury, and Evidentiary Sufficiency, Virginia Law Review, Volume 75, Number 7 (October 1989), pp. 1221-1308.

Pattberg, P. H. (2010) Public-private partnerships in global climate governance, Wiley Interdisciplinary Reviews: Climate Change, Volume 1, Number 2, pp. 279-287.

Pearce Fred (2005) The Week the Climate Changed, New Scientist, Volume 188, Issue 2521, 12 October 2005, pp. 52-53.

Perovich, Donald K. and Christopher Polashenski (2012) Albedo evolution of seasonal Arctic sea ice, Geophysical Research Letters, Volume 39, Issue 8, 20 April 2012, L051432.

Peters, Michael A. (2018) The end of neoliberal globalisation and the rise of authoritarian populism, Educational Philosophy and Theory, Volume 50, Number 4, p. 324.

Petsonk, Carol Annette (1990) The Role of the United Nations Environmental Progamme in the Development of International Environmental Law, American University International Law Review, Volume 5, Issue 2, Article 7, pp. 365-366.

Portmann, Felix T., Petra Doll, Stephanie Eisner and Martina Florke (2013) Impact of climate change on renewable groundwater resources: assessing the benefits of avoided greenhouse gas emissions using selected CMIP5 climate projections, Environmental Research Letters, Volume 8, 024023, p. 1.

Poteete, Amy and Elinor Ostrom (2004) In Pursuit of Comparable Concepts and Data about Collective Action, Agricultural Systems, Volume 82, Issue 3, pp. 215-232.

Potter, Thomas D. (1986) Advisory Group on Greenhouse Gases Established Jointly by WMO, UNEP, and ICSU, Environmental Conservation, Volume 13, Number 4, January 1986, p. 365.

Prandecki, Konrad (2017) Common Goods and Sustainable Development, European Journal of Sustainable Development, Volume 6, Number 3, p. 155.

Quéré, Corinne Le, Taro Takahashi, Erik T. Buitenhuis, Christian Rödenbeck, and Stewart C. Sutherland (2010) Impact of climate change and variability on the global oceanic sink of CO_2, Global Biogeochemical Cycles, Volume 24, GB4007.

Rajamani, Lavanya and Jacob Werksman (2018) The legal character and operational relevance of the Paris Agreement's temperature goal, Philosophical Transactions of the Royal Society A, Volume 376, Issue 2119 (2 Apirl 2018): 20160458, p. 3.

Rapaport, Ammon (1997) Order of Play in Strategically Equivalent Games in Extensive Forms, International Journal of Game Theory, Volume 26, Number 1, pp. 113-136.

Rasmussen, Kjeld, Sarah D'haen, Rasmus Fensholt, Bjarne Fog, Stephanie Horion, Jonas Ostergaard Nielsen, Laura Vang Rasmussen, and Anette Reenberg. (2016) Environmental Change in the Sahel: Reconciling Contrasting Evidence and Interpretations, Regional Environmental Change, Volume 16, Number 3, pp. 673–80.

Reid, P. C., D. G. Jones, M. Edwards, M. Starr, M. Poulins and P. Snoeijs (2007) A biological consequence of reducing Arctic ice cover: arrival of the Pacific diatom Neodenticula seminae in the North Atlantic for the first time in 800,000 years, Global Change Biology, Volume 13, Issue 9, pp. 1910-1921.

Reisman, W. Michael (1992) The View from the New Haven School of International Law, Proceedings of the Annual Meeting (American Society of International Law), Volume 86 (April 1992), p. 122.

Reisman, W. Michael, Siegfried Wiessner and Andrew R. Willard (2007) The New Haven School: A Brief Introduction, The Yale Journal of International Law, Volume 32, pp. 575-582.

Renaudeau, D., J. Gourdine and N. St-Pierre (2011) A meta-analysis of the effects of high ambient temperature on growth performance of growing-finishing pigs, Journal of Animal Science, Volume 89, Issue 7, 1 July 2018, pp. 2220-2230.

Revelle, Roger and Hans E. Suess (1957) Carbon Dioxide Exchange between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO_2 during the Past Decades, Tellus, Volume 9, pp. 18-27.

Ridgwell, Andy and Daniela N. Schmidt (2010) Past constraints on the vulnerability of marine calcifiers to massive carbon release, Nature Geoscience, Volume 3, Number 3, March 2010, pp. 196-200.

Roach, J. Ashley (2014) Today's Customary International Law of the Sea, Ocean Development and International Law, Volume 45, Issue 3, pp. 239-259.

Rockström, Johan, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin, III, Eric F. Lambin, Timothy M. Lenton, Marten Scheffer, Carl Folke, Hans Joachim Schellnhuber, Björn Nykvist, Cynthia A. de Wit, Terry Hughes, Sander van der Leeuw, Henning Rodhe, Sverker Sörlin, Peter K. Snyder, Robert Costanza1, Uno Svedin, Malin Falkenmark, Louise Karlberg, Robert W. Corell, Victoria J. Fabry, James Hansen, Brian Walker, Diana Liverman, Katherine Richardson, Paul Crutzen and Jonathan A. Foley (2009) Planetary Boundaries: Exploring the Safe Operating Space for Humanity, Ecology and Society, Volume 14, Number 2, Article 32.

Rosen, Amanda M. (2015) The Wrong Solution at the Right Time: The Failure of the Kyoto Protocol on Climate Change, Politics and Policy, Volume 43, Number 1, p. 32.

Rosenkranz, Stephanie and Patrick W. Schmidt (2007) Can Coasean Bargaining Justify Pigouian Taxation, Economica, Volume 74, Issue 296, pp. 573-585.

Ruddiman, William F. (2003) The Anthropogenic Greenhouse Era Began Thousands of Years Ago, Climate Change, Volume 61, pp. 261-293.

Ruggie, John Gerard (1975) International Responses to Technology: Concepts and Trends, International Organization, Volume 29, pp. 557-83.

Ruggie, John Gerard (1982) International Regimes, Transactions and Change: Embedded Liberalism in the Postwar Economic Order, International Organization, Volume 36, Issue 2, International Regimes (Spring 1982), pp. 379–415.

Sabine, Christopher L., Richard A. Feely, Nicolas Gruber, Robert M. Key, Kitack Lee, John L. Bullister, Rik Wanninkhof, C. S. Wong, Douglas W. R. Wallace, Bronte Tilbrook, Frank J. Millero, Tsung-Hung Peng, Alexander Kozyr, Tsueno Ono, and Aida F. Rios (2004) The Oceanic Sink for Anthropogenic CO_2, Science, Volume 305, 16 July 2004, pp. 367-371.

Sagan, Scott D. (1996) Why Do States Build Nuclear Weapons? Three Models in Search of a Bomb, International Security, Volume 21, Number 3 (Winter, 1996-1997), pp. 54-86.

Sagar, Ambuj D. (2000) Wealth, Responsibility, and Equity: Exploring an Allocation Framework for Global GHG Emissions, Climatic Change, Volume 45, Issues 3/4, p. 511.

Schewe, J., J. Heinke, D. Gerten, I. Haddeland, N.W. Arnell, D.B. Clark, R. Dankers, S. Eisner, B. Fekete, F.J. Colón-González, S.N. Gosling, H. Kim, X. Liu, Y. Masaki, F.T. Portmann, Y. Satoh, T. Stacke, Q. Tang, Y. Wada, D. Wisser, T. Albrecht, K. Frieler, F. Piontek, L.Warszawski and P. Kabat (2014) Multi-model assessment of water scarcity under climate change, Proceedings of the National Academy of Sciences of the United States of America, Volume 111, Issue 9, p. 3245.

Schiermeier, Quirin (2012) The Kyoto Protocol: Hot Air, Nature, Volume 491, 29 November 2012, pp. 565-568.

Schmitt, Raymond W. (2008) Salinity and the Global Water Cycle, Oceanography, Volume 21, Number 1, March 2008, pp. 12-19.

Schroder, D. and W. M. Connolley (2007) Impact of instantaneous sea ice removal in a coupled general circulation model, Geophysical Research Letters, Volume 34, Issue 14, 19 July 2007, L030253.

Scree, James A. and Ian Simmonds (2010) The central role of diminishing sea ice in recent Arctic temperature amplification, Nature, Volume 46, 29 April 2010, pp. 1334-1337.

Seager, R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Veechi, H. P. Huang, N. Harnik, A. Leetmaa, N. C. Lau, C. Li, J. Velex, N. Naik (2007) Model projections of an imminent transition to a more arid climate in southwestern North America, Science, Volume 316, Issue 5828, 5 April 2007, pp. 1181-1184.

Shah, Anup (2001) COP6 – The Hague Climate Conference, Global Issues, 4 September 2001.

Shelton, Dinah (2009) Common Concern of Humanity, Environmental Policy and Law, Volume 39, Issue 2, p. 83.

Skelcher, Chris (2005) Jurisdictional Integrity, Polycentrism, and the Design of Democratic Governance, Governance, Volume 18, Issue 1, pp. 89-110.

Small, Christopher and Robert J. Nicholls (2003) A global analysis of human settlement in coastal zones, Journal of Coastal Research, Volume 19, Issue 3, pp. 584–599.

Solomon, Susan, Diane J. Ivy, Doug Kinnison, Michael J. Mills, Ryan R. Neely III and Anja Schmidt (2016) Emergence of healing in the Antarctic ozone layer, Science, Volume 353, Issue 6296, 15 July 2016, pp. 269-274.

Solomon, Susan, Gian-Kasper Plattner, Reto Knutti, and Pierre Friedlingstein (2009) Irreversible climate change due to carbon dioxide emissions, Proceedings of the National Academy of Sciences, Volume 106, Number 10 (10 February 2009), pp. 1704-1709.

Spielhagen, Robert F., Kirstin Werner, Steffen Aagaard Sørensen, Katarzyna Zamelczyk, Evguenia Kandiano, Gereon Budeus, Katrine Husum, Thomas M. Marchitto, Morten Hald (2011) Enhanced Modern Heat Transfer to the Arctic by Warm Atlantic Water, Science, Volume 331, 28 January 2011, pp. 450-453.

Staten, Paul W. and Thomas Reichler (2014) On the ratio between shifts in the eddy-driven jet and the Hadley cell edge, Climate Dynamics, Volume 42, Issue 5-6, March 2014, pp. 1229-1242.

Stavins, Robert N. and Robert C. Stowe (2010) What Had Copenhagen Wrought? A Preliminary Assessment, Environment: Science and Policy for Sustainable Development, Volume 52, Number 3, pp. 8-14.

Supit, I., C.A. van Diepen, A.J.W. de Wit, P. Kabat, B. Baruth and F. Ludwig (2010) Recent changes in the climate yield potential of various crops in Europe, Agricultural Systems, Volume 103, Issue 9, November 2010, pp. 683-694.

Thomas, Ellen (2007) Cenozoic mass extinctions in the deep sea: What perturbs the largest habitat on Earth? In: Large Ecosystem Perturbations: Causes and Consequences [Monechi, S., Coccioni, R., and Rampino, M.R., (eds.)], Geological Society of America Special Paper 424, pp. 1–23.

Thompson, David W J and Susan Solomon (2002) Interpretation of Recent Southern Hemisphere Climate Change, Science, Volume 296, 3 May 2002, pp. 895-899.

Tollefson, Jeff (2016) The Hostile Ocean that Slowed Climate Change, Nature, Volume 539 (17 November 2016), pp. 346-348.

Tregonning, Ken and Alan Roberts (1979) Complex systems which evolve towards homeostatis, Nature, Volume 281 (18 October 1979), pp. 563-564.

Unruh, G. C. (2000) Understanding carbon lock-in, Energy Policy, Volume 28, Issue 12, October 2000, pp. 817-830.

Van Dingenen, R., F.J. Dentener, F. Raes, M.C. Krol, L. Emberson and J. Cofala (2009) The global impact of ozone on agricultural crop yields under current and future air quality legislation, Atmospheric Environment, Volume 43, Issue 3, pp. 604-618.

Victor, David G. (1999) Enforcing International Law: Implications for an Effective Global Warming Regime, Duke Environmental Law and Policy Forum, Duke University, Volume 10, Number 1, Fall 1999, pp. 151-153.

Victor, David G. (2000) Enforcing International Law: Implications for an Effective Global Warming Regime, Duke Environmental Law and Policy forum, Volume 10, p. 147.

Vieira, Monica Brito (2003) Mare Liberum vs. Mare Clausum: Grotius, Freitas, and Selden's Debate on Dominion over the Seas, Journal of the History of Ideas, Volume 64, Number 3 (July 2003), pp. 361-377.

Wahl, Eugene R. and Caspar M. Ammann (2007) Robustness of the Mann, Bradley, Hughes reconstruction of Northern Hemisphere surface temperatures: Examination of criticisms based on the nature and processing of proxy climate evidence, Climate Change, Volume 85, Issue 1, November 2007, pp. 33-69.

Wang, Xueman and Glenn Wiser (2002) The Implementation and Compliance Regimes under the Climate Change Convention and its Kyoto Protocol, RECIEL, Volume 11, Number 2, p. 182.

Wara, Michael (2007) Is the global carbon marketing working? Nature, Volume 445 (8 February 2007), pp. 595-596.

Watts, Nick, W Neil Adger, Paolo Agnolucci, Jason Blackstock, Peter Byass, Wenjia Cai, Sarah Chaytor, Tim Colbourn, Mat Collins, Adam Cooper, Peter M Cox, Joanna Depledge, Paul Drummond, Paul Ekins, Victor Galaz, Delia Grace, Hilary Graham, Michael Grubb, Andy Haines, Ian Hamilton, Alasdair Hunter, Xujia Jiang, Moxuan Li, Ilan Kelman, Lu Liang, Melissa Lott, Robert Lowe, Yong Luo, Georgina Mace, Mark Maslin, Maria Nilsson, Tadj Oreszczyn, Steve Pye, Tara Quinn, My Svensdotter, Sergey Venevsky, Koko Warner, Bing Xu, Jun Yang, Yongyuan Yin, Chaoqing Yu, Qiang Zhang, Peng Gong, Hugh Montgomery, Anthony Costello (2015) Health and climate change: policy responses to protect public health, Lancet, Volume 386, Number 10006, 7 November 2015, pp. 1861-1914.

Weart, Spencer R. (2012) The Evolution of International Cooperation in Climate Science, Journal of International Organization Studies, Volume 3, Number 1, pp. 41-59.

Weart, Spencer R. (2013) The rise of interdisciplinary research on climate, Proceedings of the National Academy of Sciences, Volume 110, Supplement 1 (26 February 2013), p. 3663.

Weis, Tony (2010) The accelerating biophysical contraditions of industrial capitalist agriculture, Journal of Agrarian Change, Volume 10, Number 3, pp. 316-317.

Weiss, Edith Brown (2011) The Evolution of International Law, Japanese Yearbook of International Law, Volume 54 (2011), pp. 1-27.

White, Edward (1986) From Realism to Critical Legal Studies: A Truncated Intellectual History, Southwestern Law Journal, Volume 40, pp. 819-843.

Wijkman, P. M. (1982) Managing the Commons, International Organization, Volume 36, Number 3, pp. 511-536.

Wilson, S.K., N.J. Graham, M.S. Pratchett, G.P. Jones, and V.C. Polunin (2006) Multiple disturbances and the global degradation of coral reefs: are reef fishes at risk or resilient? Global Change Biology, Volume 12, Issue 11, pp. 2220-2234.

Winton, Michael (2008) Sea Ice-Albedo Feedback and Nonlinear Arctic Climate Change. In Arctic Sea Ice Decline: Observations, Projections, Mechanisms, and Implications, Geophysical Monograph Series 180 (2008), American Geophysical Union, pp. 111-131.

Wirth, David A. (2017) The Paris Agreement as a New Component of the UN Climate Regime, International Organizations Research Journal, Volume 14, Number 4, pp. 185-214.

Zaelke, Durwood and James Cameron (1990) Global Warming and Climate Change - An Overview of the International Legal Process, American University International Law Review, Volume 5, Number 2, pp. 249-290.

Zalasiewicz, Jan, Colin N. Waters, Mark Williams, Anthony D. Barnosky, Alejandro Cearreta, Paul Crutzen, Erle Ellis, Michael A. Ellis, Ian J. Fairchild, Jacques Grinevald, Peter K. Haff, Irka Hajdas, Reinhold Leinfelder, John McNeil, Eric O. Odada, Clément Poirier, Daniel Richter, Will Steffen, Colin Summerhayes, James P. M. Syvitski, Davor Vidas, Michael Wagreich, Scott L. Wing, Alexander P. Wolfe, ZhiSheng An and Naomi Oreskes (2015) When did the Anthropocene begin? A mid-twentieth century boundary level is stratigraphically optimal, Quaternary International, Volume 383 (5 October 2015), pp. 196-203.

Zalasiewicz, Jan, Mark Williams, Colin N. Waters, Anthony D. Barnosky and Peter Haff (2014) The technofossil records of humans, The Anthropocene Review, Volume 1, Issue 1, pp. 34-43.

Zhang, Yi Ge, Mark Pagani, Zhonghui Liu, Steven M. Bohaty and Robert DeConto (2013) A 40-million-year history of atmospheric CO_2, Philosophical Transactions of the Royal Society A, 371: 20130096.

Zhao Jimin (2002) The Multilateral Fund and China's Compliance with the Montreal Protocol, Journal of Environment and Development, Volume 11, Number 4, December 2002, pp. 331-354.

Zillman, John (2009) A History of Climate Activities, World Meteorological Organization, A History of Climate Activities, Bulletin Volume 58, Number 3 (2009).

Zwiers, Francis W., Xuebin Zhang and Yang Feng (2011) Anthropogenic Influence on Long Return Period Daily Temperature Extremes at Regional Scales, Journal of Climate, Volume 24, Issue 3, 1 February 2011, pp. 881-892.

IPCC

Beade, A.P.M. (2007) Annex 1: Glossary. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Bindoff, N.L., P.A. Stott, K.M. AchutaRao, M.R. Allen, N. Gillett, D. Gutzler, K. Hansingo, G. Hegerl, Y. Hu, S. Jain, I.I. Mokhov, J. Overland, J. Perlwitz, R. Sebbari and X. Zhang (2013) Detection and Attribution of Climate Change: from Global to Regional. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and

New York, NY, USA.

Church, J.A., P.U. Clark, A. Cazenave, J.M. Gregory, S. Jevrejeva, A. Levermann, M.A. Merrifield, G.A. Milne, R.S. Nerem, P.D. Nunn, A.J. Payne, W.T. Pfeffer, D. Stammer and A.S. Unnikrishnan (2013) Sea Level Change. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Ciais, P., C. Sabine, G. Bala, L. Bopp, V. Brovkin, J. Canadell, A. Chhabra, R. DeFries, J. Galloway, M. Heimann, C. Jones, C. Le Quéré, R.B. Myneni, S. Piao and P. Thornton (2013) Carbon and Other Biogeochemical Cycles. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Cubasch, U., D. Wuebbles, D. Chen, M.C. Facchini, D. Frame, N. Mahowald, and J.-G. Winther (2013) Introduction. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D.W. Fahey, J. Haywood, J. Lean, D.C. Lowe, G. Myhre, J. Nganga, R. Prinn, G. Raga, M. Schulz and R. Van Dorland (2007) Changes in Atmospheric Constituents and in Radiative Forcing. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (1988) Report of the First Session of the WMO/UNEP Intergovernmental Panel on Climate Change, World Meteorological Organization, Geneva.

IPCC (1990a) First Assessment Report. [Houghton, J. T., G. J. Jenkins, J. J. Ephraums, Tegart, WJ. McG., G. W. Sheldon, D. C. Griffiths and F. M. Bernthal (eds)], Digitized by the Digitization and Microform Unit, UNOG Library, 2010.

IPCC (1990b) Policymakers Summary: Formulation of the Response Strategies. In Climate Change: IPCC Response Strategies. Contribution of Working Group III to the First Assessment Report of the

Intergovernmental Panel on Climate Change [Federick M. Bernthal (ch.)], Digitized by the Digitization and Microform Unit, UNOG Library, 2010.

IPCC (1999) Aviation and the Global Atmosphere. Prepared in collaboration with the Scientific Assessment Panel to the Montreal Protocol on Substances that Deplete the Ozone Layer [J. E. Penner, D. H. Lister, D. J. Griggs, D. J. Dokken, M. McFarland (eds.)], Cambridge University Press, Cambridge, 373 pp.

IPCC (2007) Summary for Policymakers: Human and Natural Drivers of Climate Change. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2012) Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA.

IPCC (2013a) Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2013b) IPCC Factsheet: What is the IPCC? Intergovernmental Panel on Climate Change Secretariat, 30 August 2013.

IPCC (2014a) Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2014b) Climate Change 2014: Synthesis Report. In: Contribution of Working Groups I, II and III

to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

IPCC (2014c) Summary for Policymakers. In: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland.

IPCC (2017a) Organization, Intergovernmental Panel on Climate Change, World Meteorological Organization and United Nations Environmental Programme.

IPCC (2017b) Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (SR2): Background report for the scoping meeting. Working Group III Technical Support Unit, Inter-Governmental Panel on Climate Change (IPCC), London, UK.

IPCC (2018a) Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

IPCC (2018b) IPCC Special Report on Global Warming of 1.5°C: Frequently Asked Questions, IPCC SR1.5, Pre-trickle back version, 6 October 2018.

IPCC (2019) Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]. In press.

Jiménez Cisneros, B.E., T. Oki, N.W. Arnell, G. Benito, J.G. Cogley, P. Döll, T. Jiang, and S.S. Mwakalila (2014) Freshwater resources. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Le Treut, H., R. Somerville, U. Cubasch, Y. Ding, C. Mauritzen, A. Mokssit, T. Peterson and M. Prather (2007) Historical Overview of Climate Change. In Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Nicholls, R.J., P.P. Wong, V.R. Burkett, J.O. Codignotto, J.E. Hay, R.F. McLean, S. Ragoonaden and C.D. Woodroffe (2007) Coastal systems and low-lying areas. In Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.)]. Cambridge University Press, Cambridge, UK.

Porter, J.R., L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso (2014) Food security and food production systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Rhein, M., S.R. Rintoul, S. Aoki, E. Campos, D. Chambers, R.A. Feely, S. Gulev, G.C. Johnson, S.A. Josey, A. Kostianoy, C. Mauritzen, D. Roemmich, L.D. Talley and F. Wang (2013) Observations: Ocean. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Rochon, R., D. Attard and R. Beetham (1990) Legal and Institutional Mechanisms. In Climate Change: IPCC Response Strategies. Contribution of Working Group III to the First Assessment Report of the Intergovernmental Panel on Climate Change [Federick M. Bernthal (ch.)], Digitized by the Digitization and Microform Unit, UNOG Library, 2010.

Seneviratne, S. I., N. Nicholls, D. Easterling, C. M. Goodess, S. Kanae, J. Kossin, Y. Luo, J. Marengo, K. McInnes, M. Rahimi, M. Reichstein, A. Sorteberg, C. Vera, and X. Zhang (2012) Changes in climate extremes and their impacts on the natural physical environment. In Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, K. J. Mach, G.-K. Plattner, S. K. Allen, M. Tignor and

P. M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Smith J.B., H-J Schellnhuber, M. M. Q. Mirza, S. Fankhauser (Switzerland), R. Leemans, Lin Erda, L. Ogallo, B. Pittock, R. Richels, C. Rosenzweig, U. Safriel, R.S.J. Tol, J. Weyant, G. Yohe, W. Bond, T. Bruckner, A. Iglesias, A.J. McMichael, C. Parmesan, J. Price, S. Rahmstorf, T. Root, T. Wigley, K. Zickfeld (2001) Vulnerability to Climate Change and Reasons for Concern: A Synthesis. In Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change [C. Hope and S.K. Sinha (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Stocker, T.F., D. Qin, G.-K. Plattner, L.V. Alexander, S.K. Allen, N.L. Bindoff, F.-M. Bréon, J.A. Church, U. Cubasch, S. Emori, P. Forster, P. Friedlingstein, N. Gillett, J.M. Gregory, D.L. Hartmann, E. Jansen, B. Kirtman, R. Knutti, K. Krishna Kumar, P. Lemke, J. Marotzke, V. Masson-Delmotte, G.A. Meehl, I.I. Mokhov, S. Piao, V. Ramaswamy, D. Randall, M. Rhein, M. Rojas, C. Sabine, D. Shindell, L.D. Talley, D.G. Vaughan and S.-P. Xie (2013) Technical Summary. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Vaughan, D.G., J.C. Comiso, I. Allison, J. Carrasco, G. Kaser, R. Kwok, P. Mote, T. Murray, F. Paul, J. Ren, E. Rignot, O. Solomina, K. Steffen and T. Zhang (2013) Observations: Cryosphere. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Wong, P.P., I.J. Losada, J.-P. Gattuso, J. Hinkel, A. Khattabi, K.L. McInnes, Y. Saito, and A. Sallenger (2014) Coastal Systems and Low-Lying Areas. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

UNEP

Multilateral Fund (2018) Welcome to the Multilateral Fund for the Implementation of the Montreal Protocol, Secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol, United Nations Environmental Programme (UNEP), Nairobi, Kenya.

Ozone Secretariat (2007) Primer for Members, Implementation Committee Under the Non-Compliance Procedure of the Montreal Protocol on Substances that Deplete the Ozone Layer, October 2007, Ozone Secretariat, United Nations Environmental Programme (UNEP), Nairobi, Kenya.

Ozone Secretariat (2012) Handbook for the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme (UNEP), Nairobi, Kenya.

Ozone Secretariat (2018) Institutions: Assessment Panels, Ozone Secretariat, United Nations Environmental Programme (UNEP), Nairobi, Kenya.

Ozone Secretariat (2018) Institutions: Implementation Committee under the Non-Compliance Procedure of the Montreal Protocol, Ozone Secretariat, United Nations Environmental Programme (UNEP), Nairobi, Kenya.

Ozone Secretariat (2018) Kigali Amendment: Thirty Five Parties to the Montreal Protocol have Ratified, Ozone Secretariat, United Nations Environmental Programme (UNEP), Nairobi, Kenya.

Ozone Secretariat (2018) Treaties and Decisions: Status of Ratification, United Nations Environmental Programme (UNEP), Nairobi, Kenya.

UNEP (1972) Declaration of the United Nations Conference on the Human Environment, United Nations Environmental Programme, Stockholm, 16 June 1972 [hereinafter Stockholm Declaration].

UNEP (1976) Barcelona Convention for the Protection of the Mediterranean Sea against Pollution, 16 February 1976, United Nations Treaty Series, Volume 1102, p. 27 (No. 16908).

UNEP (1985) Vienna Convention for the Protection of the Ozone Layer, 22 March 1985, United Nations Treaty Series, Volume 1513, p. 293 (No. 26164).

UNEP (1987) The Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, 16 September 1987 [hereinafter Montreal Protocol], United Nations Treaty Series, Volume 1522, p. 3 (No. 26369).

UNEP (1990) Decision II/8: Financial Mechanism. In Report of the Second Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, UNEP/OzL.Pro.2/3, United Nations Environmental Programme, 27 June 1990.

UNEP (1991) Report of the Ad Hoc Working Group of Legal and Technical Experts on Biological Diversity on the Work of its Second Session, Ad Hoc Working Group of Legal and Technical Experts on Biological Diversity, United Nations Environmental Programme, 7 March 1991.

UNEP (1992) Decision IV/5: Non-Compliance Procedure. In Report of the Fourth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.4/15, 25 November 1992.

UNEP (1992) Annex V: Indicative list of measures that might be taken by a Meeting of the Parties in respect of Non-Compliance with the Protocol. In Report of the Fourth Meeting of the Parties to the

Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.4/15, 25 November 1992.

UNEP (1992) Annex VIII: Indicative List of Categories of Incremental Costs. In Report of the Fourth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.4/15, 25 November 1992.

UNEP (1992) Rio Declaration on Environment and Development, United Nations Conference on Environment and Development, Rio de Janeiro, June 3-14, 1992 [hereinafter Rio Declaration].

UNEP (1995) Decision VII/17. In Report of the Seventh Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.7/12, 27 December 1995.

UNEP (1995) Decision VII/18. In Report of the Seventh Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.7/12, 27 December 1995.

UNEP (1995) Decision VII/19. In Report of the Seventh Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.7/12, 27 December 1995.

UNEP (1996) Paragraph 1 to Annex V: Terms of the Technology and Economic Assessment Panel (TEAP). In Report of the Eighth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.8/12, 19 December 1996.

UNEP (1996) Paragraph 3.5 to Annex V: Terms of the Technology and Economic Assessment Panel (TEAP). In Report of the Eighth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Environmental Programme, UNEP/OzL.Pro.8/12, 19 December 1996.

UNEP (2012) One Planet, How Many People? A Review of Earth's Carrying Capacity, UNEP Global Environmental Alert Service (GEAS), June 2012, United Nations Environmental Programme, Nairobi, Kenya.

UNEP (2015) Ozone Secretariat: Treaties and Decisions: Status of Ratifications, United Nations Environmental Programme, Nairobi, Kenya.

UNEP (2016) 40 Decades of Environmental Leadership, United Nations Environmental Programme, Nairobi, Kenya.

UNEP (2017) Emissions Gap Report 2017: Executive Summary, United Nations Environmental Programme, Nairobi, Kenya.

UNEP (2018) Emissions Gap Report 2018: Executive Summary, United Nations Environmental Programme, Nairobi, Kenya.

UNEP (2018) Methyl Bromide, Ozone Action, United Nations Environmental Programme, Nairobi, Kenya.

UNFCCC

UNFCCC (1995) Annotations to the Provisional Agenda, Including Suggestions for the Organization of Work, FCCC/CP/1995/1, English, 20 March 1995.

UNFCCC (1995) Establishment of a multilateral consultative process for the resolution of questions regarding the implementation of the Convention, Decision 20/CP.1, FCCC/CP/1995/7/Add.1, English.

UNFCCC (1995) Decision 1/CP.4.

UNFCCC (1995) Decision 2/CP.4.

UNFCCC (1995) Decision 3/CP.4.

UNFCCC (1995) Decision 4/CP.4.

UNFCCC (1995) Decision 5/CP.4.

UNFCCC (1995) Decision 6/CP.4.

UNFCCC (1995) Decision 7/CP.4.

UNFCCC (1995) Decision 8/CP.4.

UNFCCC (1995) Part 1: Proceedings, Report of the Conference of the Parties on its First Session, held in Berlin from 28 March to 7 April 1995, FCCC/CP/1995/7, 24 May 1995.

UNFCCC (1995) Review of first communications from the Parties included in Annex I to the Convention, Decision 2/CP.1, FCCC/CP/1995/7/Add.1, English.

UNFCCC (1995) The Berlin Mandate: Review of the adequacy of Article 4, paragraph 2 (a) and (b), of the Convention, including proposals related to a protocol and decisions on follow-up, Decision 1/CP.1, FCCC/CP/1995/7/Add.1, English, 6 June 1995.

UNFCCC (1996) Report of the Conference of the Parties on its Second Session, held at Geneva from 8 July to 19 July 1996, FCCC/CP/1996/15, 29 October 1996.

UNFCCC (1996) Report of the Conference of the Parties on its Second Session, held at Geneva from 8 July to 19 July 1996, Addendum, Annex, FCCC/CP/1996/15/Add.1, 29 October 1996.

UNFCCC (1998) Multilateral consultative process, Decision 10/CP.4, Report of the Conference of Parties on its Fourth Session, held at Buenos Aires from 2 to 14 November 1998, FCCC/CP/1998/16/Add.1, 25 January 1999.

UNFCCC (1998) Review of the financial mechanism, Decision 3/CP.4, Report of the Conference of Parties on its Fourth Session, held at Buenos Aires from 2 to 14 November 1998, FCCC/CP/1998/16/Add.1, 25 January 1999.

UNFCCC (2001) Decisions 2-24/CP.7.

UNFCCC (2002) Decision 24/CP.7: Procedures and mechanisms relating to compliance under the Kyoto Protocol, Report of the Conference of the Parties on its Seventh Session, held at Marrakesh from 29 October to 10 November 2001, FCCC/CP/2001/13/Add.3, 21 January 2002.

UNFCCC (2005) Decision 1/CMP.1: Consideration of commitments for subsequent periods for Parties included in Annex I to the Convention under Article 3, paragraph 9, of the Kyoto Protocol,

FCCC/KP/CMP/2005/8/Add.1, 9-10 December 2005, p. 3.

UNFCCC (2006) Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005, Addendum, Part Two: Action taken by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol at its first session, Annex to Decision 27/CMP.1 on Procedures and Mechanisms Relating to Compliance under the Kyoto Protocol, 92, FCCC/KP/CMP/2005/8/Add.3, 30 March 2006 (hereinafter "Compliance Procedures").

UNFCCC (2008) Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007, Addendum, Part Two: Action taken by the Conference of the Parties at its thirteenth session.

UNFCCC (2009) Copenhagen Accord, Draft decision -/CP.15, FCCC/CP/2009/L.7, 18 December 2009.

UNFCCC (2010) Report of the Conference of the Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009, Addendum, Part Two: Action taken by the Conference of the Parties at its fifteenth session, Decision 2/CP.15, FCCC/CP/2009/11/Add.1, 30 March 2010, pp. 4-9 (hereinafter Copenhagen Accord).

UNFCCC (2010) Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 201, Addendum, Part Two: Action taken by the Conference of the Parties at its sixteenth session, Decision 1/CP.16, FCCC/CP/2010/7/Add.1, 15 March 2011 (hereinafter 'Cancun Agreements').

UNFCCC (2011) Decision 1/CMP 7, Paragraph 1, Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its seventh session, held in Durban from 28 November to 11 December 2011, Addendum, Part Two: Action taken by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol at its seventh session, FCCC/KP/CMP/2011/10/Add.1, 15 March 2012.

UNFCCC (2011) Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November to 11 December 2011, Addendum, Part Two: Action taken by the Conference of the Parties at its seventeenth session, FCCC/CP/2011/9/Add.1, 15 March 2012 (hereinafter Durban Platform for Enhanced Action).

UNFCCC (2012) Doha Amendment to the Kyoto Protocol, Doha, 8 December 2012, Decision 1/CMP.8.

UNFCCC (2014) First steps to a safer future: Introducing The United Nations Framework Convention on Climate Change, United Nations Framework Convention on Climate Change.

UNFCCC (2014) Report of the Conference of the Parties on its nineteenth session, held in Warsaw from 11 to 23 November 2013, Addendum, Part two: Action taken by the Conference of the Parties at its nineteenth session, Decision 1/CP.19 2(b), FCCC/CP/2013/10/Add.1, 31 January 2014.

UNFCCC (2014) Status of Ratification of the Convention, United Nations Framework Convention on Climate Change.

UNFCCC (2016) Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015, Addendum: Part two: Action taken by the Conference of the Parties at

its twenty-first session, FCCC/CP/2015/10/Add.1, 26 January 2016.

UNFCCC (2018) Amendment to Annex B of the Kyoto Protocol, Process and Meetings: The Kyoto Protocol, United Nations Climate Change.

UNFCCC (2018) Doha Amendment, Process and Meetings, Kyoto Protocol, United Nations Framework Convention on Climate Change (UNFCCC).

UNFCCC (2018) The Paris Agreement: essential elements, Process and Meetings: The Paris Agreement, United Nations Framework Convention on Climate Change (UNFCCC).

UNFCCC (2019) Decisions adopted at the Climate Change Conference in Katowice, Poland, 2-14 December 2018, United Nations Climate Change.

UNFCCC Secretariat (2019) Foreword by Patricia Espinoza, Executive Secretary of UN Climate Change, Climate Action and Support Trends, United Nations Climate Change.

UNFCCC (2019) Kyoto Protocol – Status of Ratification, United Nations Climate Change.

UNFCCC (2019) Nationally Determined Contributions (NDCs): Intended Nationally Determined Contributiions (INDCs), United Nations Framework Convention on Climate Change.

UNFCCC (2019) Process and Meetings: Conference, United Nations Climate Change.

UNFCCC (2019) Status of Ratification of the Convention, United Nations Climate Change.

UNFCCC (2019) What is the Kyoto Protocol? United Nations Climate Change.

UNFCCC (2019) What is the Paris Agreement? United Nations Framework Convention on Climate Change.

United Nations

Ban Ki Moon (2007) High-Level Event on Climate Change with the Secretary General, President of Indonesia and the Executive Secretary of the UN Framework Convention on Climate Change, United Nations Secretary-General Press Conference, 24 September 2007.

UNCTAD (2016) Module 3: The Economics of Climate Change. In: Trade, the Environment and Sustainable Development: Transition to a Low-Carbon Economy, Virtual Institute Teaching Material, United Nations Conference on Trade and Development, UNCTAD/GDS/2016/2.

UNDESA (2019) Sustainable Development Goals, Division for Sustainable Development Goals, Department of Economic and Social Affairs, United Nations.

UNDP (2019) Sustainable Development Goals, United Nations Development Programme.

UNECE (2004) 1979-2004: Twenty five years of International Cooperation on the Convention on Long-range Transboundary Air Pollution, Secretariat for the Convention on Long-range Transboundary Air Pollution, United Nations Economic Commission on Europe, Geneva, Switzerland.

UNECE (2012) Status of ratification of the 1979 Geneva Convention on Long-range Transboundary Air Pollution as of 24 May 2012.

UNECE (2018) The Air Convention and its Protocols: Protocols, United Nations Economic Commission

for Europe.

UNGA (1948) Universal Declaration of Human Rights, General Assembly Resolution 217A (III), 183rd Plenary Meeting, UN Doc A/810 at 71 (1948).

UNGA (1961) Resolution 1721 (XVI): International cooperation in the peaceful uses of outer space, United Nations General Assembly, 1085th Plenary Meeting, 20 December 1961.

UNGA (1962) Resolution 1802 (XVII): International cooperation in the peaceful uses of outer space, United Nations General Assembly, 1192nd Plenary Meeting, 14 December 1962.

UNGA (1966) International Covenant on Civil and Political Rights, General Assembly Resolution 2200A (XXI) of 16 December 1966, 999 UNTS 171, 6 ILM 368.

UNGA (1966) International Covenant on Economic, Social and Cultural Rights, General Assembly Resolution 2200A (XXI) of 16 December 1966, 993 UNTS 3.6 ILM 360.

UNGA (1968) Resolution 2398 (XXIII): Problems of the human environment, United Nations General Assembly, 1733rd Plenary Meeting, 3 December 1968.

UNGA (1970) Declaration of Principles Governing the Sea-Bed and the Ocean Floor, and the Sub-soil thereof, beyond the Limits of National Jurisdiction, United Nations General Assembly Resolution A/RES/25/2749, 12 December 1970.

UNGA (1972) Institutional and financial arrangements for international environmental cooperation, United Nations General Assembly Resolution A/RES/27/2997, 15 December 1972.

UNGA (1974) Declaration for the Establishment of a New International Economic Order, United Nations General Assembly Resolution A/RES/S-6/3201, 1 May 1974.

UNGA (1983) Process of Preparation of the Environmental Perspectives to Year 2000 and Beyond, United Nations General Assembly Resolution A/RES/38/161, 19 December 1983, Meeting No. 102.

UNGA (1986) Declaration on the Right to Development, United Nations General Assembly Resolution, A/RES/41/128, 4 December 1986.

UNGA (1987) Report of the World Commission on Environment and Development, United Nations General Assembly Resolution A/RES/42/187, 11 December 1987, 96th Plenary Meeting.

UNGA (1988) A/RES/43/53, United Nations General Assembly, 6 December 1988.

UNGA (1989) United Nations Conference on Environment and Development, United Nations General Assembly Resolution, A/RES/44/228, 85th plenary meeting, 22 December 1989.

UNGA (1990) Protection of Global Climate for Present and Future Generations of Mankind, United Nations General Assembly Resolution, A/Res/45/212, 71st Plenary Meeting, 21 December 1990.

UNGA (1992) Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests. In Annex III of the Report of the United Nations Conference on Environment and Development, Rio de Janeiro, June 3-14, 1992, A/CONF.151/26 (Vol. III), 14 August 1992.

UNGA (1994) United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, United Nations General Assembly, New York, A/AC.241/27, 12 September 1994.

UNGA (2001) Reference document on the participation of civil society in United Nations conferences and special sessions of the General Assembly during the 1990s, Prepared by Office of the President of the Millennium Assembly, 55th session of the United Nations General Assembly, 1 August 2001.

UNGA (2005) 2005 World Summit Outcome, United Nations General Assembly Resolution, A/Res/60/1, 24 October 2005.

UNGA (2012) The Future We Want, United Nations General Assembly Resolution, A/Res/66/288, 11 September 2012.

UNGA (2015) Transforming our World: the 2030 Agenda for Sustainable Development, United Nations General Assembly, New York, A/RES/70/1, 21 October 2015.

UNODC (2017) World Drug Report 2017, United Nations Office on Drugs and Crime (UNODC), Vienna, Austria.

United Nations (1951) Chile: Presidential Declaration concerning continental shelf, 23 June 1947, Chapter 1: National Legislation, Part I: Continental Shelf, Book 1: Laws and Regulations on the Regime of the High Seas, Volume 1 (1951).

United Nations (1951) Peru: Presidential Decree No. 781, concerning submerged continental or insular shelf, 1 August 1947, Chapter 1: National Legislation, Part I: Continental Shelf, Book 1: Laws and Regulations on the Regime of the High Seas, Volume 1 (1951).

United Nations (1972) Report of the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972, United Nations, A/CONF.48/14/Rev.1.

United Nations (1990) Resolution 44/23, 17 November 1989, Resolutions and Decisions adopted by the General Assembly during its Forty-Fourth Session, Volume 1, 19 September 1989 to 29 December 1989, Supplement No. 49 (AQ/44/49).

United Nations (2001) Governments Adopt Bonn Agreement on Kyoto Protocol Rules, Press Release ENV/DEV/594, 23 July 2001.

United Nations (2012) United Nations Convention on the Law of the Sea: A Historical Perspective, Division for Ocean Affairs and Law of the Sea, Office of Legal Affairs, United Nations.

United Nations (2015) World Population Prospects: The 2015 Revision: Key Findings and Advance Tables, Population Division, Department of Economic and Social Affairs, United Nations, New York, NY, USA.

United Nations (2018) Agenda 21, UNCED 1992, Sustainable Development Knowledge Platform, Department of Social and Economic Affairs, United Nations.

United Nations (2018) Subsidiary Body for Scientific and Technological Advice (SBSTA), United Nations Framework Convention for Climate Change, United Nations, New York.

United Nations (2018) United Nations Conference on Environment and Development (UNCED), Earth Summit, Sustainable Development Knowledge Platform, Department of Social and Economic Affairs, United Nations.

United Nations (2018) United Nations Conference on Sustainable Development, Rio+20, Sustainable

Development Knowledge Platform, Department of Social and Economic Affairs, United Nations.

United Nations (2018) United Nations Sustainable Development Summit, Sustainable Development Knowledge Platform, Department of Social and Economic Affairs, United Nations.

United Nations (2018) World Summit on Sustainable Development (WSSD), Johannesburg Summit, Sustainable Development Knowledge Platform, Department of Social and Economic Affairs, United Nations.

United Nations (2019) Climate Action Summit 2019: A Race We Can Win.

UN Secretary-General (2004) Entry into Force of Kyoto Protocol, Following Russia's Ratification, Historic Step Forward to Combat Global Warming, Secretary-General says in Nairobi, SG/SM/9599-ENV/DEV/797, 18 November 2019.

UN Secretary-General (2007) Message on the International Day for the Preservation of the Ozone Layer, United Nations, New York, 16 September 2007.

UN Secretary-General (2008) More than just talk, International Herald Tribune (France), 17 June 2008.

WCED (1987) Report of the World Commission on Environment and Development: Our Common Future, World Commission on Environment and Development (WCED) [Gro Harlem Brundtland (chair)], United Nations, New York, 300 pp.

WSSD (2002) Draft plan of implementation of the World Summit on Sustainable Development, World Summit on Sustainable Development (WSSD), A/CONF.199/L.1 (26 June 2002).

UN Specialized Agencies

FAO (2018) Fish projections in the OECD-FAO Agricultural Outlook 2017-2026, GLOBEFISH – Analysis and Information on world fish trade, Food and Agriculture Organization (FAO) of the United Nations.

GATT (1994) General Agreements on Tariffs and Trade 1994, Legal texts: the WTO agreements, World Trade Organization.

GEF (2016) 25 Years of the GEF, Global Environment Facility (GEF), World Bank, United Nations Development Programme (UNDP) and United Nations Environment Progamme (UNEP).

ICAO (2007) Resolution A36-22, Consolidated statement of continuing ICAO policies and practices related to environmental protection, Resolutions Adopted by the Assembly, 36th Assembly, Appendix K, Montreal, 18 – 28 September 2007, Provisional Edition, September 2016, ICAO.

ICAO (2016) Resolution A39-03, Resolutions Adopted by the Assembly, 39th Assembly, Montreal, 27 September – 6 October 2016, Provisional Edition, October 2016, ICAO.

ICAO (2018) Top 3 misconceptions about CORSIA, Environmental Protection, ICAO.

ICJ (2019) Statute of the International Court of Justice (ICJ).

IMF (2008) GDP Nominal Data, World Economic Outlook Database, April 2018.

IMF (2015) IMF World Economic Outlook Database 2015, International Monetary Fund.

WMO (1979) Declaration of the World Climate Conference, World Meteorological Organization,

IOC/SAB-IV/INF.3.

WMO (1986) Report of the International Conference on the Assessment of the Role of Carbon Dioxide and of other Greenhouse Gases in Climate Variations and Associated Impacts, Villach, Austria, 1985, WMO No. 661, WMO/UNEP/ICSU.

WMO (1989) Proceedings of the World Conference on the Changing Atmosphere: Implications for Global Security, Toronto, Canada, 27-30 June 1988, WMO No. 710, World Meteorological Organization, Geneva; United Nations Environmental Programme, Nairobi; p. 296.

WMO (2012) WMO Greenhouse Gas Bulletin, Number 8, 19 November 2012, World Meteorological Organization.

WMO (2016) History of IMO, World Meteorological Organization.

WMO (2018) Greenhouse gas levels in atmosphere reach new record, Press Release Number 22112018, 20 November 2018, World Meteorological Organization.

World Bank (2013) Resilient Coastal Cities June 2013 The Economic, Social and Environmental Dimensions of Risk, World Bank, Caribbean Knowledge Series (June 2013).

World Bank (2014) A Wicked Problem: Controlling Global Climate Change, Feature Story, Mike Toman, The World Bank, 30 September 2014.

World Bank (2014) Turn Down the Heat: Confronting the New Climate Normal, World Bank Group, Washington, DC, USA.

World Bank (2018) Gross Domestic Product 2018: GDP Ranking, World Bank Group.

WTO (2018) Trade and Environment, World Trade Organization.

United States

Statement on the Convention on the Law of the Sea, 18 WEEKLY COMP. PRES. Doc. 887 (1982).

Statement by the President, 18 WEEKLY COMP. PRES. D3c: 94 (Jan. 29, 1982).

Statement by the President, 10 March 1983, Proclamation No. 5030, 48 Federal Register, 10,605 (1983).

Title IV of the Clean Air Act, 42 USC 7651.

US President Harry S. Truman (1945) 1945 US Presidential Proclamation No. 2667, Policy of the United States with Respect to the Natural Resources of the Subsoil and Sea Bed of the Continential Shelf, Washington, USA, 28 September 1945.

US President John F. Kennedy (1961) Address at the United Nations General Assembly, 25 September 1961, John F. Kennedy Presidential Library and Museum.

US President George W. Bush (2001) Text Of A Letter From The President To Senators Hagel, Helms, Craig, and Roberts, The White House, Office of the Press Secretary, 13 March, 2001.

US President Barack Obama (2014) State of the Union Address, 28 January 2014.

US Senate (1997) Senate Resolution 98, 25 July 1997, 105th Congress Session (1997-1998), USA.

European Union

Council of the European Union (2011) Council Conclusion 15353/11, 10 October 2011.

EASAS (2018) New data confirm increased frequency of extreme weather events, European national science academies urge further action on climate change adaptation, European Academies Science Advisory Council, 21 March 2018.

Eur-Lex (2019) Subsidiarity, Glossaries of Summaries, Summaries of EU Legislation, Access to European Union Law.

Europa (2008) Summary of Treaty: Montreal Protocol on substances that deplete the ozone layer, Treaties Office Databse, Europe External Action Service, 16/05/2008.

European Commission (2007) The Montreal Protocol, Luxembourg: Office for Official Publications of the European Communities.

Netherlands Ministry of Housing, Physical Planning and Environment (1989) Noordwijk Conference Report, Ministerial Conference on Atmospheric Pollution and Climate Change, 6-7 November 1989, Noordwijk, Netherlands, organized by the Minister of Housing, Physical Planning, and Environment of the Netherlands in cooperation with UNEP and WMO.

Other Countries

ASEAN (1990) Kuala Lumpur Accord on Environment and Development, Association of South East Asian Nations, 19 June 1990.

ASEAN (2002) Agreement on Transboundary Haze Pollution, Association of South East Asian Nations, 10 June 2002.

ASEAN (2015) Status of ratification of the 2002 Agreement on Transboundary Haze Pollution as of 20 January 2015, Association of South East Asian Nations.

Bureau of Meteorology (2017) The Southern Annular Mode (SAM), Australian Government Bureau of Meteorology.

Department of Statistics (2018) Environment: Air Quality and Climate: M890191 - Air Temperature And Sunshine, Relative Humidity And Rainfall, Annual, Government of Singapore.

Treaties

ATS (2013) Antarctic Treaty, 1 December 1959, Article IV.1, Antarctic Treaty Secretariat, Buenos Aires, Argentina.

Canada-United States of America: Convention for the Protection of Migratory Birds in the United States and Canada, 16 August 1916, in Charles Bevan, Treaties and Other International Agreements of the United States of America 1776-1949, Volume 12, p. 375 (Treaty Series No. 628).

Canada-United States: Great Lakes Water Quality, 22 November 1978, United States treaties and Other

International Agreements, Volume 30, p. 1383.

Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (1984), New York, 10 December 1984, No. 24841, United Nations Treaty Series, Volume 1465, p. 85.

Convention for the Protection of Birds Useful to Agriculture, 19 March 1902, in Clive Parry (ed.), Consolidated Treaty Series, Volume 191, p. 91.

International Convention for the Prevention of Pollution of the Sea by Oil, 12 May 1954, in United Nations Treaty Series, Volume 327, p. 3 (No. 4714).

International Convention for the Regulation of Whaling (1946) United Nations Treaty Series, Volume 161, No. 2124, 2 December 1946.

London Convention for the Protection of Wild Animals, Birds and Fish in Africa, 19 May 1900, in British and Foreign State Papers, Volume 94, p. 715.

Treaty for the Preservation and Protection of Fur Seals, 7 June 1911, in Statues at Large of the United States of America, Volume 37, p. 1542.

UNCLOS II (1960) Final Act of the Second United Nations Conference on the Law of the Sea, A/CONF.19/L.15, Geneva, Switzerland 17 March – 26 April 1960.

UNECE (1979) Economic Commission for Europe Convention on Long-Range Transboundary Air Pollution (LRTAP), 13 November 1979, E/ECE/1010 (1979), United Nations Treaty Series, Volume 1302, p. 217 (No. 21623).

UNECE (1999) Gothenburg Ministerial Declaration. In the Report of the Seventeen Session of the Executive Body, Annex II, ECE/EB.AIR/68, 27 December 1999.

UNECE (2016) The 1979 Geneva Convention on Long-range Transboundary Air Pollution, United Nations Economic Commission on Europe, 2016.

United Nations (1945) Charter of the United Nations, San Francisco, CA, USA, 26 June 1945.

United Nations (1969) Vienna Convention on the Law of Treaties, Vienna, 23 May 1969.

United Nations (1982) United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982 [hereinafter UNCLOS III].

United Nations (1992) Convention on Biological Diversity, Rio de Janeiro, 5 June 1992, United Nations Treaty Series, Volume 1760, p. 79 (No. 30619).

United Nations (1992) United Nations Framework Convention on Climate Change, United Nations, New York, 9 May 1992.

United Nations (1998) Kyoto Protocol to the United Nations Framework Convention on Climate Change, United Nations, Kyoto, 11 December 1997, United Nations Treaty Series, Volume 2303, p. 162 (No. 30822).

United Nations (2015a) Adoption of the Paris Agreement, Decision 1/CP.21, Annex to Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015, Addendum: Part two: Action taken by the Conference of the Parties at its twenty-first session, FCCC/CP/2015/10/Add.1, 26 January 2016.

UNTC (2019) Law of the Sea, Chapter XXI, Status as at: 09 September 2019, United Nations Treaty Collection.

VCLT (1969) Vienna Convention on the Law of Treaties (VCLT), Vienna, 23 May 1969, No. 18232, United Nations Treaty Series.

Vienna Convention on Civil Liability for Nuclear Damage, 21 May 1963, in United Nations Treaty Series, Volume 1063, p. 265 (No. 16197).

Washington Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, 12 October 1940, in United Nations Treaty Series, Volume 161, p. 193 (no. 485).

Washington International Convention for the North-West Atlantic Fisheries, 8 February 1949, in United Nations Treaty Series, Volume 157, p. 157 (No. 2053).

Washington International Treaties for the Regulation of Whaling, 2 December 1946, in United Nations Treaty Series, Volume 161, p. 72 (No. 2124).

Washington Treaty Relating to Boundary Waters between the United States and Canada, 11 January 1909, in Charles Bevans, Treaties and Other International Agreements of the United States 1776-1949, Volume 12, p. 319 (Treaty Series No. 548).

WHO (2003) World Health Organization Framework Convention on Tobacco Control, 16 June 2003, United Nations Treaty Series, Volume 2302, p. 166 (No. 41032).

Court Cases

Alejandro Alvarez (1948) diss op. ICJ: Admission of a State to the United Nations, Reports 1947-1848, p. 68.

Alejandro Alvarez (1950) diss. op. ICJ: Competence of the General Assembly Case, Reports 1950, p. 12.

Barcelona Traction (Second Phase), Reports, 1970, p. 3.

ICJ (1969) North Sea Continental Shelf, Reports, 1969, p. 3.

ICJ (1996) Legality of the Threat of Nuclear Weapons, Advisory Opinion, ICJ Reports 1996, p. 226.

ICJ (1996) Threat or Use of Nuclear Weapons, Reports, 1996.

PICJ (1927) Case of the SS Lotus, Series A, 10, 1927.

ICJ (1997) Gabcikovo-Nagymaros Project (Hungary v. Slovakia), Judgement, ICJ Reports 1997, p. 7.

Trail Smelter Case (United States v. Canada), Ad Hoc International Arbitral Tribunal, 11 March 1941. In United Nations Reports of International Arbitral Awards, Volume 3 (1949), p. 1938.

News Reports

Bannon, Eoin (2016) Global Aviation CO2 Deal Adopted With Mixed Results, Just As Paris Agreement Takes Off, International Coalition for Sustainable Aviation (ICSA), 6 October 2016.

Black, Richard (2009) Why did Copenhagen fail to deliver a climate deal? BBC News, 22 December 2009.

Booker, Christopher (2008) Global warming: Reasons why it might not actually exist, The Telegraph, 30 December 2008.

Cama, Timothy and Devin Henry (2017) Trump: we are getting out of Paris climate deal, The Hill, 1 June 2017.

Carrington, Damian (2018) Mysterious rise in banned ozone-destroying chemical shock scientists, The Guardian, 16 May 2018.

CBC News (2010) The world's worst natural disasters: Calamities of the 20th and 21st centuries, CBC, 31 August 2010 (updated).

Chalkin, Andrew (2018) Who Took the Earthrise Photo from Apollo 8:The mission returned to Earth with one of the most famous images in history, Smithsonian Magazine, January 2018, Smithsoninan.com.

Chemnick, Jean (2015) How Paris may succeed where Copenhagen failed, Paris Climate Talk, 11 December 2015.

Chestney, Nina (2019) Global carbon emissions hit record high in 2018: IEA, Reuters, 26 March 2019.

Cooper, Helene (2009) Leaders Will Delay Deal on Climate Change, The New York Times, 14 November 2009.

Crouch, David (2018) The Swedish 15-year-old who's cutting class to fight the climate crisis, The Guardian, 1 September 2018.

Deen, Thalif (2015) U.S. Lifestyle is Not Up for Negotiation, Inter Press Service: News Agency, 1 May 2012.

Elliot, Larry (2018) US economists win Nobel prize for work on climate and growth, The Guardian, 8 October 2018.

Feldstein, Martin S., Ted Halstead and N. Gregory Mankiw (2018) A Conservative Case for Climate Action, Opinion, The New York Times, 8 February 2017.

Goodman, Amy (2016) Noam Chomsky: The Two Biggest Threats Facing the Survival of Humanity, Alternet, 16 May 2016.

Guterres, Antonio (2018) Climate change: An existential threat to humanity, Keynote address to R20 Austrian World Summit, 15 May 2018, Vienna, Austria.

Guterres, Antonio (2018) Secretary-General's press encounter on climate change [with Q&A], United Nations Secretary-General, United Nations, 29 March 2018.

Harvey, Fiona (2018) Climate change aid to poor nations lags behind Paris pledges, The Guardian, 3 May 2018.

Kaplan, Sarah (2018) These whales will be extinct in 25 years, scientists say — unless we act now to save them, The Washington Post, 20 April 2018.

Kazan, Liz (2018) 5 Surprising Stats Show Why High Seas Need Protection: Region covers two-thirds of the ocean and supports millions of species—including ours, PEW, 7 June 2018.

Knaus, Christopher and Nick Evershed (2017) Great Barrier Reef at terminal stage: scientists despair at latest coral bleaching data, The Guardian, 9 April 2017.

Lott, Trent and John Breaux (2018) Here's How to Break the Climate Impasse, Opinion, The York Times, 20 June 2018.

McCarthy, Shawn and Eric Reguly (2015) Catherine McKenna pushes for 1.5 C target in Paris climate talks, The Globe and Mail, 6 December 2015.

McGrath, Matt (2019) Climate change: Electrical industry's 'dirty secret' boosts warming, BBC News online, 13 September 2019.

Monbiot, George (2016) Neoliberalism – the ideology at the root of all our problems, The Guardian, 15 April 2016.

Phillips, Tom, Fiona Harvey and Alan Yuhas (2015) Breakthrough as US and China agree to ratify Paris climate deal, The Guardian, 3 September 2016.

Plumer, Brad (2016) 197 countries just agreed to phase out HFCs — a potent greenhouse gas in air conditioners, Vox, 15 October 2016.

Readfearn, Graham (2013) Climate sceptics more likely to be conspiracy theorists and free market advocates, study claims, The Guardian, 2 October 2013.

Reuters (1983) Around the World; Acid Rain Study On Scandinavian Lakes, The New York Times, 6 September 1983.

Reuters (2016) FACTBOX-Climate change proposals for Exxon, Chevron shareholders, Reuters Commodities, 26 May 2016.

Rich, Nathaniel (2018) Losing Earth: The Decade We Almost Stopped Climate Change, The New York Times Magazine, 1 August 2018.

Russell, Gordon (2005) Nagin orders first-ever mandatory evacuation of New Orleans, the Times-Picayune, 28 August 2005.

Stiglitz, Joseph (2002) The Chilean Miracle: Combining Markets with Appropriate Reform, Commanding Heights Interview, Public Boardcasting Service, Arlington, VA, USA.

Straits Times (2019) Firefighters in Bolivia lose hope of taming blazes as burned area doubles, The Straits Times online, 24 September 2019.

Straits Times (2019) Toxic air from fires in Indonesia putting 10m kids at risk: UN, The Straits Times online, 25 September 2019.

The Economist (2013) Climate Science: A Sensitive Matter, The Economist, 30 March 2013.

The Economist (2018) India shows how hard it is to move beyond fossil fuels, The Economist, Briefing on the black hole of coal, 2 August 2018.

Unger, David J. (2013) Billion-dollar weather: The 10 most expensive US natural disasters, the Christian Science Monitor, 27 June 2013.

United Nations Security Council (2019) Climate change recognized as 'threat multiplier', UN Security Council debates its impact on peace, UN News, 25 January 2019.

Vidal, John (2009) Rich nations failing to meet climate aid pledges, The Guardian, 20 February 2009.

Vidal, John (2009) Copenhagen climate summit in disarray after 'Danish text' leak, The Guardian, 8 December 2009.

Wasmi, Naser Al (2017) UAE's coastal cities at high risk from rising sea levels, The National, Friday, 21 April 2017.

Watson, John S. (2016) Why I think oil and natural gas are indispensable for the foreseeable future. Interview with LinkedIn Executive Editor Dan Roth, 30 August 2016.

Watts, Jonathan (2010) Copenhagen destroyed by Danish draft leak, says India's environment minister, The Guardian, 12 April 2010.

Yellen, Janet L. and Ted Halstead (2018) The Most Ambitious Climate Plan In History, Commentary, Environment, Fortune Magazine, 10 September 2018.

Other Reports and Documents

Abbott, Kenneth W. (2011) The Transnational Regime Complex for Climate Change, Version 2 (November 2011), Arizona State University, Tempe, AZ, USA, pp. 31-32.

Almeida, Miguel Ozorio de (1972) Environment and Development: The Founex Report on Development and Environment [1971], Carnegie Endowmnet for International Peace, Washinton, DC, USA, 84 pp.

Arendt, A., A. Bliss, T. Bolch, J.G. Cogley, A.S. Gardner, J.-O. Hagen, R. Hock, M. Huss, G. Kaser, C. Kienholz, W.T. Pfeffer, G. Moholdt, F. Paul, V. Radić, L. Andreassen, S. Bajracharya, N.E. Barrand, M. Beedle, E. Berthier, R. Bhambri, I. Brown, E. Burgess, D. Burgess, F. Cawkwell, T. Chinn, L. Copland, B. Davies, H. De Angelis, E. Dolgova, L. Earl, K. Filbert, R. Forester, A.G. Fountain, H. Frey, B. Giffen, N. Glasser, W.Q. Guo, S. Gurney, W. Hagg, D. Hall, U.K. Haritashya, G. Hartmann, C. Helm, S. Herreid, I. Howat, G. Kapustin, T. Khromova, M. König, J. Kohler, D. Kriegel, S. Kutuzov, I. Lavrentiev, R. LeBris, S.Y. Liu, J. Lund, W. Manley, R. Marti, C. Mayer, E.S. Miles, X. Li, B. Menounos, A. Mercer, N. Mölg, P. Mool, G. Nosenko, A. Negrete, T. Nuimura, C. Nuth, R. Pettersson, A. Racoviteanu, R. Ranzi, P. Rastner, F. Rau, B. Raup, J. Rich, H. Rott, A. Sakai, C. Schneider, Y. Seliverstov, M. Sharp, O. Sigurðsson, C. Stokes, R.G. Way, R. Wheate, S. Winsvold, G. Wolken, F. Wyatt, N. Zheltyhina (2015) Randolph Glacier Inventory – A Dataset of Global Glacier Outlines: Version 5.0. Global Land Ice Measurements from Space, Digital Media, Boulder, Colorado, USA.

Bannon, Eoin (2016) Global Aviation CO2 Deal Adopted With Mixed Results, Just As Paris Agreement Takes Off, International Coalition for Sustainable Aviation (ICSA), 6 October 2016.

Bay, Michael (1998) Armageddon, Jerry Bruckheimer, Gale Anne Hurd & Michael Bay (Producers), Touchstone Pictures, USA.

Bergstrom, S., D. Black, N. P. Bochkov, S. Eklund, R. J. H. Kruisinga, A. Leaf, O. Obasanjo, I. Shigematsu, M. Tubiana, and G. Whittembury (1983) Effects of Nuclear War on Health and Health Services, Report of the International Committee of Experts in Medical Sciences and Public Health, World Health Organization, World Health Organization Pub. A36.12, Geneva, Switzerland.

BIC (2019) A Global Community: Websites and contact information, Baha'i International Community (BIC).

BIC (2019) What Baha'is Believe, Baha'i International Community (BIC).

Black, Duncan (1996) International Trade and the Montreal Protocol, 1 June 1996, Brookings Institute Press, Washington, DC, USA, 118 pp, pp. 105-114.

Bloomberg, Michael R., Henry M. Paulson, Jr., Thomas F. Steyer, Henry Cisneros, Gregory Page, Robert E. Rubin, George P. Shultz, Donna E. Shalala, Olympia Snowe and Alfred Sommer (2014) Risky Business: The Economic Risks of Climate Change in the United States, Risky Business Project, Risky Business, June 2014, p. 24.

Bodansky, Daniel (2012) The Durban Platform: Issues and Options for a 2015 Agreement, Center for Climate and Energy Solutions, Arlington, VA, USA, p. 1.

BP (2015) BP Statistical Review of World Energy 2015, British Petroleum.

Buontempo, Carlo, Ben Booth, Dave Rowell and Wilfran Moufouna-Oki (2010) Sahelian climate: past, current; projections, Met Office, Exeter, UK, p. 5.

Burke, Lauretta Burke, Kathleen Reythar, Mark Spalding and Alison Perry (2011) Reefs at Risk Revisited, World Research Institute, Washington, DC, p. 1.

C2ES (2019) Paris Agreement: Q&A, Center for Climate and Energy Solutions, Arlington, VA, USA.

Carbon Brief (2018) COP24: Key outcomes agreed at the UN climate talks in Katowice, Carbon Brief, 16 December 2018.

CED (2015) Crony Capitalism: Unhealthy Relations between Business and Government, Committee for Economic Development of the Conference Board, Arlington, VA, USA.

Chakrabarty, Dipesh (2015) The Human condition in the Anthropocene, Lecture II, The Tanner Lectures in Human Values (18-19 February 2015), Yale University, New Haven, CT, USA, p. 179.

Chowdhury, Saber Hossain and Collin Challen (2009) Climate change equity: is it a plan, an aspiration or a fashion statement? A Report of a Joint Inquiry by Bangladesh Parliament's All Party Group on Climate Change and Environment and the UK All Party Parliamentary Climate Change Group, Dhaka, London and Copenhagen, December 2009, p. 7.

Climate Leadership Council (2018) Foreword. In Exceeding Paris: How the Baker-Shultz Plan Would Significantly Exceed the U.S. Paris Commitments, September 2018.

Coady, David, Ian Parry, Louis Sears, and Baoping Shang (2015) How Large Are Global Energy Subsidies? International Monetary Fund, Fiscal Affairs Department, WP/15/105, May 2015.

Cogswell, Nathan and Yamide Dagnet (2019) Why Does the Paris Climate Agreement Need a Rulebook? 7 Questions and Answers, World Resources Institute, 13 June 2019.

Cole, Daniel H. (2011) From Global to Polycentric Climate Governance, EUI Working Paper RSCAS 2011/30, European University Institute, Florence, Italy, p. 1.

Deudney, Daniel and G. John Ikenberry (2012) Democratic Internationalism: An American Grand Strategy for a Post-exceptionalist Era, Working Paper, November 2012, International Institutions and Global Governance Program, Council on Foreign Relations, New York, NY, USA.

Dooley, J. J. (2008) U.S. Federal Investments in Energy R&D: 1961-2008, PNNL-17952 (October 2008), Pacific Northwest National Laboratory, US Department of Energy, pp. 11-13.

EIA (2013) EIA Energy International Outlook 2013 with Projections to 2040, United States Energy Information Administration.

Eija Ritta Korhola (2014) The Rise and Fall of the Kyoto Protocol: Climate Change as a Political Process, Academic Dissertation, Faculty of Biological and Environmental Science, University of Helsinki, Helsinki, p. 24.

Ellen Gray (2018) Unexpected future boost of methane possible from Arctic permafrost, NASA Global Climate Change, NASA's Earth Science New Team, 20 August 2018.

EPA (2014) Overview of Greenhouse Gas Emissions. In: Climate Change, United States Environmental Protection Agency.

EPA (2016) Climate Change Indicators in the United States: Atmospheric Concentrations of Greenhouse Gases, United States Environmental Protection Agency, updated April 2016.

EPA (2017) International Actions - The Montreal Protocol on Substances that Deplete the Ozone Layer, United States Environmental Protection Agency.

Fairbridge, Rhodes W. and Larry D. Agenbroad (2018) Holocene Epoch, Encyclopaedia Britannica (online), 7 December 2018 (updated).

Falk, Armin and James J. Heckman (2009) Lab Experiments are a Major Source of Knowledge in the Social Sciences, Discussion Paper No. 4540 (October 2009), The Institute for the Study of Labor (IZA), Bonn, Germany, p. 2.

Falk, Richard A. (2012) Can We Overcome the Global Crisis: Obstacles, Options, and Opportunities, Keynote Address delivered at the Tanner Conference on Global Crisis (2012), Tanner Humanities Center, University of Utah, Salt Lake City, UT, USA, p. 2.

Fournier, Louise (2017) Compliance Mechanism under the Kyoto Protocol: Lessons for Paris, Edinburgh Law School, University of Edinburgh, DOI: 10.13140/RG.2.2.13842.66240, p. 12.

Franz, Wendy E. (1997) The Development of an International Agenda for Climate Change: connecting Science to Policy, ENRP Discussion Paper E-97-07, Kennedy School of Government, Harvard University, August 1997, p. 15.

Friman, Mathias (2007) Historical Responsibility in the UNFCCC, Centre for Climate Science and Policy Research, Report 07:01, Linkoping University, Sweden, p. 1.

G-77 (1964) group was formed on 15 June 1964 by the "Joint Declaration of the Seventy-Seven Countries" issued at the United Nations Conference on Trade and Development (UNCTAD).

Graduate Institute Geneva (2019) The Evolution of the International Climate Change Regime, News, International Climate Change Regime, Graduate Institute Geneva, 16 April 2019.

Grieger, Andreas (2012) Only One Earth: Stockholm and the Beginning of Modern Environmental Diplomacy, Environment & Society Portal, Arcadia, No. 10, Rachel Carson Center for Environment and Society.

Heal, Geoffery and Howard Kunreuther (2011) Tipping Climate Negotiations, Working Paper 16954 (April 2011), National Bureau of Economic Research, Cambridge, MA, USA, p. 1.

Hess, David (2016) Chicago School of Economics. Extracted from Encyclopaedia Britannica (online).

HKIEBS (2000) Asian Financial Crisis: Causes and Development, Hong Kong Institute of Economics and Business Strategy, University of Hong Kong, Hong Kong, People's Republic of China.

Horner, Christopher C. (2000) Chirac: Kyoto "First Step towards Global Governance", Op-Eds and Articles, Competitive Enterprise Institute, 19 November 2000.

Horner, Christopher and Marlo Lewis, Jr. (2017) The Legal and Economic Case Against the Paris Climate Treaty: Canceling U.S. Participation Protects Competitiveness and the Constitution, Issue Analysis 2017 No. 6 (May 2017), Competitive Enterprise Institute, Washington, DC, USA, p. 1.

ICS (2018) Working Group on the 'Anthropocene', Subcommission on Quarternary Stratigraphy, International Commission on Stratigraphy (ICS), 9 March 2018.

ICSU (2015) The International Council for Science and Climate Change: 60 Years of Facilitating Climate Change Research and Informing Policy, International Council for Science (ICSU), Paris, p. 14.

ICSU (2016) A Brief History of ICSU, International Council of Science. In 1998, Members agreed that the Council's current composition and activities would be better reflected by modifying the name from the International Council of Scientific Unions to the International Council for Science, while its rich history and strong identity would be well served by retaining the existing acronym, ICSU.

ICSU (2016) History: ICSU and Climate Change, Climate Change, Science for Policy, International Council for Science (ICSU).

IEA (2015) IEA Key World Energy Statistics 2015, International Energy Agency.

ILC (2006) Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law, Report of the Study Group of the International Law Commission, UN Doc. A/CN.4/L.682.

Jaeger, Jill (1988) Developing Policies for Responding to Climate Change: A Summary of the Discussion and Recommendations of the Workshops Held in Villach (28 Sep – 2 Oct, 1987) and Bellagio (9-13 Nov, 1987) under the Auspices of the Beijer Institute, Stockholm, World Meteorological Organization, Geneva; United Nations Environmental Programme, Nairobi, Kenya.

James Malone (1983) Assistant Secretary of State and the United States Representative to UNCLOS under Reagan, quoted by Curtis, Sign the Sea-Law Treaty, N.Y. Times, Feb. 21, 1983, at A17, Col. 4.

Jónsdóttir, Helga (2013) The Kyoto Protocol Compliance System: Is the System effective Enough to Ensure Compliance, LL.M. in Environmental Law, Spring Semester 2013, Stockholm Universitet, Stockholm, p. 35.

Keohane, Robert O. and David G. Victor (2010) The Regime Complex for Climate Change, Discussion Paper 10-33 (January 2010), The Harvard Project on International Climate Agreements, Harvard Kennedy School, Harvard University, Cambridge, MA, USA.

Knott, Stephen (2019) George H. W. Bush: Campaigns and Elections, Miller Centre, University of Virginia (2019).

Laurence Boisson de Chazournes (2008) United Nations Framework Convention on Climate Change, United Nations Audiovisual Library of International Law.

Leone, Faye (2019) UNEP Reports on Strengthening and Upgrading Process Since 2012, International Institute for Sustainable Development (IISD), 7 March 2019.

Levin, Jonathan and Paul Milgrom (2004) An Introduction to Rational Choice Theory.

Metcafe, Gilbert E. (2018) Environmental Assurance Mechanism: adding Environmental Certainty to a Carbon Tax, RFF Report (June 2018), Resources for the Future, Washington, DC, USA.

Mitchell, Ronald B. (2018) International Environmental Agreements (IEA) Database Project (Version 2018.1), University of Oregon, Eugene, Oregon, USA.

Mordfin, Robin I. and Marsha Ferziger Nagorsky (2011) Chicago and Law and Economics: A History, The University of Chicago, The Law School, 11 October 2011.

Morel, Romain and Igor Shishlov (2015) Ex-Post Evaluation of the Kyoto Protocol: four Key Lessons for the 2105 Paris Agreement, Climate Report No. 44 (May 2014), CDC Climat Research, p. 1.

Moury, Matthew B. and Vahid Majidi (2014) (U) Declassified Determination that the total weapon yield of the B53/W53 Y1 was 9 Mt, Department of Energy and Department of Defense, USA.

NASA (2010) TIROS: the Nation's first Weather Satellite, NASA Explorer/Early Satellites, 2 April 2010.

NASA (2017) Sea Ice Extent Sinks to Record Lows at Both Poles, United States National Aeronautical and Space Administration, 23 March 2017.

Nexus Polling (2018) The Yale Program on Climate Change Communication and George Mason University Center for Climate Change Communication, in conjunction with Nexus Polling, conducted an online survey of 1,876 registered voters 29-30 August 2018.

NOAA (2018) Can a coral reef recover from bleaching and other stressful events? National Oceanic and Atmospheric Administration, United States Department of Commerce.

Noordwijk Ministerial Declaration on Climate Change (1989) is often referred to as the Noordwijk Declaration on Atmospheric Pollution and Climate Change. It was reprinted in American University Journal of International Law and Policy, Volume 5 (1990), pp. 592-601.

Nordhaus, William D. (1976) Economic growth and climate: The problem of carbon dioxide, Cowles Foundation for Research in Economics Discussion Paper No. 435, Yale University, New Haven, CT, USA.

NSIDC (2017c) All About Sea Ice: Arctic vs. Antarctic, United States National Snow and Ice Data Center (NSIDC), University of Colorado, Boulder, USA.

Ocean Institute (2019) Whales of the World: Blue Whale, Ocean Institute, Dana Point, CA, USA.

OECD (2018) Financing Climate Futures: Rethinking Infrastructure, OECD/The World Bank/UN Environment, OECD Publishing, Paris, France.

Olmstead, Sheila M. and Robert N. Stavins (2006) An International Architecture for the Post-Kyoto Era, RWP06-009, March 2006, John Kennedy School of Government, Harvard University, Cambridge, MA, USA, p. 1.

Ostrom, Elinor (2007) Sustainable Social-Ecological Systems: An Impossibility? Presented at the 2007

Annual Meetings of the American Association for the Advancement of Science, "Science and Technology for Sustainable Well-Being," 15–19 February, San Francisco, CA, USA, p. 8.

Ostrom, Elinor (2009) Beyond Markets and States: Polycentric Governance of Complex Economic Systems, Nobel Memorial Prize in Economic Sciences Lecture, 8 December 2009.

Pennell, Nick (2010) Bottom Up & Country Led: A New Framework for Climate Change Action, Booz & Co., 23 November 2010. Cited in: Daniel H. Cole (2011) supra note 2033, p. 15.

Pidwirny, Michael (2006) Atmospheric Effects on Incoming Solar Radiation, Fundamentals of Physical Geography, 2nd Edition.

Samuelson, Paul A. (1970) Maximum Principles in Analytical Economics, Nobel Memorial Prize in Economic Sciences Lecture, 11 December 1970.

Saravesi, Annalisa (2016) The Paris Agreement: A New Beginning? Research Paper 2016/03, Edinburgh School of Law, University of Edinburgh, Edinburgh, UK, p. 3.

Selin, Henrik and Björn-Ola Linnér (2005) The Quest for Global Sustainability: International Efforts on Linking Environment and Development, CID Working Paper 5; Science, Environment and Development Group, Center for International Development, Harvard University, Cambridge, MA, USA, p. 8.

Simmon, Robert (2017) Earth's Energy Budget, NASA Earth Observatory.

SMIC (1971) Inadvertent Climate Modification: Report of Conference, Study of Man's Impact on Climate (SMIC), Stockholm, MIT Press, Cambridge, USA, pp. 125-29.

Sunstein, Cass R. (2006) Montreal versus Kyoto: A Tale of Two Protocols, AEI-Brookings Joint Center for Regulatory Studies, Working Paper No. 06-17, 45 pp, p. 23.

The Nobel Prize (2018) The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2018, The Nobel Foundation.

Treves, Tulio (2019) 1958 Geneva Conventions on the Law of the Sea, Geneva, 29 April 1958.

UCS (2011) Climate Hot Map, Union of Concerned Scientists, Cambridge, MA, USA.

UCS (2015) Each Country's Share of CO_2 Emissions, Union of Concerned Scientists, 11 October 2018.

UCS (2016) The Hidden Cost of Fossil Fuels.

US Census Bureau (2015) FFF: Hurricane Katrina 10th Anniversary: 29 August 2015, United States Department of Commerce, United States Census Bureau, Release Number: CB15-FF.1629, July 2015.

USGS (2016) The World's Water, United States Geological Survey (USGS), U.S. Department of the Interior.

WCRP (2016) World Climate Research Programme.

Weiss, Edith Brown (2009) The Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Audiovisual Library of International Law.

Welch, Charles (2016) The Ozone Hole, Ozone Hole Inc.

Werksman, Jacob (2016) International Legal Character of the Paris Agreement, Notes for the Third Environmental Law Brodies Lecture, 9 February 2016, University of Edinburgh in association with Brodies LLP, Edinburgh, UK, p. 7.

White, Wallace (1989) Her Deepness, The New Yorker, July 3, 1989, pp. 41-65.

Worldometer (2018) Current World Population, Population, Worldometers.info.

Zoller, Elisabeth (1996) Southey Memorial Lecture: Constitutionalism in the Global Era, Paper 579, Maurer School of Law, Indiana University, Bloomington, IN, USA, pp. 1143-1151.

Websites

http://classics.mit.edu/Aristotle/nicomachaen.1.i.html

http://climateproject.global.ucsb.edu/publications/pdf/Richard,%20Falk.%20Can%20We%20Overcome%20the%20Global%20Crisis.pdf

http://ec.europa.eu/world/agreements/prepareCreateTreatiesWorkspace/treatiesGeneralData.do?step=0&redirect=true&treatyId=524#targetText=The%20parties%20committed%20to%20reduce,period%20to%20meet%20both%20obligations.

http://europa.eu/rapid/press-release_PRES-11-359_en.htm?locale=en

http://in.reuters.com/article/oil-climatechange-factbox-idINL2N18M1DZ

http://legal.un.org/avl/ha/ccc/ccc.html

http://legal.un.org/avl/ha/dunche/dunche.html#3

http://legal.un.org/avl/ha/gclos/gclos.html

http://legal.un.org/avl/ha/vcpol/vcpol.html

http://legal.un.org/avl/pdf/ls/greenwood_outline.pdf

http://legal.un.org/diplomaticconferences/1960_los/docs/english/vol_1/a_conf19_l15.pdf

http://legal.un.org/ilc/texts/instruments/english/conventions/1_1_1969.pdf

http://news.bbc.co.uk/2/hi/8426835.stm

http://nsdl.library.cornell.edu/websites/wiki/index.php/PALE_ClassicArticles/GlobalWarming/Article4.ht

ml

http://ozone.unep.org/en/handbook-montreal-protocol-substances-deplete-ozone-layer/2

http://ozone.unep.org/en/institutions

http://ozone.unep.org/en/treaties-and-decisions

http://ozone.unep.org/sites/ozone/modules/unep/ozone_treaties/inc/datasheet.php

http://paleobiology.si.edu/geotime/main/htmlversion/holocene3.html

http://public.wmo.int/en/about-us/who-we-are/history-IMO

http://quaternary.stratigraphy.org/workinggroups/anthropocene/

http://sedac.ipcc-data.org/ddc/ar5_scenario_process/RCPs.html

http://ssrn.com/abstract=2270336

http://thehill.com/policy/energy-environment/335955-trump-pulls-us-out-of-paris-climate-deal

http://unesdoc.unesco.org/images/0003/000376/037648eb.pdf

http://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

http://unfccc.int/essential_background/convention/items/6036.php

http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php

http://unfccc.int/kyoto protocol/compliance/items/3026.php

http://unfccc.int/kyoto protocol/compliance/plenary/items/3788.php

http://unfccc.int/resource/docs/2009/cop15/eng/l07.pdf

http://unfccc.int/resource/docs/cop2/15.htm

http://unfccc.int/resource/docs/cop2/15a01.pdf

http://unfccc.int/resource/docs/cronvkp/kpeng.pdf

http://web.unep.org/exhibit/

http://www.abc.net.au/science/moon/earthrise.htm

http://www.alternet.org/world/noam-chomsky-climate-change-nuclear-proliferation-pose-worst-threat-ever-faced-humans

http://www.bom.gov.au/climate/enso/history/ln-2010-12/SAM-what.shtml

http://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2015/bp-statistical-review-of-world-energy-2015-full-report.pdf

http://www.cdcclimat.com/IMG/pdf/14-05_climate_report_no44_-_analysis_of_the_kp-2.pdf

http://www.cicep.no/copguide/2015/10/25/cartagena-dialogue

http://www.climatecentral.org/news/antarctica-co2-400-ppm-million-years-20451

http://www.climatehotmap.org/global-warming-solutions/

http://www.csmonitor.com/Environment/2013/0627/Billion-dollar-weather-The-10-most-expensive-US-natural-disasters/Drought-and-heat-wave-1988-78.8-billion
http://www.multilateralfund.org/default.aspx

http://www.ecologyandsociety.org/vol15/iss4/art38/

http://www.economist.com/news/science-and-technology/21574461-climate-may-be-heating-up-less-response-greenhouse-gas-emissions

http://www.eesi.org/topics/fossil-fuels/description

http://www.eia.gov/forecasts/archive/ieo13/pdf/0484(2013).pdf

http://www.environmentandsociety.org/node/3867

http://www.fao.org/3/s5280t/s5280t0p.htm

http://www.fao.org/in-action/globefish/news-events/details-news/en/c/1032635/

http://www.icsu.org/about-icsu/about-us/a-brief-history

http://www.icsu.org/science-for-policy/climate-change/history-icsu-and-climate-change

http://www.iea.org/publications/freepublications/publication/key-world-energy-statistics-2015.html

http://www.ifrc.org/docs/idrl/I520EN.pdf

http://www.imf.org/external/pubs/ft/weo/2015/01/weodata/weorept.aspx?pr.x=21&pr.y=15&sy=2006&ey=2016&ssd=1&sort=country&ds=.&br=1&c=001%2C110%2C163%2C200&s=NGDP_RPCH&grp=1&a=1#download

http://www.imf.org/external/pubs/ft/weo/2018/01/weodata/index.aspx

http://www.ipcc.ch/ipccreports/far/wg_III/ipcc_far_wg_III_full_report.pdf

http://www.ipcc.ch/news_and_events/docs/factsheets/FS_what_ipcc.pdf

http://www.ipcc.ch/organization/organization.shtml

http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtm
http://www.multilateralfund.org/default.aspx

http://www.nature.com/polopoly_fs/1.20978!/menu/main/topColumns/topLeftColumn/pdf/539346a1.pdf

http://www.newworldencyclopedia.org/entry/Internal_combustion_engine

http://www.nola.com/katrina/index.ssf/2005/08/nagin_orders_first-ever_mandatory_evacuation_of_new_orleans.html

http://www.nytimes.com/1983/09/06/world/around-the-world-acid-rain-study-on-scandinavian-lakes.html

http://www.ozonelayer.noaa.gov/science/basics.htm

http://www.scientificamerican.com/article/why-is-there-more-methane-in-the-atmosphere/

http://www.telegraph.co.uk/news/earth/environment/globalwarming/4029837/Global-warming-Reasons-why-it-might-not-actually-exist.html

http://www.theozonehole.com/

http://www.thenational.ae/uaes-coastal-cities-at-high-risk-from-rising-sea-levels

http://www.ucsusa.org/clean_energy/our-energy-choices/coal-and-other-fossil-fuels/the-hidden-cost-of-fossil.html#.V14IzuZ96nS

http://www.unccd.int/Lists/SiteDocumentLibrary/conventionText/conv-eng.pdf

http://www.un-documents.net/a17-5217.pdf

http://www.un-documents.net/a25r2749.htm

http://www.un-documents.net/a27r2997.htm

http://www.un-documents.net/aconf48-14r1.pdf

http://www.unece.org/env/lrtap/lrtap_h1.html

http://www.unece.org/env/lrtap/status/lrtap_st.html

http://www.unece.org/fileadmin/DAM/env/lrtap/ExecutiveBody/2004_lrtap_eng.pdf

http://www.unece.org/fileadmin/DAM/env/lrtap/full%20text/1979.CLRTAP.e.pdf

http://www.unep.org/documents.multilingual/default.asp?documentid=78&articleid=1163

http://www.uneptie.org/ozonaction/information/mmcfiles/4870-e-sgmsg.pdf

http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/resolutions/res_16_1721.html

http://www.un.org/depts/los/convention_agreements/convention_historical_perspective.htm

http://www.un.org/documents/ga/conf151/aconf15126-3annex3.htm

http://www.un.org/documents/ga/res/41/a41r128.htm

http://www.un.org/documents/ga/res/43/a43r053.htm

http://www.un.org/documents/ga/res/45/a45r212.htm

http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/70/1

http://www.un.org/ga/president/55/speech/civilsociety1.htm

http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang=E

http://www.worldbank.org/en/news/feature/2014/09/30/a-wicked-problem-controlling-global-climate-change.print

http://www.worldometers.info/world-population/?

https://cei.org/content/chirac-kyoto-first-step-toward-global-governance

https://climate.nasa.gov/news/2785/unexpected-future-boost-of-methane-possible-from-arctic-permafrost/

https://datacatalog.worldbank.org/dataset/gdp-ranking

https://data.giss.nasa.gov/gistemp/news/20170714/

http://digitalcommons.law.yale.edu/fss_papers/2464

https://documents-dds-ny.un.org/doc/RESOLUTION/GEN/NR0/243/58/IMG/NR024358.pdf?OpenElement

https://e360.yale.edu/features/how_long_can_oceans_continue_to_absorb_earths_excess_heat

https://easac.eu/press-releases/details/new-data-confirm-increased-frequency-of-extreme-weather-events-

european-national-science-academies/

https://ebooks.adelaide.edu.au/h/hume/david/treatise-of-human-nature/B3.2.7.html

https://ec.europa.eu/clima/sites/clima/files/docs/montreal_prot_en.pdf

https://en.unesco.org/about-us/introducing-unesco

https://eur-lex.europa.eu/summary/glossary/subsidiarity.html

https://fas.org/sgp/othergov/doe/decl/b53-yield.pdf

https://fordham.universitypressscholarship.com/view/10.5422/fordham/9780823249923.001.0001/upso-9780823249923-chapter-2

http://fortune.com/2018/09/10/baker-shultz-climate-plan/

https://genographic.nationalgeographic.com/development-of-agriculture/

https://globaljustice.yale.edu/oslo-principles-global-climate-change-obligations

https://graduateinstitute.ch/communications/news/evolution-international-climate-change-regime

http://haze.asean.org/status-of-ratification/

https://iea.uoregon.edu/

http://kapfam.com/site/program-areas/environment/

https://news.nationalgeographic.com/news/2010/03/100304-snowball-earth-ice-global-warming/

https://news.un.org/en/story/2018/05/1009782

https://news.un.org/en/story/2019/01/1031322

https://nsidc.org/cryosphere/seaice/characteristics/difference.html

https://obamawhitehouse.archives.gov/the-press-office/2014/01/28/president-barack-obamas-state-union-address

https://oceanservice.noaa.gov/facts/eutrophication.html

https://oceanservice.noaa.gov/facts/reef-resilience.html

https://ourfiniteworld.com/2012/03/12/world-energy-consumption-since-1820-in-charts/

https://oll.libertyfund.org/titles/vattel-le-droit-des-gens-ou-principes-de-la-loi-naturelle-2-vols

http://ozone.unep.org/en/focus

https://public.wmo.int/en/bulletin/history-climate-activities

https://public.wmo.int/en/media/press-release/greenhouse-gas-levels-atmosphere-reach-new-record

https://pubs.usgs.gov/fs/2010/3021/pdf/fs2010-3021.pdf

http://pwccc.wordpress.com/progama/

https://report.ipcc.ch/sr15/pdf/sr15_faq.pdf

https://sdg.iisd.org/news/unep-reports-on-agencys-strengthening-and-upgrading-process-since-2012/

https://stats.oecd.org/glossary/detail.asp?ID=884

https://sustainabledevelopment.un.org/milestones/unced

https://sustainabledevelopment.un.org/milesstones/wssd

https://sustainabledevelopment.un.org/outcomedocuments/agenda21

https://sustainabledevelopment.un.org/post2015/summit

https://sustainabledevelopment.un.org/rio20.html

https://sustainabledevelopment.un.org/sdgs

https://thehill.com/policy/energy-environment/335955-trump-pulls-us-out-of-paris-climate-deal

https://treaties.un.org/Pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en

https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-7-c&chapter=27&clang=_en

https://treaties.un.org/doc/Treaties/1992/06/19920605%2008-44%20PM/Ch_XXVII_08p.pdf

https://unfccc.int/decisions_katowice

https://unfccc.int/kyoto_protocol

https://unfccc.int/process-and-meetings/the-convention/status-of-ratification/status-of-ratification-of-the-convention

https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs#eq-4

https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement

https://unfccc.int/process-and-meetings#:606038e4-000c-47ee-8c49-4f590df37224

https://unfccc.int/process/bodies/subsidiary-bodies/sbsta

https://unfccc.int/process/the-kyoto-protocol/amendment-to-annex-b

https://unfccc.int/process/the-kyoto-protocol/status-of-ratification

https://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf

https://unfccc.int/resource/docs/cop4/16a01.pdf#page=8

https://unfccc.int/resource/docs/cop4/16a01.pdf#page=42

https://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf

https://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf

https://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf

https://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf

https://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf

https://unfccc.int/resource/ccsites/senegal/fact/fs220.htm

https://unfccc.int/resource/ccsites/senegal/fact/fs221.htm

https://water.usgs.gov/edu/earthwherewater.html

http://web.unep.org/ozonaction/what-we-do/methyl-bromide

https://www2.usgs.gov/climate_landuse/clu_rd/paleoclimate/archives.asp

https://www3.epa.gov/climatechange/ghgemissions/gases.html

https://www3.epa.gov/climatechange/science/indicators/ghg/ghg-concentrations.html

https://www.americanscientist.org/article/understanding-the-butterfly-effect

https://www.bahai.org/beliefs/

https://www.bbc.com/news/science-environment-49567197

https://www.biologicaldiversity.org/campaigns/ocean_plastics/

https://www.bloomberg.com/view/articles/2018-05-16/richard-feynman-and-the-true-story-of-the-mushroom-cloud

https://www.britannica.com/biography/Vilfredo-Pareto

https://www.britannica.com/science/Holocene-Epoch

https://www.britannica.com/topic/Chicago-school-of-economics

https://www.britannica.com/topic/Commission-on-Global-Governance

https://www.britannica.com/topic/liberal-internationalism

https://www.britannica.com/topic/liberalism

https://www.c2es.org/content/paris-climate-agreement-qa/

https://www.c40.org/

https://www.cambridge.org/core/journals/global-constitutionalism

https://www.carbonbrief.org/cop24-key-outcomes-agreed-at-the-un-climate-talks-in-katowice

https://www.cbd.int/doc/meetings/iccbd/bdn-02-awg-02/official/bdn-02-awg-02-05-en.pdf

https://www.census.gov/newsroom/facts-for-features/2015/cb15-ff16.html

https://www.clcouncil.org/founding-members/

https://www.clcouncil.org/media/Exceeding-Paris.pdf

https://www.congress.gov/bill/105th-congress/senate-resolution/98

https://www.economist.com/briefing/2018/08/02/india-shows-how-hard-it-is-to-move-beyond-fossil-fuels

https://www.eenews.net/special_reports/paris_climate_talks/stories/1060029405

https://www.eia.gov/outlooks/steo/

https://www.eolss.net/Sample-Chapters/C01/E6-158-20-00.pdf

https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

https://www.epa.gov/ozone-layer-protection/international-actions-montreal-protocol-substances-deplete-

ozone-layer

https://www.icao.int/about-icao/Pages/default.aspx

https://www.icao.int/environmental-protection/Pages/A39_CORSIA_FAQ6.aspx

https://www.icj-cij.org/

https://www.icj-cij.org/en/statute

https://www.icsa-aviation.org/global-aviation-co2-deal-adopted-with-mixed-results-just-as-paris-agreement-takes-off/

https://www.iea.org/topics/energypoverty/

https://www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf

http://www.imo.org/en/About/Pages/Default.aspx

https://www.ipcc.ch/2019/08/08/land-is-a-critical-resource_srccl/

https://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf

http://www.ipsnews.net/2012/05/us-lifestyle-is-not-up-for-negotiation/

https://www.jfklibrary.org/Asset-Viewer/DOPIN64xJUGRKgdHJ9NfgQ.aspx

https://www.law.ed.ac.uk/sites/default/files/2019-06/BrodiesLectureontheLegalCharacteroftheParisAgreementFinalBICCLEdinburgh.pdf

https://www.law.uchicago.edu/news/chicago-and-law-and-economics-history

https://www.linkedin.com/pulse/why-i-think-oil-natural-gas-indispensable-foreseeable-john-s-watson

https://www.nasa.gov/feature/goddard/2017/sea-ice-extent-sinks-to-record-lows-at-both-poles

https://www.nasa.gov/multimedia/imagegallery/image_feature_1627.html

https://www.nationalgeographic.com/environment/global-warming/global-warming-causes/

https://www.ncdc.noaa.gov/sotc/global/201706

https://www.nobelprize.org/prizes/economic-sciences/2018/press-release/

https://www.nobelprize.org/uploads/2018/06/ostrom_lecture.pdf

https://www.nobelprize.org/uploads/2018/06/samuelson-lecture.pdf

https://www.nytimes.com/2009/11/15/world/asia/15prexy.html?_r=1

https://www.nytimes.com/2017/02/08/opinion/a-conservative-case-for-climate-action.html

https://www.nytimes.com/2018/06/20/opinion/climate-change-fee-carbon-dioxide.html

https://www.nytimes.com/interactive/2018/08/01/magazine/climate-change-losing-earth.html?src=longreads&utm_source=Longreads+Newsletters&utm_campaign=8bd2e726a7-Longreads_Top_5_August_3_2018&utm_medium=email&utm_term=0_bd2ad42066-8bd2e726a7-241689933&mc_cid=8bd2e726a7&mc_eid=b1f927fc66

https://www.ocean-institute.org/whales-world

https://www.pewtrusts.org/en/research-and-analysis/articles/2018/06/07/5-surprising-stats-show-why-high-seas-need-protection

https://www.publicfinanceinternational.org/news/2019/01/un-chief-warns-insufficient-political-will-climate-change

https://www.reuters.com/article/us-iea-emissions/global-carbon-emissions-hit-record-high-in-2018-iea-idUSKCN1R7005

https://www.scar.org/policy/antarctic-treaty-system/

https://www.scientificamerican.com/article/seas-rising-but-florida-keeps-building-on-the-coast/

https://www.semanticscholar.org/paper/Introduction-to-Choice-Theory-Levin-

Milgrom/06cb6027bfbb124a0e4ce8452cc9e81953f6e88d

https://www.smithsonianmag.com/science-nature/who-took-legendary-earthrise-photo-apollo-8-180967505/

https://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html

https://www.straitstimes.com/asia/se-asia/toxic-air-from-fires-in-indonesia-putting-10m-kids-at-risk-un

https://www.theglobeandmail.com/news/world/climate-talks-hinge-on-financing-for-developing-nations/article27626639/

https://www.theguardian.com/books/2016/apr/15/neoliberalism-ideology-problem-george-monbiot

https://www.theguardian.com/environment/2009/feb/20/climate-funds-developing-nations

https://www.theguardian.com/environment/2009/dec/08/copenhagen-climate-summit-disarray-danish-text

https://www.theguardian.com/environment/2010/apr/12/copenhagen-destroyed-danish-draft-leak

https://www.theguardian.com/environment/2016/sep/03/breakthrough-us-china-agree-ratify-paris-climate-change-deal

https://www.theguardian.com/environment/2017/apr/10/great-barrier-reef-terminal-stage-australia-scientists-despair-latest-coral-bleaching-data

https://www.theguardian.com/environment/2017/jul/10/earths-sixth-mass-extinction-event-already-underway-scientists-warn

https://www.theguardian.com/environment/2018/may/03/climate-change-aid-poor-nations-paris-cop21-oxfam

https://www.theguardian.com/environment/2018/may/16/mysterious-rise-in-banned-ozone-destroying-chemical-shocks-scientists

https://www.theguardian.com/environment/2019/may/17/why-the-guardian-is-changing-the-language-it-uses-about-the-environment

https://www.theguardian.com/environment/planet-oz/2013/oct/02/climate-change-denial-skeptics-psychology-study-conspiracy-theories

https://www.theguardian.com/science/2018/sep/01/swedish-15-year-old-cutting-class-to-fight-the-climate-crisis

https://www.theguardian.com/world/2018/oct/08/two-us-economists-win-nobel-prize-for-work-on-climate-and-growth-william-nordhaus-paul-romer

https://www.ucsusa.org/global-warming/science-and-impacts/science/each-countrys-share-of-co2.html

https://www.unece.org/env/lrtap/status/lrtap_s.html

https://www.unog.ch/80256EDD006B8954/(httpAssets)/36BC4F83BD9E4443C1257AF3004FC0AE/%24file/Historical_overview_of_the_League_of_Nations.pdf

https://www.un.org/en/climatechange/un-climate-summit-2019.shtml

https://www.un.org/press/en/2001/envdev594.doc.htm

https://www.un.org/press/en/2004/sgsm9599.doc.htm

https://www.un.org/en/events/ozoneday/background.shtml

https://www.un.org/sg/en/content/sg/articles/2008-06-17/more-just-talk

https://www.un.org/sg/en/content/sg/press-encounter/2007-09-24/press-conference-high-level-event-climate-change-secretary

https://www.un.org/sg/en/content/sg/press-encounter/2018-03-29/secretary-generals-press-encounter-climate-change-qa

https://www.un.org/un70/en/content/history/index.html

https://www.undp.org/content/undp/en/home/sustainable-development-goals.html

https://www.unsystem.org/members/specialized-agencies

https://www.vox.com/2016/10/15/13292878/montreal-protocol-cut-hfcs

https://www.washingtonpost.com/national/health-science/these-whales-will-be-extinct-in-25-years-scientists-say--unless-we-act-now-to-save-them/2018/04/20/57bf89b2-4320-11e8-8569-26fda6b404c7_story.html?noredirect=on

https://www.wcrp-climate.org/

https://www.wri.org/blog/2019/06/why-does-paris-climate-agreement-need-rulebook-7-questions-and-answers

https://www.wto.org/english/docs_e/legal_e/ursum_e.htm#General

https://www.wto.org/english/tratop_e/envir_e/envir_e.htm