The Post Consumptive Residues of Information and Communication Technologies – Transnational E-waste Flows and Developmental Dilemmas

Janani Vasudev
Siemens Corporate Technology - India
#84, Keonics Electronics City
Hosur Road, Bangalore – 560100
Email: janani.vasudev@siemens.com

Balaji Parthasarathy
International Institute of Information Technology
26C (Opp. Infosys Gate 1), Electronics City
Hosur Road, Bangalore – 560100
Email: pbalaji@iiitb.ac.in

Abstract- One consequence of the increased ubiquity and shortening product cycles of information and communication technologies (ICTs) is the proliferation of hazardous electronic waste (e-waste). Despite governance mechanisms to control the management and disposal of e-waste, significant quantities are exported from developed to developing countries, where they are processed in unsafe conditions in the informal sector. To understand this phenomenon, this paper examines e-waste management and disposal in India. It shows that so long as benefits from transnational e-waste flows exceed the benefits of compliance with regulations, such flows will continue. It argues that tightening regulations alone will not improve e-waste management and disposal; instead, the regulations must acknowledge and facilitate an international division of labor in the e-waste recycling industry. By doing so, they will not only address the need for employment in the informal sector; but also promote a cleaner environment.

Index terms: e-waste, division of labor, developmental dilemmas

I. E-WASTE AND TRANSNATIONAL FLOWS

E-waste is a generic term for various forms of electrical and electronic equipment that have ceased to be of value to their owners [1]. Although there is no standard definition, this paper will adopt the one put forth by the Indian Institute of Materials Management (IIMM). According to the IIMM, “e-waste refers to equipment or products having a battery or an electrical cord, which have become obsolete, either due to advancement in technology, changes in fashion, style and status or are nearing the end of their useful life.” 1 It can contain electronic devices like computers, televisions, cellular phones, printers, and fax machines; components like processors, chips, printed circuit boards; or peripherals like floppy disks, compact discs, and printer cartridges. Global generation of e-waste increased from less than 8 million tons in 1995 to over 25 million in 2003, growing three times faster than any other waste stream. 2 Discarded electronics are the fastest growing component of municipal trash in the US and Europe [2]. Since no product so typifies the problems posed by obsolete electronics as the personal computer (PC), this study will focus on post-consumptive computer waste.

As rapid technological advances have created faster and more powerful computers, they have also become cheaper and more ubiquitous. Although these are signs of a growing industry, such indicators obscure a larger problem. Improvements in technology have reduced the average life span of the PC from four or five years in 1997 to two years in 2005 [3]. As better computers are released into the market at shorter intervals, the problem is not only about coping with technological progress, but also about managing the electronic discards when old computers are abandoned for new ones, even before they are functionally obsolete. According to the Environment Protection Agency (EPA) 3, in the US, over 50 million PCs are rendered obsolete every year – about as many as are sold in that country [4]. Similar PC obsolescence rates are also evident in other developed countries like Australia, Canada, and Japan, where computers are often replaced before they are functionally obsolete.

3 While several countries have established EPAs, the US was the first to establish one in 1970. Henceforth, in this paper, EPA refers to the US EPA, unless otherwise specified.
4 According to a World Bank Classification, using 2005 gross national per capita (GNI) data, developed countries are those with a GNI of over $10,000, while developing countries are those with a GNI below this amount [22].
Besides the growing volume of e-waste, the problem is exacerbated by its toxicity. E-waste contains hazardous materials like lead, mercury, cadmium and chromium that contaminate the environment when improperly disposed. The toxicity of e-waste therefore warrants effective mechanisms for management and disposal. Even while the need to safely manage and dispose is recognized, significant quantities of e-waste are exported from developed to developing countries where they are processed in unsafe conditions. For instance, about 50-80% of e-waste collected for recycling in the US is exported to Asia, where it is processed in unhealthy conditions in the informal sector [5]. Nevertheless, developed countries are not the only ones responsible for such flows. For their part, developing countries also readily absorb e-waste flows as they offer various social and economic benefits including cheap ICT access and employment in the informal sector. Consequently, both the developed and developing countries routinely engage in and benefit from transnational e-waste flows, violating regulatory structures like the Basel Convention and its Amendment (see Section 2) that attempt to control them.

Thus, as e-waste management and disposal becomes increasingly global, this paper raises the following question - how do the existing transnational and local regulatory regimes facilitate e-waste management and disposal, either by their existence or subversion? To address this question, the paper highlights the developmental dilemmas and ideological tensions underlying transnational e-waste flows and examines their economic and social implications for developing countries. It shows that so long as the benefits from non-compliance with regulations exceed the benefits from compliance, and they are weakly enforced, transnational e-waste flows will continue. The paper argues that tightening regulations alone will not improve e-waste management and disposal; instead, the regulations must acknowledge and facilitate an international division of labor in the e-waste recycling industry. Doing so not only addresses the need for employment in the informal sector, but also promotes a cleaner environment in developing countries.

Specifically, the paper will examine e-waste management and disposal in India where the dilemmas of international e-waste flows are acutely manifest. Before evaluating e-waste flows and its specificities in India, Section II will identify the developmental dilemmas and associated tensions in transnational e-waste flows. Section III will present a framework that traces the activities and materials flow in the e-waste management and disposal system. It will then identify the key actors and the roles they play within the global regulatory regime to describe an international division of labor in the e-waste recycling industry. Sections IV and V describe the local regulatory regime and the organization of the e-waste recycling industry in India respectively. Section VI describes how the developmental dilemmas are manifest in the country. The paper will conclude by arguing that to prevent illegal flows, regulations must not ban transnational e-waste flows outright, but must be sensitive to the international division of labor in the e-waste recycling industry. This does not imply facilitating a one-way flow of e-waste from developed to developing countries. It is also to ensure a reverse flow of partially processed e-waste back to the developed countries for material recovery. As the risky material recovery processes move away from them, developing countries cease to be pollution havens and the burden of safe e-waste management falls on the generators of e-waste. Reducing the distance between conspicuous consumers and their waste is a means to encourage conscious consumption of information technology products.

II. E-WASTE FLOWS AND DEVELOPMENTAL DILEMMAS

While there are three broad arguments for transnational e-waste flows, these arguments are also much criticized, reflecting the contentious implications of e-waste flows for developing countries. The section will present the developmental dilemmas and tensions underlying transnational e-waste flows.

In 1991, the former Chief Economist of the World Bank, Larry Summers, spoke of the economic sense of transnational waste flows by arguing that “…the least developed countries, specifically those in Africa, were seriously under polluted and thus could stand to benefit from pollution trading schemes as they have air and water to spare…”[6]. His view is an instance of the pollution haven hypothesis which states that “higher the costs of disposal caused by the increasingly strict environmental regulations in developed countries, higher the incentive of recycling industries to move to the less developed world, where environmental restrictions are not severe. Thus, from a global perspective, pollution simply moves from one place to another, rather than being treated adequately in regions where the polluting products are made and used [7: 609].” In essence, as compliance with environmental regulations increases the costs of e-waste disposal in developed countries, it becomes profitable for them to export waste to developing countries where such regulations are typically lax.

Although it may make economic sense for developed countries to export their e-waste to developing countries, they ignore the impacts of the distancing of waste [8]. When producers and consumers of waste are highly distanced or separated by geography, the environmental impacts tend to be severe, i.e. “when the distance between the consumers and their wastes increase, they tend to have little understanding about where their post-consumptive wastes actually go, and consequently, make decisions that perpetuate the generation of waste. Once the waste is out of sight, people tend to forget about it, assuming that it is someone else’s responsibility [8:4].” In this case, when e-waste is exported from the developed to developing countries, the gap in understanding, and the geographical distance between consumers and their waste, perpetuates a vicious cycle of undesirable consumption choices in developed countries.
The second argument invokes the employment opportunities that transnational e-waste flows provide in developing countries. As Section III will explain, a few processes in e-waste recycling are technology-intensive, while others are best done manually. As labor in developed countries that generate the waste is expensive, it is lucrative to carry out the manual recycling operations in developing countries where such labor is abundant and cheap. Doing so not only reduces the recycling costs for the generators in developed countries, but it also generates employment opportunities in developing countries. However, even while such activities may be economically beneficial for the informal sector in the developing countries, in the absence of the necessary technologies and adequate personal protection equipment (PPE) that will ensure the safe and efficient disposal of e-waste, they pose severe environmental and occupational health hazards.

While the first two arguments evaluate e-waste flows from a post-consumption perspective, the final argument evaluates the residual utility of unwanted PCs, before they end up as e-waste. It views transnational e-waste flows as facilitating ICT access in the developing countries, and thereby contributing to bridging the digital divide by improving access to ICTs to deliver various social benefits. To this end, governments in developing countries engage in imports presuming that such a supply will help bridge the digital divide and reduce the costs of establishing an ICT infrastructure [9]. However, environmentalists opine that such flows could be more a burden than a boon and have sought to ban transnational flows contending that the "justifications of 'building bridges over the digital divide' are excuses to obscure and ignore the fact that these bridges double as toxic waste pipelines [10]." This is because, irrespective of their utility, these PCs eventually become a part of the waste stream and the burden of their safe disposal falls on developing countries.

III. MATERIALS FLOW IN THE E-WASTE MANAGEMENT AND DISPOSAL SYSTEM

The frequency of disposal, the incentives, awareness, and availability of feasible disposal mechanisms play an important role in end-of-life PC management. The framework for materials flow (Fig. 1) identifies the actors involved at various stages and their interactions. The actors in the framework include producers, consumers and the agencies that handle downstream products. Some of the actors may be involved in more than one stage; while the output from one stage may feed back into the system.

Four end-of-life options have been identified for obsolete computers [11]. First, the computer can be reused – i.e. it can be resold to another user as is or with modifications. Secondary markets may exist for such sales. Second, the computer can be stored. In this case, the computer is no longer valuable to the owner. Third, it can be recycled. Recycling involves disassembly and/or destruction of a computer in order to recover components.

5 The term digital divide has at least four interpretations – a gap in access to use of ICTs; a gap in the ability to use ICTs; a gap in actual use or a gap in the impact of use. However, due to the ease of measurement, the term is typically associated only with the first and third interpretations [23:2]. "The original sense of the digital divide term – which attached overriding importance to the physical availability of computers and connectivity, rather than to issues of content, language, education, literacy, or community and social resources – is difficult to overcome" [24:6].
and materials. Finally, the computer can be landfilled. In this model, reuse and storage are no more than intermediate stages between consumption and disposal; only recycling and landfilling are terminal points. Storage in most cases is within the consumers’ premises while the other options are handled by the agencies. Agencies may include either the manufacturers (in case they take back old machines for new) or the original owner, if he engages in direct sale of his used PC. They may also include retailers, who sell in used computer markets, and recyclers.

Recycling typically involves segregation and disassembly, followed by shredding or pulverizing, and material recovery. The various stages involved in recycling are depicted in Fig. 2. Discarded PCs sent for recycling are first disassembled into their components.\(^6\)\(^7\) Upon disassembly, the functional components are segregated from the non-functional ones. The disassembled functional components are reused as is, while the non-functional ones are disassembled further on the basis of their composition – ferrous and non-ferrous metals, plastics and glass – before being shredded. Although both shredding and pulverizing imply crushing, shredded e-waste has a higher granularity than pulverized e-waste.\(^8\) The last stage in recycling is material recovery. Material recovery involves recovering glass, plastics, ferrous and non-ferrous metals.

Both device and component level disassembly and segregation are manual (Fig. 2). Given the volume and intricacy of designs, automating these processes is not yet technically feasible or economical. Consequently, manual disassembly and segregation is the most cost effective method [12]. On the other hand, shredding, pulverizing, and material recovery are best done using mechanized processes. Even while partial material recovery involving glass, plastics and ferrous metals may be undertaken manually, the efficient and

\(^6\)In general, most PCs that are sent for recycling are already disassembled. In these cases, the first step in the recycling process is the segregation of components.

\(^7\)The term ‘components’ includes uninterrupted power supplies (UPS), keyboards, mouse, motherboards, fans, cables etc. ‘Disassembled’ components include individual ICs, capacitors etc.

\(^8\)Most recyclers do not differentiate between the two processes and use the term interchangeably.
safe recovery of non-ferrous metals, especially copper and gold, entails mechanized processes [13].

After recycling, a portion of recycled components, like reclaimed metal, feeds back into the cycle as raw materials for the manufacturing process. Recycled plastics may find use in other sectors that, for instance, make utensils or decorative plastic flowers. The components that cannot be recycled, the residues of the recycling processes and the fraction of e-waste that is disposed with trash are eventually dumped in landfills.

The economics and environmental implications of each of these options vary. For instance, the efficiency of recycling not only depends on the process employed but also the materials recycled. As manufacturers strive to lower costs by reducing the quantity of precious metal used, the value of recycled electronics is diminished, making recycling less economical [14].

All the actors in Fig. 1 function within a global regulatory regime that is constituted by international and local laws. The regulatory regime governs the e-waste trade, the collection, management and disposal of e-waste, and defines the responsibilities of the actors. Tracing the activities throughout the lifecycle and the interaction between the actors and the regulatory regime at each stage is crucial to assess the consumption pattern and the quantity of waste generated, and how it is eventually managed and distributed.

Regulations that address transnational e-waste flows include international agreements like the Basel Convention that was passed in 1992 to restrict trade in e-waste between the developed and developing countries. However, even while there was a significant reduction in the exports of toxic waste for disposal in developing countries after the Convention, the trade began to assume a new form under the guise of recycling due to a loophole in the rules [15]. In an attempt to close this recycling loophole, the Basel Ban Amendment was passed in 1995. Nevertheless, even with the Amendment, there remain weaknesses that allow the exports to continue. The Amendment does not ban toxic waste trade among the developing or developed countries, and it has been difficult to get key countries to ratify the Convention. For instance, although Japan, Australia and the EU have ratified the Convention, the US, which is the largest exporter of e-waste, has not [ibid].

Other international regulations, like the Waste from Electrical and Electronic Equipment (WEEE) and the Restriction on the Use of Certain Hazardous Substances (RoHS), that came into effect in 2005 and 2006 respectively in the EU, place the responsibility of product recycling and reuse on manufacturers. They mandate manufacturers to reduce the use of toxic materials which make waste management and disposal difficult and expensive. Nonetheless, these regulatory structures are also routinely ignored and e-waste continues to be exported from the developed to developing countries. Thus, this trend reveals that, in addition to the four end-of-life options for PCs identified in [11], a fifth option exists in the form of e-waste exports from developed to developing countries. Fig. 3 traces the global flows of e-waste.

IV. THE REGULATORY REGIME AND E-WASTE FLOWS IN INDIA

This section will examine how the flows illustrated in Fig. 3 are manifest in India. After China, India is the second largest importer of e-waste from developed countries [5]. Besides imports, between 1993 and 2000, PC ownership per capita in India grew by 604% compared to the world average of 181%, and the total PC base grew from an estimated 450,000 to 4,200,000 [17 cited in 16:498]. A consequence of the growing PC sales is the increasing volume of e-waste in the domestic waste stream.

There is no specific legislation for e-waste management and disposal in India. However, certain legislations like the Hazardous Waste (HW) Management Rules of 1989, and its Amendments in 2000 and 2003, indirectly address e-waste management and disposal. They follow the stipulations of the Basel Convention, which India ratified in 1992, and define 18 categories of waste which are hazardous above a certain quantity. Although the categories of waste in the HW Management Rules, 1989, did not address e-waste, Lists A and B of Part A in Schedule 3 in the Amendments to the Rules classify e-waste as hazardous and, subsequently, statutory controls were placed on its imports and exports. Despite these restrictions, the Directorate General of Commercial Intelligence and Statistics (DGCIS) data indicates that hazardous waste have come into the country through intermediate ports like Dubai [12] that are important centers for transshipment of wastes from developed countries and are not a party to the Basel Convention.

In addition, there are also laws that control the imports of both new and used PCs and PC components. Under these laws, while new computers and components can be imported freely without licenses into the country, used computers can be imported only against a license. Nevertheless, trade practices take advantage of loopholes in these regulations, and consequently, e-waste continues to flow into the country. For instance, used computers and peripherals can be imported without any license and are exempt from customs duty, when received as donations. This distinction between donations and other used computers facilitates illegal imports. Since computers as donations can be freely imported and avail of tax benefits, importers procure old computers as donations to a school [18]. In this sense, “to get the benefit of tax concession and ease in import, they get registration of a school under the Society Act 1968, without actually establishing such a school [ibid: 33].” Thus, even while the government has eased the process of imports of PCs for donations in the public interest, it has eased illegal imports.

V. THE E-WASTE MANAGEMENT AND DISPOSAL INDUSTRY IN INDIA

In 2000, 93% of the total labor force in India was employed in the informal sector. Reflecting

9 http://envfor.nic.in/cpcb/hpcreport/chapter_2.htm (accessed March 21, 2007)
the predominance of informal operations in various industries in the country, the e-waste management and disposal industry too is dominated by a “very entrepreneurial informal sector [1: 454]” that has developed organically from metal scrap operations. As computers began entering the waste stream in the late 1990s, the scrap-dealers began absorbing e-waste into their input stream as there were no specific regulations addressing its management and disposal. More than 2000 recyclers are involved in e-waste recycling in India [19] and “a noticeable degree of specialization has emerged, with some waste processors focusing only on e-waste [18:500].” They handle disassembly, segregation, component and material recovery from various computer components [19] and different players specialize in recovering specific materials. Most of these activities involve manual techniques and their recovery rates from the crude recycling processes are barely 0.1% by weight. This contrasts with the 30-40% achieved by the formal recycling units in the country [12], and the 99% recovery achieved by recycling facilities overseas. Thus, even while the informal recycling activities are economically useful and yield reusable components and metal, the extraction of precious and nonferrous metals from circuit boards or plastic-coated cable in e-waste, without proper pollution control equipment and technology, creates environmental and occupational hazards[7]. A formal e-waste recycling sector exists in parallel with the informal sector in the country. According to the Environment Waste Agency (EWA) in Bangalore, there are three formal e-waste recycling units in the country – Trishyiraya in Chennai, E-Parisaraa and Ash Recyclers in Bangalore. Although both the formal and informal recyclers perform metal recovery, their processes differ. In contrast to the informal recyclers who use manual recovery techniques, the formal recyclers use mechanized shredding or pulverization to recover metal[14], although disassembly and segregation of e-waste is manual. However, despite the efforts of the government to promote formal recycling units, their mechanized processes increase the cost of recycling and, subsequently reduce the rates they offer for e-waste in comparison their informal counterparts. This reduces the share of their operations and consequently, they process barely 1% of the total e-waste in the country.

Fig. 4 shows that domestic consumers interact with both the formal and the informal sector. Among domestic consumers, while large corporate consumers tend to dispose their waste to formal recyclers, households and smaller organizations dispose to the informal sector. Illegally imported e-waste is also managed by the informal sector. The figure also shows that e-

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13 Interview with industry representative, April 2, 2007.


14 The field work for the paper revealed that two of the three formal units in the country export the shredded/pulverized e-waste to recycling facilities abroad for metal recovery. This is because these units lack the technical expertise that enables their foreign counterparts to engage in safe and efficient metal recovery.

15 Ibid.
waste flows seamlessly not only within the informal sector, but also across the boundaries of the formal and informal sectors.

The e-waste trade across sectoral boundaries has been facilitated by unclear regulations. The HW Management Rules Amendments in 2000 and 2003 deemed e-waste hazardous because it contains harmful nonferrous chemicals including lead, mercury and cadmium. These rules mandated all facilities that collect, treat, store and dispose these hazardous wastes be authorized. Nevertheless, e-waste trade in the informal sector continues for two reasons. One, being profitable, it became integral to the informal recycling operations. Second, ambiguities in the regulations that are elaborated further in the paper allow the scrap-dealers to carry out these restricted operations even within the regulatory regime.

Thus, according to the HW Management Rules, the formal e-waste recycling units are the only agencies authorized to procure e-waste directly from the consumers. These units recover material and components through segregation, disassembly, shredding or pulverizing, and material recovery. Besides being formal recyclers, these are the only units in the country that are authorized to trade in e-waste. Therefore, under the existing licensing conditions, it is illegal for a scrap-dealer to procure e-waste directly from consumers. However, there are no regulations that restrict scrap-dealers from procuring certain portions of segregated or disassembled e-waste from the formal recyclers.16

Even while the formal recyclers are the only ones authorized to deal with e-waste, there are no regulations that mandate consumers to dispose their e-waste to the formal units. Free to dispose it to any agency of their choice, consumers do not discriminate between the formal and the informal sector. Thus, although it is legal for a consumer to dispose his e-waste to a scrap-dealer, it is illegal for the scrap-dealer to procure such waste from the consumer under the HW Management Rules. These conflicting provisions in the regulations have thus fostered e-waste trade in the ‘gray market’.

Further, formal recycling units are licensed only on the basis of their recycling processes, i.e. it is not illegal for a formal recycling unit to procure its e-waste from the informal sector so long as it is processed safely. This contradicts the HW Management Rules that mandate all e-waste scrap-dealers be authorized. These ambiguities have created fuzzy boundaries between the formal and informal e-waste recycling sectors and have given rise to activities that exploit this fuzziness. As a consequence, e-waste flows seamlessly across sectoral boundaries, all within the regulatory regime.

16 The field work for this paper revealed that it was not illegal for a scrap-dealer to trade in and recycle the non-hazardous, ferrous portions of e-waste. However, since ‘e-waste’ itself is a mix of hazardous and non-hazardous ferrous and non-ferrous metals, it is considered illegal for a scrap-dealer to engage in ‘e-waste’ trade and recycling. (Interview with industry representative, March 14, 2007).
VI. THE DILEMMAS OF E-WASTE FLOWS IN INDIA

Having examined the regulatory regime and the e-waste trade, this section will describe how the developmental dilemmas underlying e-waste flows are manifest in India. Although the Indian government recognizes the environmental impacts of the uncontrolled and risky low-cost informal e-waste recycling operations and has designed regulations to address them, the informal sector continues to thrive. As Section V has pointed out, the ambiguity in regulations like the HW Management Rules has created fuzzy boundaries between the formal and informal e-waste recycling sectors in the country.

Consequently, e-waste flows across sectoral boundaries have enabled an interdependent relationship between the formal and informal recycling units. As the formal units begin to receive e-waste from the gray market, they are likely to process illegally imported e-waste that has been routed from the ports to the gray market. However, these operations cannot be dismissed as illegitimate. In some cases, the relationship between the e-waste recycling sectors also mirrors the international division of labor in the global e-waste recycling industry, with each sector complementing the other. In this sense, besides procuring e-waste, the formal sector is increasingly using the informal sector’s expertise in manual segregation and disassembly to complement its mechanized recycling processes. This interdependent relationship not only facilitates a steady supply of e-waste and skilled labor to the formal sector, but also generates employment for the informal sector.

In Delhi alone, the various waste collection and material recovery processes employ more than one million of the urban poor, and about 10,000 of them are engaged in the e-waste trade and reprocessing units [20]. Most of those who are engaged in these activities are rural, landless migrants from the neighboring states as the skills needed for entry are low. Additionally, the substantial profit margin that is possible in neighboring states as the skills needed for entry are low.

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The rationale behind such moves is two-fold. As this paper has shown, imported e-waste is largely processed by the informal sector in developing countries. Although the sector specializes in manual recycling processes, their material recovery operations are crude and rudimentary. Consequently, not only do their operations have adverse occupational health and environmental effects, they also have poor recovery rates. On the other hand, manual recycling operations are expensive in developed countries. However, the technology for safe, efficient and profitable metal recovery is available. Regulations that permit transnational e-waste flows will allow developed countries to take advantage of the cheap labor in developing countries. Further, by routing a steady flow of e-waste for disassembly and segregation they also address the issue of employment. Two, if the regulatory authorities in developing countries ensure that the informal sector’s skills in manual segregation and disassembly complements the mechanized shredding and pulverization processes of the formal sector, they will facilitate more value addition to the recycling operations. However, they also have to ensure that the workers are provided adequate PPEs, to mitigate the adverse impacts of unsafe recycling. By highlighting a local division of labor between the formal and informal sector that mirrors the international divide, such initiatives to identify complementary roles can potentially address the concerns of all actors.

Underscoring a division of labor that exists in the global e-waste recycling industry, will not only provide employment in developing countries, but also promote a cleaner environment. While environmental regulations are stringent in developed countries, they tend to be lax and weakly enforced in developing countries, thus encouraging unsafe informal recycling operations. However, by transferring only the manual recycling processes to the developing world and by recalling the segregated and disassembled e-waste for material recovery, developed countries will facilitate an exit of developing countries from material recovery operations. These operations are then restricted to those countries with the regulatory and

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17 Interview with official from Karnataka State Pollution Control Board (KSPCB), April 11, 2007.

VII. CONCLUSIONS

To the extent that there are no unforeseen changes in demand or improvements in manufacturing technology, e-waste generation is likely to grow as the capabilities of PCs increase and their prices fall. Dealing with such growth will require governance structures. However, as this paper has shown, as long as the costs of compliance with governance structures exceed the benefits from transnational e-waste flows, they will be ignored. In this situation, it is crucial for these structures to comprehend the economic and social consequences of these flows and incorporate them in a manner that benefits all actors. Thus, regulations like the Basel Convention and its Amendment must not ban e-waste trade outright. Nevertheless, the purpose is not to encourage the creation of pollution havens through unidirectional e-waste flows from developed to developing countries. Instead, given the economic logic of e-waste recycling, regulations must acknowledge the international division of labor in this industry and facilitate a two-way flow of e-waste between the developed and developing countries.

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technological capability to engage in them with minimal hazards. Indeed, as the environmentally most dangerous operations in e-waste recycling are pushed back, the responsibility of safe management falls back on the generators of e-waste addressing the concerns about the impacts of *distancing* of waste. What is true for imports also applies for the growing volume of domestic e-waste generated in developing countries. Being a part of a regulatory regime that permits flows will allow them to send the most toxic aspects of material recovery to developed countries while recycling waste for manual operations.

Even while the transnational e-waste flows currently seem to vindicate the *pollution haven* hypothesis, as the paper has shown, freer flows have the potential to promote cleaner environments even in countries with weak environmental regulations. This is not to preclude the importance of key generators to ratify the Basel Convention and its Amendment, and the role for regulations like the WEEE or the RoHS. These are essential to assign responsibility of e-waste management to specific actors and to proactively reduce the absolute quantity of e-waste generated. However, even if regulatory loop-holes are plugged and a country like the US becomes a signatory, to minimize the quantity of e-waste and its impacts on the environment, acknowledging the division of labor offers a pragmatic means towards sustained economic benefits and a greener environment.

Much as codes and regulations attempt to take advantage of transnational e-waste flows to benefit society, increasing the awareness among the public about safe e-waste management and disposal is crucial. In developed countries, it is central to diverting e-waste from landfills and recycling it. In developing countries it is more about deflecting e-waste from the informal sector and educating those employed in the sector about the hazards they are exposed to. Although policies designed to change public behavior may take a while to sink in, such a change is already emerging among corporate consumers. When it will set in among others remains to be seen.

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