

Assessing Energy Status in Egyptian Industrial Sector

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Abstract: In view of the current energy crisis worldwide due to the depletion of fossil fuels resources and increasing consumers demand, implementation of proper energy management (EM) become a must. The present study aims to evaluate the status of energy management practices in one of the top energy consuming sectors in Egypt, the industrial sector. That was done in order to assess the current level of energy management practices, consequently recommend improvement options and further need for studies.

Data was collected from globally published documents related to energy management in Egypt during the period from 2000 till 2018. By studying and analyzing this data it was found that limited documents were published concerning the implemented cases of energy management systems in the Egyptian industrial sector, 97% of the published documents were case study reports and only 3% were research papers. The published documents represented EM practices in 14 industries. The top local industries with publications were Steel, Petrochemicals, Gas and Oil, Cement and Equipment & appliances.

Results indicated that many challenges face the implementation of energy management system in the local industrial sector such as: non-availability of data for development of proper EM strategies, lack of awareness about EM among top management and shop floor employees, usage of old and inefficient machinery. Additionally there is a huge gap between the academic and industrial sector in terms of knowledge share, consultancy and cooperation.

The potential of implementing EM practices in Egyptian industrial sector is a huge one, that can be encouraged by many practices like: raising awareness about the importance of EM and its benefits among decision makers in the industry, archive energy related data for development of proper EM strategies and replace inefficient machinery with efficient one. Furthermore, bridges of collaboration between the academic and industrial sector are highly encouraged to study best practices for each industry. Only two research papers were found related to this important issue, further publications must be done studying the local industrial case and sharing this important knowledge with academics, researchers and experts in the field.

Keywords: *Energy management, Egypt, Publications, Industrial Sector, Electricity*

1) Introduction

Egypt is the largest oil producing country outside the Organization of Petroleum Exporting Countries (OPEC) in Africa and the third largest natural gas producer on the continent. Egypt's location reserved an important role in the international energy market. The country is determining to be an electricity hub in the Middle East. It already has grid connection with Jordan, Iraq, Syria, Turkey, and Libya and has the intention to expand the grid with other African countries. A \$1.6 billion deal between the Egypt and Saudi Arabia to provide the two countries with 3.5 GW electricity cables was established. Egypt also has

signed a lot of agreements between 2013-2014 altering conventional ways of producing electricity and varying the national energy mix ^(1,2).

Fossil fuel are the main resource for energy in Egypt especially Natural gas and Oil. This dependence on Natural gas is justified by the new expansion in natural gas exploration in the western desert and off shore ⁽²⁾. However, Egypt has been suffering from the energy crises since 2011 due to the high rise in demand from the end users, absence of enough fuel to run the power stations, poor infrastructure of generating units and transmission lines, in addition to Egypt's growing population which helped to raise the energy demand. Egypt electricity generation relies on thermal power stations and these power plants are in service for more than 20 years ^(2,3). Moreover, end users are rapidly increasing which is a burden on the supply grid and the current energy consumption is not an efficient one. With this in regard, energy efficiency became a must to tackle the problem ⁽⁴⁾.

Upon these stated facts, measures should be taken to reduce the increasing energy consumption in Egypt in an efficient way. The aim of this study is to assist in addressing the energy crisis in Egypt by identifying energy reduction opportunities in the Egyptian industrial sector and recommend related improvement options. The industrial sector in Egypt is the second highest consumer of energy accounting for 19.4% of the total energy consumption ⁽⁵⁾.

2) Methods and Data Collection

In order to assess the energy management status of the industrial sector in Egypt, its application of energy saving measurements and potential for implementing energy reduction approaches, the published documents related to energy management in Egypt were collected from 2000 till 2018 following the developed model by ⁽⁶⁾. These published documents were screened, reviewed, studied and analyzed. Selection criteria included only the published documents related to Energy management in Egypt which can be found by researchers and scholars though the Google search engine. Criteria also included published documents by both Egyptian and non-Egyptian scholars, companies and organizations. Published research papers, review articles, conference papers and case study reports were considered.

3) Results and discussion

3.1. Status of publication in Egypt

By reviewing the published documents related to energy status in Egypt and its energy management applications it was found that there is no historical data and limited energy profiles are available. The total of publications were only 66 documents. The majority of these documents (97%) were case study reports and only 3% were research papers (Figure 1). The published documents represented conducted works in 14 industry, which are presented in figure (2).

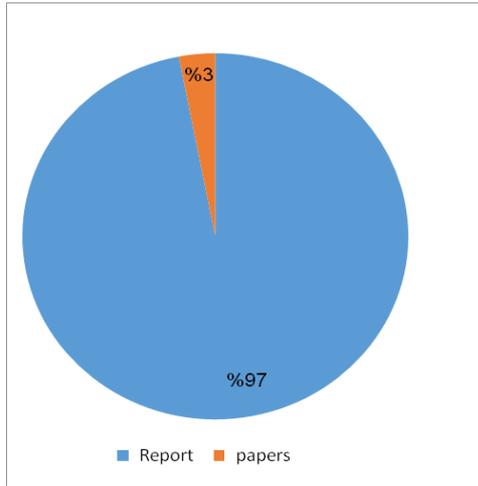


Fig.1. Percentage of published documents related to Energy Management in the Egyptian industrial sector

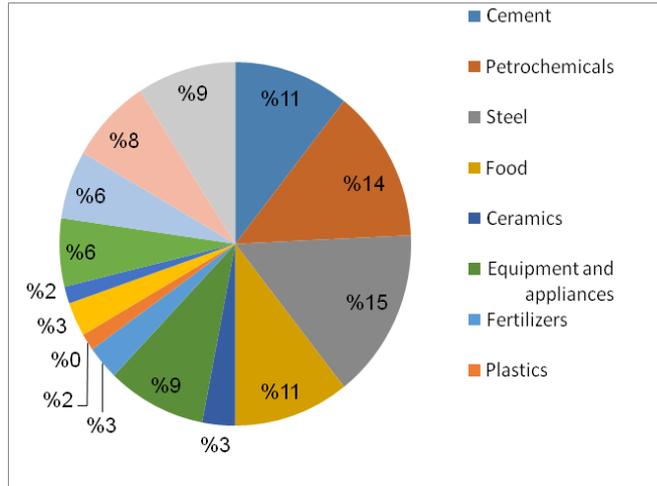


Fig.2. Percentage of published documents per type of industry

3.2.Covered industries

Study results show that the published documents related to energy management application in Egypt cover 14 industries. Figure.3. shows the addressed industries and related publications. Accordingly the top local industries with publications were the following heavy energy consuming industries: Steel, Petrochemicals, Cement, Gas and Oil, and Equipment & appliances, consecutively As per the EIA (2016)⁽⁷⁾. that classifies the industries according to their energy consumption, food industry is the most intensive energy consuming industry in spite of that the share of local food industry in the published documents was only 7 reports. While Petrochemicals industry has 9 reports and Oil & Gas industry has 5 publications.

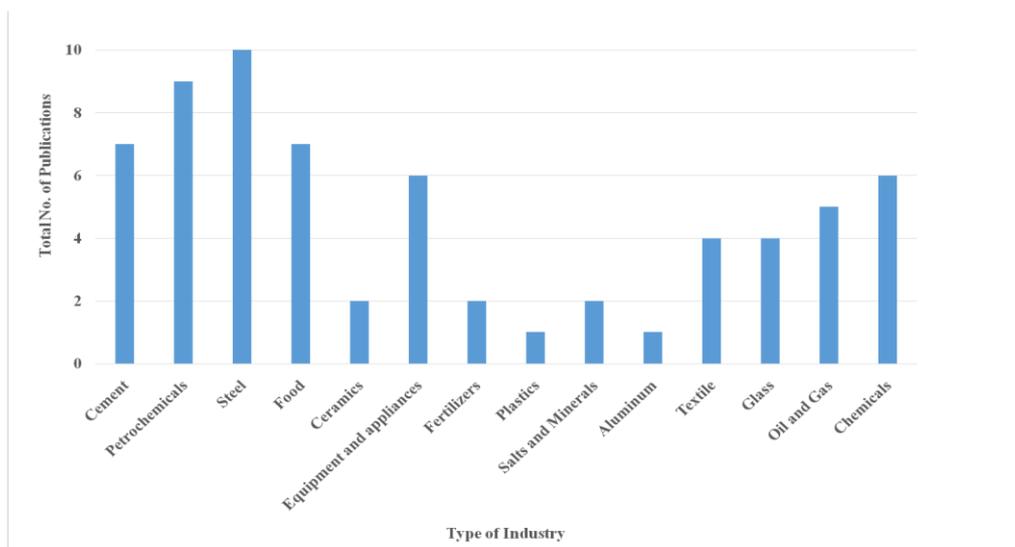


Fig.3. Number of publications per type of industry

3.3.Main findings:

By reviewing the published documents and case studies related to energy management applications in the Egyptian industrial sector several issues were identified, these issues can be summarized as following:

3.3.1. Data availability

The available data is not sufficient to develop proper strategic energy plans and policies for managers and decision makers in the industrial sector. As presented in figure 1 the total number of published work is very low. Most of the data was collected from reports from UNIDO project case studies except for only 2 published research papers. This indicates that there is no interest or proper awareness in the industrial sector to publish or even providing data for research purposes.

3.3.2. Challenges in energy management implementation

In accordance with UNIDO (2015)⁽⁸⁾ the implementation of proper energy management systems and related approaches in local industrial facilities face many obstacles such as:

- No availability of a clear energy management plan or clear energy management measures.
- Lack of communication between the board directors and top management who plan the energy management strategy in the company and shop floor personnel who implement the strategy.
- Bureaucracy and inflexibility to implement the energy management strategy.
- excessive inefficient energy consumption in the industrial sector due to accumulated inefficient equipment and processes
- Capacity building for energy management training already started a few decades ago but has not been sustained
- There is No sufficient guidance to small and medium industries
- Micro-enterprises are difficult to target because of their large numbers, different locations and inefficient technical capacities. Additionally, the informal industrial sector cannot be targeted directly before they are formalized

3.3.3.Awareness

Awareness about the importance of energy management opportunities and their implementation is a very important issue. It is a low cost opportunity for energy saving by changing human behavior in work environment. Spreading awareness on EMS through training sessions and flyers will ease the company strategy towards any future change in energy consumption. Furthermore, employee awareness leads to a reduction in energy costs⁽⁹⁾. Most of the published documents related to EM in Egyptian industrial sector complained about limited awareness either among board director or the technicians and personnel. Due to the recent minimize in energy subsidy, energy management became a must for the industrial facilities. Board directors in the industrial sector start paying attention to the

potential savings regarding their industry. In spite of that there is still lack of energy efficiency culture within both top management and shop floor employees.

3.3.4. ISO50001:2011

ISO 50001 is an international standard guideline for energy management that helps organizations save money using energy efficiently as well as helping to conserve resources and tackle climate change. The implementation of ISO 50001:2011 is done through the development of an energy management system (EMS) (ISO50001:2011). By reviewing the collected materials it was found that a total number of 35 case study companies had implemented the EMS according to ISO 50001:2011 (Figure 4). Some companies such as EZDK, Amreyah Cement, El Araby, Galaxy Chemicals and El-Dawleya for Modern Food Industries were certified or crowned their new policies by the ISO50001:2011^(10,11,12,13,14). One case study in a local textile manufacturing facility reported the development steps of their EMS according to the ISO 50001 standard and the achieved cost saving which reached about 70,000 USD/year^(15,16).

3.3.5. Focus on few improvement options

The published cases focused on three main topics as shown in Figure (4) which are :a) Implementation of EMS, b) Achieving optimum efficiency of motors, and c) Compressed Air System Optimization (CASO) :

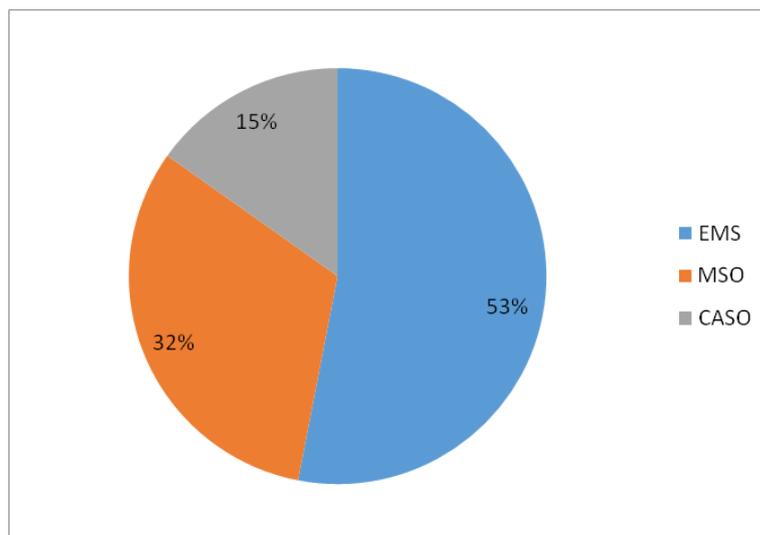


Fig.4. Percentage of focus topics

- Regarding the implementation of Energy Management Systems (EMS), the number of reported cases is 5 and they focused mainly on electrical and thermal potential savings. In some cases water savings opportunities with an impact of energy minimization were considered. In addition to several opportunities of no cost savings that were achieved by shutting down the equipment during downtime, reduction of the number of pumps, increase of chemical energy participation in the industry, usage of rice ash as insulation, optimizing the consumption of oxygen, and reduction of tap to tap time^(17,18)

-As for Motor System Optimization (MSO) it was found that 16 case studies focused on this topic. MSO was done by selection of proper sizing of motor, usage of efficient motor and

applying best maintenance practices. Some practices did not require any additional costs such as shutting off the cooling tower fan when there is no need for cooling during winter weather or night time (ref). Electric motors consume 70% of energy consumption of industrial sectors, as they are present in fans, pumps, electrical drives, ..etc⁽¹⁹⁾. Some companies focused only on MSO, others prefer to implement a more comprehensive EMS including other Electrical and thermal potential savings.

- In the case of Compressed Air System Optimization (CASO), total number of reported cases were only 5. Main problems regarding CASO reports were inappropriate use of some machinery, usage of old control system, Leakeges, poor maintenance. Additionally, waste heat recovery was available in some cases. The payback period of CASO modifications was immediate and most probably in near future less than one year^(18,19,20,21,22,23).

3.4.Greenhouse Gases (GHG) Reduction

Climate change has a drastic impact on the ecosystem especially biodiversity. Rising temperature, burning forests, melting snow packs and sea level rising are all consequences of climate change⁽²⁴⁾. The dominant cause for previous disasters is Greenhouse gases. These Greenhouse gases (GHG) are mainly emissions from burning fossil fuel which is the main source of energy⁽²⁵⁾. Greenhouse gases from energy sector represent two-thirds of all greenhouse gases⁽²⁶⁾. According to central agency for public mobilization and statistics⁽⁵⁾, electricity production is the largest carbon dioxide emitter preceding the industrial sector at the local level. The electricity production sector generates 43.28% carbon dioxide emission and the industrial sector is responsible of 15.4% of these emissions⁽⁵⁾. The reduction of energy consumption, and related combustion process is a direct reduction of emitted GHG generated from the combustion process of energy production. Many cases reported their GHG reduction due to EM practices^(13,14,18,19).

3.5.Utilities

In some companies, the industrial energy efficiency (IEE) scope targeted improving the energy consumption by addressing water saving opportunities⁽⁸⁾. Some companies do have utilities that use water excessively. They managed to take many procedures in action to reduce water consumption which should be rationally used^(11,12). Regarding the local energy saving approaches in the Egyptian industrial sector, it was found that the two sole companies who took water saving in consideration were food and chemical industry companies^(11,12). By saving water the company directly reduced the direct costs of both energy and water consumption. The addressed measures reported in this case for water saving included⁽²⁷⁾:

- Adjusting cooling water temperature at refrigeration plant to reduce energy consumption.
- Connecting air conditioning plant with cooling water to reduce compressors consumptions.
- Use reject water after treatment.
- control domestic water use, and water irrigation

4. Recommendation and improvement options and Future need of studies

It was found that there is a lot of potential for energy saving opportunities in the local industrial sector, which can be summarized as following:

4.1. Adaptation to proper energy consumption by

- Raising awareness of both top management and the employed staff of the energy consumption and related economic and environmental impact of their industry .
- Archive all energy data and related documents in the different industrial facilities.
- Set amendments to constitution or even imposing laws to force institutions to rationalize energy consumption

4.2. Introduce alternatives to fossil fuels:

- Switching fossil fuel to non-carbon based energy resource.
- Shifting from high carbon content to low carbon content.

4.3. Knowledge sharing

- Encourage collaboration between the researchers and industrial sector
- Build communication path between the researchers and industry
- Consider economic and practical aspects in future research studies related to energy management practices.
- Creation of a data bank for energy related issues that serves researchers in both the academic and industrial sector.

5. Conclusion

The local industrial sector has a lot of potential for energy saving opportunities and related green house gas reduction. Raising awareness about the importance of energy saving and related economic and environmental impacts among decision makers, top management and shop floor employees is one of the most important ways to reduce energy consumption with no cost. Further potential applications include setting amendments for energy consumption rationalization, Introduce alternatives to fossil fuels and encourage Knowledge sharing between academic and non-academic experts in the energy field.

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