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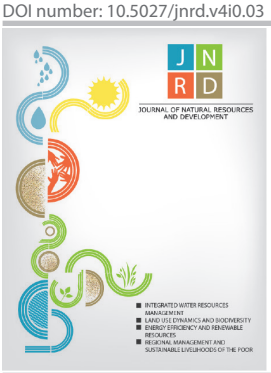

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A critical review on the National energy efficiency action plan of Egypt

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Abstract

Egypt, as with other developing countries, faces a major energy security problem, which strongly impacts all national plans for economic development. A sound energy strategy is crucially needed, and should be based on two pillars: first, boosting the production of clean energy from various renewable and non-renewable sources, and second, managing and rationalizing energy demand, with related reforms. Some steps were taken by previous Egyptian governments regarding these two pillars. In February 2008, the Ministry of Electricity and Energy of Egypt put a target of 20% of electricity to come from renewable energy resources by 2020. In July 2012, the Ministerial Cabinet approved both the Egyptian Solar Plan targeting 3500 MW of solar energy by 2027, and the National Energy Efficiency Action Plan (NEEAP) to reduce energy consumption 5% during the period from 2012-2015 compared to the average consumption of the previous 5 years. We believe that these plans will not bring their expected fruits unless they are well orchestrated with other sectoral development plans in areas such as agriculture, transport, housing and services, amongst others. This paper aims to investigate the Egyptian NEEAP and assess whether the adopted national energy efficiency plan and the associated policies on all other development sectors adopted by the government have sound implications. We aim to find out whether the development policies with a focus on energy policy are set in an integrated or fragmented way.

1. Introduction

Energy is a prime source of livelihood for many nations and is a cause of affluence for others. The world is facing twin energy-related threats: (i) not having adequate and secure supplies of energy at affordable prices and (ii) environmental harm caused by consuming too much of it. Consequently, it leads to a continuous increase in CO_2 emissions, which represents a little more than three quarters of the net greenhouse radiative forcing by human-made emissions (Mann, Alley & Pugh, 2013). As Prindle, Eldridge, Eckhardt, & Frederick (2007) argued, energy efficiency and renewable energy are the twin pillars of sustainable energy policy. In many countries energy efficiency is also seen to have a national security benefit because it can be used to reduce the level of energy imports from foreign countries and may slow down the rate at which domestic energy resources are depleted (Prindle, Eldridge, Eckhardt & Frederick, 2007). According to

the International Energy Agency (IEA), improved energy efficiency in buildings, industrial processes and transport could reduce the world's energy needs in 2050 by one third, and help control global emissions of greenhouse gases (International Energy Agency, 2006).

Egypt is a society under change. Where the main drivers in the shorter term appear to be socio-political and internal, the country will also be affected in the long term by global and climate change. This poses a series of threats to the livelihoods of people caused by limited access to natural resources in relation to the population size and economic growth. Specifically, Egypt faces a major energy security problem, which strongly impacts all national plans for economic development. The country's oil production peaked in 1993, and it became a net importer in 2010 (Mushalik, 2013). Due to population and economic growth this gap is forecasted to open further. On the other hand, national gas production initially grew steeply but has stagnated for the past three years. As it is mainly feeding the ever-growing demand for electricity, Egypt has also become a net importer of natural gas (BP, 2013).

A number of serious initiatives to reduce energy consumption have been initiated by concerned Ministries and organizations. Amongst them is the National Energy Efficiency Action Plan (NEEAP), aimed to reduce energy consumption by 5% during the period from 2012-2015 compared to the average consumption of the previous 5 years (Ministry of Electricity and Energy, 2012) .

This paper principally studies the Egyptian NEEAP and assesses whether there are sound implications for the adopted national energy efficiency plan and the associated policies in all other development sectors adopted by the government. We aim to find out whether the development policies with a focus on energy policy are set in an integrated or fragmented way.

The structure of this paper is as follows; section (2) explains the status quo of energy production and consumption in Egypt. Section (3) illustrates the Egyptian National Energy Efficiency Action Plan (NEEAP) in terms of its main targets and programs. Section (4) includes a critique to the current Egyptian NEEAP and suggestions for future development, and finally, section (5) includes the concluding remarks.

2. Energy challenges in Egypt

2.1 Challenges of Conventional Primary Energy Production

Analyzing the situation of national fossil fuel supply in Egypt reveals the difficult situation facing any Egyptian government in attempting to satisfy its needs using national resources alone. Figure 1 illustrates the historical development of national oil production and consumption in Egypt, showing that Egypt's oil production peaked in 1993 and has decreased since then. Despite the slight increase in production from 2006 until 2009, the overall historical pattern is similar to more than 60 other oil producing countries in the world (BP, 2013). It also reveals that by 2010 Egypt became a net oil importer from outside its national land. It is important to mention that the national production shown in the figure is not totally owned by the Egyptian government, but rather a great deal of it (30% to 50%) is owned by oil exploration companies in return for investments made during the exploration phase (EGAS, 2012). For more than a decade now, Egypt has been purchasing part of the oil owned by these exploration companies, until it became insufficient and now Egypt is importing oil from other foreign countries (Mushalik, 2013).

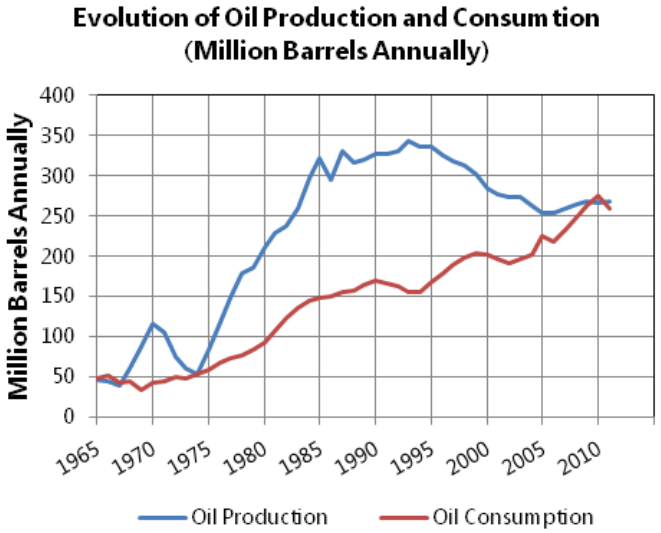

Figure 1. Evolution of national oil production and consumption from 1965 till 2011 (BP, 2013).

In terms of oil reserves, Figure 2 shows a stable reserve of around 4 billion barrels for the last 3 decades indicating no more large oil fields are expected to be discovered in the future and Egypt most probably will not be an oil rich country like its neighbours (Libya, Sudan, and Saudi Arabia) (BP, 2013). With an increasing population, oil consumption is expected to increase, and with decreasing oil production and flat reserves, Egypt will become more dependent on oil imports and be more susceptible to the high prices of oil. This means more burdens on an already exhausted national budget.

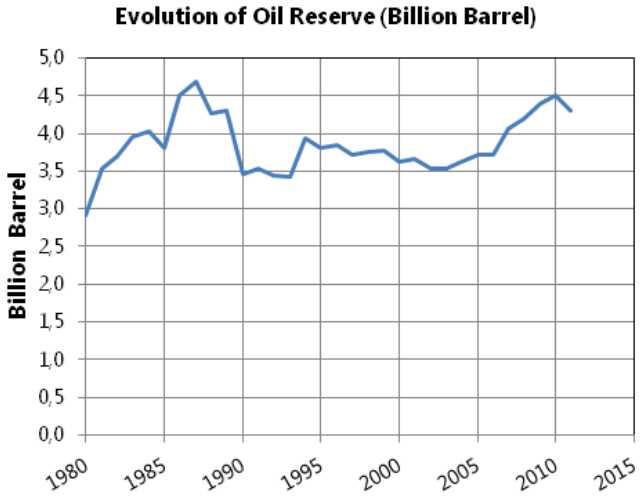

Figure 2. Evolution of oil reserve from 1980 till 2011 (BP, 2013).

Looking at natural gas numbers, the major fuel for power plants in Egypt, it can be seen that the situation is less dramatic, since national production is still greater than national consumption, as shown in Figure 3 (BP, 2013). It also shows that while consumption is monotonically increasing, production came to a halt in 2009. If both production and consumption keep their patterns, national consumption will surpass national production in just 4 years.

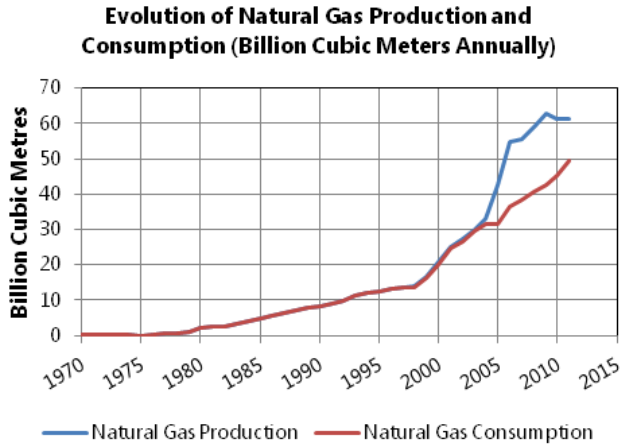

Figure 3. Evolution of natural gas production and consumption from 1970 till 2011 (BP, 2013).

It is worth mentioning here that according to the Egyptian Electricity Holding Company statistics for 2011 about 78.5% (19.4 M toe of a total 24.7 M toe of fossil fuel used in all production companies) of fossil fuel supplied to power plants is in the form of natural gas (Egyptian Electricity Holding Company, 2013). Despite the fact that gas production is greater than consumption, since 2010 power plants have experienced production disruption especially during summer times because of frequent pressure drops in natural gas pipes. Contrary to Egypt's experience of a stable and continuous supply of electricity for decades, in the last 3 years Egyptians have experienced frequent electricity outages as the Ministry of Electricity and Energy mitigate the effect of disruption in natural gas supply by implementing rolling black-outs.

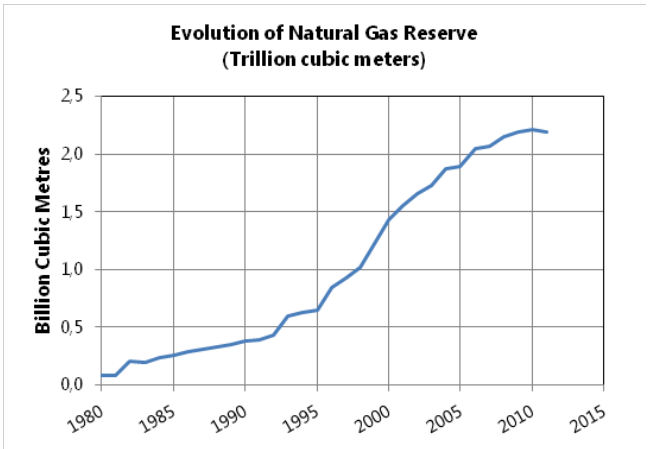

Figure 4. Evolution of natural gas reserve from 1980 till 2011 (BP, 2013).

In terms of natural gas reserves, their rate of increase has been decreasing since the beginning of the millennium, and the reserve value almost came to a peak in 2010 as shown in Figure 4 (BP, 2013). Currently, the Egyptian government is opening areas for international exploration companies in the deep water of the Mediterranean Sea where there are great hopes of finding large natural gas reserves similar to those of some neighbouring countries.

2.2 Electricity Generation in Egypt

Analyzing the electricity sector indicates that the installed capacity from thermal power plants constitutes the majority of the total installed capacity in Egypt, followed by hydro-electric power and a very minor contribution from wind power and only one solar thermal power plant, as shown in Figure 5 (NREA, 2013). Additionally, the dependence on thermal power plants has increased over the last decade, as shown in Figure 6. Comparing the figures in Figures 5 & 6 corresponding to the total installed capacity of 2002/2003 and 2011/2012, respectively, indicates that the contribution of thermal power plants to total installed capacity increased from 84.2% to 88% at the expense of hydro-electric power which decreased from 15.4% to 9.6% (NREA, 2013).

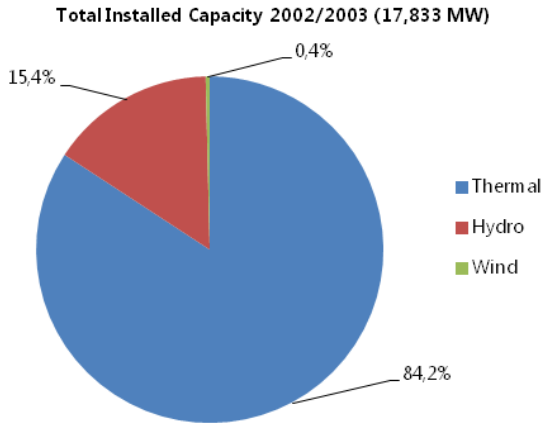

Figure 5. Total installed capacity 2002/2003 (17,833 MW) (NREA, 2013).

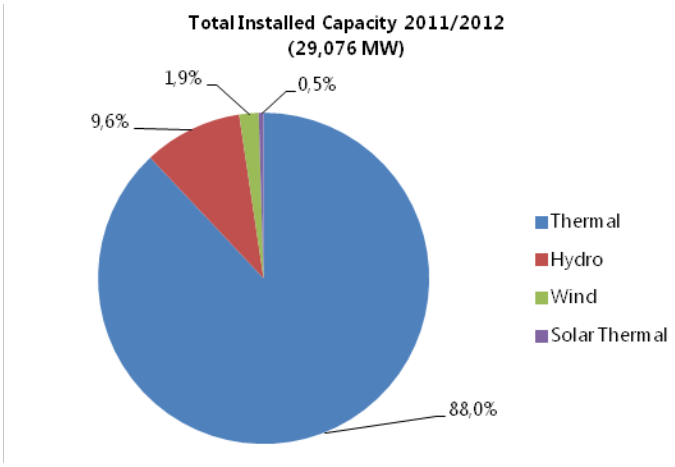

Figure 6. Total installed capacity 2011/2012 (29,076 MW) (NREA, 2013).

2.3 Electricity consumption in Egypt

According to Electricity Holding Company in Egypt, half of the electricity generated on low and medium voltage networks is consumed in the residential sector (50.7%), followed by the industrial sector (19.3%) and then the governmental sector (16.4%) as shown in Figure 7 (Egyptian Electricity Holding Company, 2013) . In addition, the residential sector represents the fastest growing sector in electricity consumption over the last 5 years. This is principally due to the expansion of residential compounds and new communities in addition to the widespread use of domestic appliances, especially household air conditioners due to hot weather during summer months.

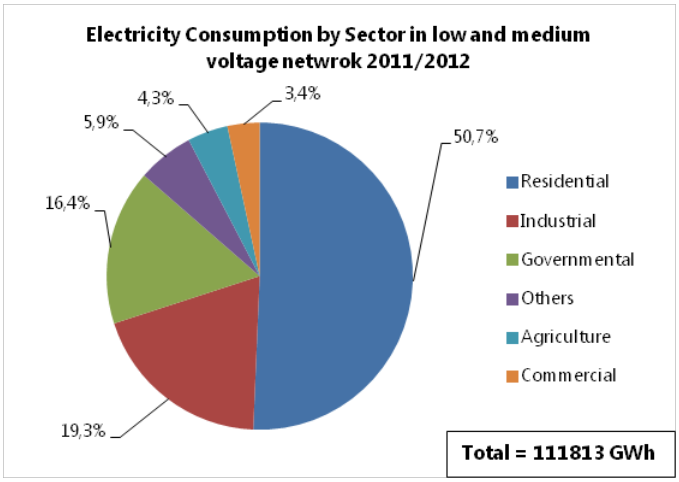

Figure 7. Electricity consumption by sector at low and medium voltage network for 2011/2012 (Egyptian Electricity Holding Company, 2013).

This non-productive consumption behavior results in a high burden on Egypt's economy where high levels of investment have to be made year after year in order to satisfy the growing consumption in the residential sector without a comparable growth in the industrial sector.

3. The National Energy Efficiency Action Plan (NEEAP): Targets and programs

Electrical Energy consumption has increased tremendously in recent years without a proportional increase in the national GDP. Electricity intensity defined as the ratio of electricity consumption to the national GDP is a standard measure for how efficiently energy is used in a country. Figure 8 shows the GDP per capita versus electrical energy consumption per capita for selected countries, including Egypt. This shows that most European countries and emerging economies (Brazil, Turkey, Malaysia, and South Africa) are doing much better in terms of energy intensity than Egypt (OECD/IEA, 2013). For example, Turkey (which has almost the same population as Egypt) has more than double the GDP per capita of Egypt while consuming only 33% more electricity per capita than Egypt. This shows a better utilization of resources pushing a growing economy.

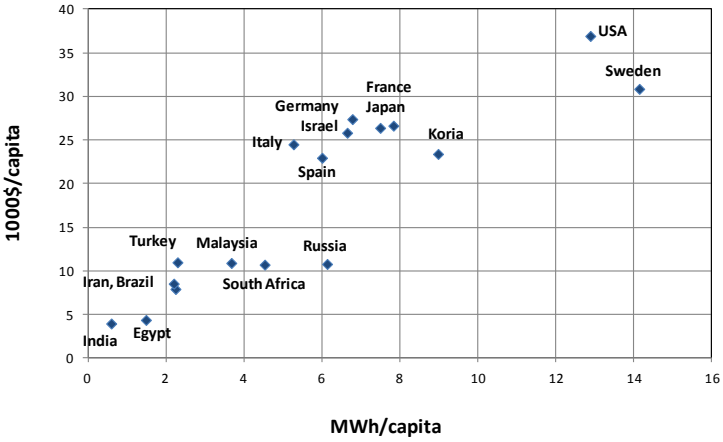

Figure 8. GDP per capita versus electrical energy consumption per capita for selected countries (OECD/IEA, 2013).

Realizing the severity of primary energy availability on the one hand, and high non-production consumption of electricity on the other, the Egyptian government has developed the National Energy Efficiency Action Plan (NEEAP) for the period 2012-2015. The NEEAP, which was approved by the Cabinet on 11/7/2012, includes targets and measures aiming to improve energy efficiency of end-users in some sectors of consumption and will be implemented in cooperation with the Ministry of Electricity and Energy and other ministries such as the Ministry of Industry and Foreign Trade, the Ministry of Housing, the Ministry of Local Development and the Ministry of Tourism (Egyptian Electricity Holding Company, 2013).

Overall, the Egyptian NEEAP has set a target to achieve cumulative energy savings of 5% of the average of the last five years of consumption (i.e. for the period 2008-2012). This is achieved through 4 different types of procedure:

- Procedures in main sectors
- Procedures in complementary sectors
- Procedures across different sectors
- Evaluation of the progress in energy efficiency policies

In the following subsections, a description of each of these procedures will be illustrated.

3.1 Energy efficiency procedures in main sectors

Main sectors include 3 main areas: the residential sector, public utilities and governmental buildings, and the tourism sector.

3.1.1 Residential Sector: efficient lighting and high efficiency household appliances

In 2010/2011, consumption in the residential sector reached 41% of total consumption. Out of this amount, 30% is consumed for lighting and 70% for the use of electrical appliances, especially air conditioners in summer (Abdin, 2009). The NEEAP aims to implement 3 procedures in the residential sector: efficient lamps, efficient appliances, and the increased use of solar water heaters.

It is worth mentioning that Compact Fluorescent Lamps (CFL) are not new in Egypt, electricity distribution companies have sold 12 million lamps at half price with an 18-month guarantee period, and another 3 million lamps are being sold with the same conditions. The NEEAP targets selling 12 million more lamps during the aforementioned period (RCREEE, 2013). Regarding energy standards and labels, they have been developed for 5 household appliances (refrigerators, automatic washing machines, air conditioners, electrical water heaters, CFL and electronic ballasts). Ministerial decrees have been issued to enforce these standards, testing laboratories have been set up under the New and Renewable Energy Authority (NREA), and a guide book has been prepared to assist consumers in their selection.

3.1.2 Public Utilities and Governmental Buildings

Given that street lighting consumes 4.9% of total energy consumption in Egypt, a program has been developed to replace the 400, and 250 watt sodium, mercury vapor, and incandescent lamps with high efficiency 250, and 150 watt sodium lamps or 85, and 120 watt CFLs without affecting lighting conditions as required by national and international norms. The NEEAP target is to replace 1 million lamps, and 340,000 lamps have been replaced to date (Egyptian Electricity Holding Company, 2013).

Governmental buildings consume about 5% of total consumption. A study has been conducted to investigate the opportunities of reducing electricity consumption in this sector leading to the following recommendations (Egyptian Electricity Holding Company, 2013):

1. An energy efficiency code for governmental buildings has been developed and a ministerial decree has been issued for its enforcement.
2. A resolution has been adopted by the Supreme Council of Energy for improving energy efficiency of governmental buildings.
3. Electricity distribution companies implemented energy efficiency projects in buildings belonging to the power sector or within the geographical area of the electricity distribution companies.
4. The Energy Efficiency Improvement project, funded by GEF and UNDP, executed by the Ministry of Electricity and Energy has implemented energy efficiency pilot projects in some governmental buildings (Ministry of Irrigation and Water Resources) and achieved 17% savings through replacing lighting systems with more efficient ones.
5. Capacity-building and training sessions have been provided to employees of governmental buildings in the field of energy efficiency auditing and efficient lighting.

As for public utilities, a program is currently underway for drinking water plants and sanitary stations to improve the power factor for stations with a power factor less than 0.9.

3.1.3 Tourism Sector

The targeted energy saving in the tourism sector focuses on increasing the use of solar water heaters in hotels located in Red Sea and Sinai governorates. Table 1 indicates the adopted procedures in the three main sectors: residential, public utilities and governmental buildings sector, and tourism, as well as the expected energy savings (GWh) for each sector in the period from 2012 to 2015.

Table 1. NEEAP procedures in the residential sector.

Procedure	Expected energy saved (GWh) (2012-2015)
The use of high efficient lamps in the residential sector (distributing 12 million lamps)	3330
The use of efficient appliances (second stage of standards and labels program)	663
Develop and implement a financing mechanism with a bank or several banks to facilitate solar water heater ownership	67

3.2 Procedures in complementary sectors

In this section, the Ministry of Electricity and Energy lists a set of renewable energy projects, 4 wind projects and 3 solar projects, in addition to 3 combined cycle power plants. It also includes a renovation of Aswan and the high dam turbines, and increasing the efficiency of 3 existing thermal power plants.

Many awareness and media campaigns are also listed to increase knowledge on energy saving among the general public. The ministry also targets reducing energy loss in the power network and increasing the use of smart meters in the residential sector.

3.3 Procedures across different sectors

This item of the NEEAP focuses on evaluating the existing potential of energy saving in the industrial, commercial and public sectors. It also provides the necessary knowledge and skills for workers and managers in these sectors to apply energy efficiency measures in their entities. Thus, the procedures range from energy auditing to capacity building, and extend to building certified labs for efficient lighting and reviewing existing legislation to promote energy efficiency (Ministry of Electricity and Energy, 2012)

3.4 Assess the evolution of energy efficiency policies

Here the NEEAP focuses on procedures that improve the structural and legislative setting in the government to boost energy efficiency in Egypt. This includes proposing a new law or decree to address energy efficiency, establishing a renewable energy fund to finance new renewable energy projects, setting a standard and color code for efficient appliances, and creating legislation to reduce or completely ban the use of inefficient lighting systems (Ministry of Electricity and Energy, 2012) .

It is worth mentioning that except for the projects listed in the first paragraph of 3.2, the remaining procedures in 3.2, 3.3, and 3.4 have no quantitative evaluation of the expected amount of energy savings over the period of the NEEAP.

4. Egyptian NEEAP: Critique and Future Development

This section presents the authors' critique of the current Egyptian NEEAP as well as suggestions for further improvements, as follows:

1. The fragmentation of the energy sector in Egypt between 2 ministries, the Ministry of Electricity and Energy and the Ministry of Petroleum, means that no one is actually overseeing the entire energy chain and planning for energy savings. This is a major structural deficiency in the Egyptian energy sector that needs a drastic decision by the ruling powers in order to merge the two ministries into one Ministry of Energy. The existence of such a single entity that looks after the whole energy chain is a must in order to be able to formulate a good master strategic plan for energy efficiency, for both primary and final energy. Unfortunately the disturbance in the Egyptian political system since the January 2011 revolution has been an obstacle to such a decision being taken by any governing power during this period.

2. The presented NEEAP is more a plan to improve electrical efficiency than energy efficiency. It introduces procedures to improve the efficiency of final energy (electricity) use and not primary energy use. This strengthens the notion that the Ministry of Electricity and Energy in Egypt is working solely as a Ministry of Electricity and not as a Ministry of Energy.

3. Though Egypt has become a net importer of fossil fuel, the NEEAP does not include any procedures for fossil fuel savings. This comes as no surprise since, as we mentioned in the first point, no one is looking after the whole energy chain in Egypt. It is worth mentioning that, lately, the government has started a smart card program for car fueling. This program was a reaction to fuel smuggling that led to repeated shortages of liquid fuel during 2012/2013, and not as a coordinated plan for energy saving. Fuel smuggling comes as a natural result of heavy fuel subsidies in Egypt while neighboring countries sell liquid fuel almost at international prices (Ministry of Petroleum, 2013).

4. The NEEAP does not address the root cause behind the over-consumption of electricity in Egypt from the residential sector which is the heavy subsidy on electricity. While the average cost of electricity for residential consumption is 33.1 pst/kWh (4.8 cent$/kWh), the average selling price is 13.9 pst/kWh (2 cent$/kWh). With residential consumption around 6000 GWh, the total subsidy for this sector alone reaches 10.6 B EGP (1.54 B $), which is far above all other sectors (EgyptEra, 2013). It is worth mentioning that the 6 brackets of electricity prices for the residential sector are 5, 11, 16, 24, 39, and 48 pst/kWh (0.72, 1.59, 2.32, 3.47, 5.64 cent$/kWh). So, it can be noticed that up to the 4th bracket with total consumption up to 650 kWh/month, the electricity price is well below the cost of generation. This heavy subsidy in the electricity sector leads to market distortion and thus over-consumption in the residential sector.
   The cost of subsidies can be summarized according to Fattouh and El-Katiri (2012) in three major areas as follows:
   a) Economic cost: energy subsidies encourage over-usage of energy, leading to high energy consumption growth rates and less interest in energy efficiency.
   b) Social cost: while energy subsidies play an important role in the well-being of the poor, richer households are likely to benefit from it as well. Additionally, a burdened national budget by fuel subsidies results in weak services in the 'pro-poor' sectors such as health and education.
   c) Environmental cost: as mentioned in the economic cost, energy subsidies increase irrational energy use which consequently leads to potential adverse environmental harm. Fuel subsidies also make renewable and clean energy technologies less competitive if not equally subsidized, and increase the burden on the national budget.

5. The amount of targeted saving is very minute considering the low energy intensity of Egypt and the huge amount of electricity consumed in non-production activities. The target saving of 5% of the average consumption of the period 2012-2015 will definitely be less than 5% by 2015, the final year of the program. Referring to Figure 8, if Egypt had the same electricity intensity as Brazil and Turkey while still maintaining the same GDP per capita as it has now, Egypt would consume 25% and 40% less electricity, respectively. This reveals that the saving potential in Egypt is much more than the targeted 5%.

6. As a result of the previous points, the NEEAP has no energy saving component in the transport and agriculture sectors and these two sectors are heavily dependent on fossil fuel rather than electricity.

7. Given the significant contribution residential buildings can make to reducing energy consumption, the focus on energy efficiency in this sector cannot be confined only to the use of efficient lamps, efficient appliances, and increased use of solar water heaters as illustrated in the Egyptian NEEAP. But rather, using less energy in buildings can be achieved through 3 wider approaches (WBCSD, 2008):
   a) A holistic design approach begins with master planning, takes the whole life cycle into account and embraces integrated building design processes.
   b) More appropriate financial mechanisms can support growing interest in high-performance buildings. For example, financial incentives can play a key role in helping energy-efficient buildings make business sense. New tax breaks and emerging markets for renewable energy should assist companies overcome internal financial obstacles and are expected to promote further investment in energy-efficient buildings.
   c) Drastic behavioral change of users.

8. Though a considerable ratio of energy consumption in the residential sector comes from the widespread use of air conditioners, there is no component in the NEEAP addressing the issue of the "building envelope", which is critical to energy efficient design. Principally, the integration of factors like shade, orientation, daylight, ventilation and appropriate materials is urgently needed. The energy-efficiency planning of the building envelope means

guaranteeing that necessary interior climate conditions can be maintained throughout the year with low energy requirements. A building envelope optimized for energy aspects has a maximized passive capacity and hence represents the foundation for valuable energy concepts in the future. Possible measures that can be taken into consideration during the planning and design of buildings are as follows (Hegger, Fuchs, Stark, & Zeumer, 2008):

For sites:
a) Longitudinal facades of buildings with Northern and Southern orientation
b) Evergreen trees on the north side to protect from winter winds
For buildings:
a) Masonry materials that change temperature slowly
b) Courtyard with fountain or pool for cooling effect
c) Overhangs or thick walls to protect windows from sun
d) Windows placed for good cross ventilation
e) Light exterior colors to reflect sun's heat

9. The NEEAP includes activities regarding renewable energy projects, however:
   a) These projects are not energy efficiency projects, but rather electricity generating projects.
   b) Saving electricity from existing over-consumption behavior is environmentally and economically better than generating electricity from expensive renewable energy resources, especially in a country such as Egypt where electricity is heavily subsidized.

5. Concluding remarks

Though the Egyptian NEEAP, issued in 2012, can be considered an initial step in the right direction to improving energy use in Egypt, more could have been planned and targeted by this document, not only in terms of quantitative measures but also of the structure of the energy sector as a whole. The fragmentation of how the energy sector is managed in Egypt between 2 ministries leads to conflict and a lack of a single responsible entity in charge of overseeing the entire energy chain. The issue of high electricity subsidies, particularly in the residential sector, is perceived as one of the major causes of over-consumption in this sector. The focus of the NEEAP is principally on electrical energy reduction and not energy efficiency in its wider perspective; it has no energy saving component in the transport and agriculture sectors despite their importance as two sectors that are heavily dependent on fossil fuels rather than electricity. Given the fact that approximately half of the electricity generated on low and medium voltage networks is consumed in the residential sector, attention should be placed on more innovative techniques to reduce energy consumption in this sector in particular. The NEEAP aims to implement 3 procedures in the residential sector to reduce electrical energy consumption: efficient lamps, efficient appliances, and the increased use of solar water heaters; however, these are perceived as insufficient. A holistic approach beginning with master planning, taking the whole life-cycle into account and embracing integrated building design processes is indispensable. This approach is essential to maximizing the potential of individual technologies and innovations. It begins at the community planning level to gain efficiencies on a larger scale than can be achieved in individual buildings and to integrate other energy uses, such as transport. Finally, raising society's awareness of the necessity to implement energy efficiency measures and the crucial need of behavioral change in users is one of the main factors needed to promote the measures addressed in the NEEAP and to foster the achievements of its targets.

References

Abdin, A. (2009). Energy Efficiency in the Building Sector and Market Opportunities in Egypt: Cairo University.

BP (2013). BP Statistical Review of World Energy 2013, http://www.bp.com/statisticalreview

Egypt Electricity Regulatory Agency (EgyptEra) (2013). Report on the cost of production, distribution, and transmission of electricity for 2011/2012. Retrieved from:http://egyptera.org/Downloads/reports/%D8%AA%D9%82%D8%B1%D9%8A%D8%B1%20%D8%AA%D9%83%D9%84%D9%81%D8%A9%20%D8%A3%D9%86%D8%AA%D8%A7%D8%AC%20%D9%88%D9%86%D9%82%D9%84%20%D9%88%D8%A-A%D9%88%D8%B2%D9%8A%D8%B9.pdf

Egyptian Electricity Holding Company (2013). Annual Report 2011/2012. Arab: Republic of Egypt, Ministry of Electricity and Energy. http://www.egelec.com/mysite1/annual%20report/annual%20report.htm

Egyptian Natural Gas Holding Company "EGAS" (2012). International Bid Round, Main Contract Terms and Conditions http://www.egas.com.eg/BidRound2012/Terms_Conditions_2012.pdf

Fattouh, B and El-Katiri, L. (2012). Energy Subsidies in the Arab World: United Nations Development Programme, Regional Bureau for Arab States Arab Human Development - Report Research Paper Series.

Hegger, M., Fuchs, M., Stark, T., & Zeumer, M. (2008). Energy Manual: Sustainable Architecture: Birkhauser; Basel. Boston.Berlin.

International Energy Agency (2006). World Energy Outlook 2006: OECD/IEA.

Mann, M., Alley, R., & Pugh, E. (2013). METEO 469: From Meteorology to Mitigation: Understanding Global Warming: The Pennsylvania State University. Retrieved from https://www.e-education.psu.edu/meteo469/node/181.

Ministry of Electricity and Energy (2012). Egypt's National Energy Efficiency Action Plan (NEEAP): Ministry of Electricity and Energy, Arabic version.

Ministry of Petroleum (2013). Smart Card Program for Car Fueling. Retrieved from https://www.esp.gov.eg/

Mushalik, M. (2013). 2/3 of Egypt's oil is gone 20 years after its peak. Crude Oil Peak, Retrieved from http://crudeoilpeak.info/23-of-egypt%E2%80%99s-oil-is-gone-20-years-after-its-peak

NREA (2013). Annual Report 2011/2012.New Renewable Energy Authority Ministry of Electricity and Energy. http://www.nrea.gov.eg

OECD/IEA (2013). International Energy Agency statistics http://www.iea.org/statistics/

Prindle, W., Eldridge, M., Eckhardt, M., & Frederick, A. (2007). The Twin Pillars of Sustainable Energy: Synergies between Energy Efficiency and Renewable Energy Technology and Policy: American Council for an Energy-Efficient Economy (ACEEE), Report Number E074. http://www.aceee.org/research-report/e074

Regional Center for Renewable Energy and Energy Efficiency "RCREEE" (2013). Egyptian NEEAP Follow-up [PowerPoint slides]. Retrieved from https://www.slideshare.net/secret/H12nxtKtKEMsyl

WBCSD. (2008). Energy Efficiency in Buildings, Business Realities and opportunities: Facts & Trends: World Business Council for Sustainable Development.