A Guide to Renewable Energy in Egypt and Jordan

Current Situation and Future Potentials

FRIEDRICH EBERT STIFTUNG

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Forward

Richard Probst

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The energy-policy context in the MENA region continues to be marked by a lopsided dependence on non-renewable, fossil energy sources. High population growth and energy-intensive consumption in the region will cause energy needs to surge by 6 to 7% per year in the future if consumption patterns stay the same. It is estimated that this will lead to a doubling of energy needs by the year 2020. To be able to meet a soaring demand for energy already evident at present, numerous countries in the region are increasingly turning to non-sustainable energy sources that are damaging to the climate. In addition, some countries in the region are continuing to push forward in varying levels of intensity with national civil nuclear programs, which in addition to environmental implications also pose challenges in terms of security policy. The subsidization of fossil energy sources in the region is putting a tremendous strain on government budgets. The subsidization regime is not contributing to socially just support for the weakest private households, however. On the contrary, subsidies serve the purpose of papering over ongoing structural social tensions in the Middle East and North Africa.

However, MENA continues to be a region with a huge potential for the expansion of renewable energy sources. Renewable energy sources nevertheless only account for 2.5% of total regional energy production in 2015. Although the underlying statutory conditions needed for the expansion of renewable energies and the promotion of energy efficiency (energy governance) have been established in most of these countries, there is an absence of resolute political implementation at the national level as well as critical analysis by key political and civil society stakeholders. Also, academic research is mostly focusing on technical aspects of renewable energy instead of the underlining social benefits, which will serve the respective societies. The present low price of oil may moreover make it appear economically opportune to avoid investment costs in renewable energy and continue to bank on conservative energy sources.

Having these regional developments in mind, it seems that the book "A Guide to Renewable Energy in Egypt and Jordan: Current Situation and Future Potentials" comes at the right time. Against all these odds a continued debate about the status quo of renewable energy and the social benefits and future of renewable energy is more important than ever. An enlightened debate about socio-economic aspects of a renewable energy transition in the MENA region is the call of the day. Egypt and Jordan may serve as good regional case studies, and lessons from these two countries can be learned for other countries of the region. Especially the focus on socio-economic aspects, which is the core of the book, is too often neglected in regional and national debates. The book could serve as an introduction to the renewable energy systems of Egypt and Jordan and should, ideally, create debate and foster political will to continue on the pathway of an energy transition towards the establishment of a sustainable and renewable energy future.

In 2015, FES in the MENA region created a regional sustainability-project, working on Renewable Energy and Climate Change. The office of FES Amman serves as a regional link for MENA activities under this sustainability project. The establishment of this project is in line with the needed energy-political shift within the region. The project supports and encourages a transition towards an energy supply based on renewable energy sources and the search for suitable policies to promote energy savings and energy efficiency measures.

The team of FES Amman is very grateful for the contribution of all four authors and their valuable contribution in each of the chapters. Thanks to Dr. Maged Mahmoud and Dr. El-Khayat from RCREEE for their insights and contribution to the Egyptian section, and to Dr. Ahmed Al-Salaymeh and Khawla Spetan from the University of Jordan for adding the Jordanian perspective. This book is a collaborative work between Egypt and Jordan's FES office that builds the nexus of policy and practice. A special thank goes therefore to Amal Abu-Jeries, Project Manager at FES office in Amman, and Fady Salah, Program Manager at FES office in Cairo, for their work on reviewing the book and making this regional project happen. Thanks to their work and commitment, this regional publication saw light after being an initial idea developed in the office of FES in Cairo and Amman■

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Introduction

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Program Manager, FES Jordan

Introduction

Egypt and Jordan, like many other countries in the Middle East, faced political uncertainty and an unfortunate economy as the so-called Arab Spring emerged and spread across the Arab World. Social factors, weak economies, and a lack of socially just distribution of welfare were significant reasons behind the so-called Arab Spring. Facing a political, fiscal and economic crisis, Egypt and Jordan struggle hard in order to take different reform strategies in various policy fields into consideration. Energy is one of the impediments that these countries face. Despite the fact that the MENA region has enough natural sustainable and renewable energy sources, most countries still depend on the imports of fossil fuels. Along with a future turn towards a renewable energy transition some important questions come along: What kind of renewable energy technologies and projects are available in Egypt and Jordan and who are the different stakeholders in this field? What are the core benefits of renewable energy and energy efficiency strategies? Is there a market for renewable energy sources that can enhance economic activity and has an appealing potential for growth and job creation? These and other questions have been debated in recent years due to the scarcity of resources and the economic crisis afflicting these countries. In short, there may be serious problems facing these two countries but solutions are, in principle, available.

According to the World Bank estimates, the region receives between 22 and 26% of all solar radiation striking the earth; this translates to a potential for solar energy per square kilometer per year equivalent to the energy generated from 1 to 2 million barrels of oil.[1] In addition, and according to the World Energy Outlook 2012 published by the Paris-based International Energy Agency, the share of renewable energy in total power generation in the Middle East is set to increase from the 2% in 2010, to 12% by 2035.[2]

Egypt and Jordan are considered good examples for other countries in the MENA region as they stand up to the many challenges in the field of energy supply, which is still a burden to governments and a barrier for social and economic development in both countries. The high demand and consumption of energy, population growth, limited non-renewable sources (with their negative impact on the ecosystems), human health and economic development have all prompted these governments to find alternative energy sources, revise their energy strategies and take a major regulatory shift in perspective to increasingly turning to renewable energy. For example, Egypt has already started its consideration of renewable energy since the 1970s. However, a renewable energy strategy was only formulated in the early 1980s as an integral part of the national energy planning in Egypt. Hence, the strategy objectives were never fully accomplished, save on the institutional level through establishing a dedicated renewable energy authority in 1986. Nevertheless, Egypt successfully became the leading Arab country in wind energy with over 700 megawatt of

[1] Jaikishin, Asnani, IFC Knowledge Series in MENA, *International Finance Cooperation*, World Bank Group, Issue 5, http://www.ifc.org/wps/wcm/connect/c6a15e8042cbdd4daa2bee384c61d9f7/Knowledg+issue+05+v6.pdf?MOD=AJPERES&The%20Potential%20of%20Renewable%20Energy%20in%20MENA (Accessed on 23rd August, 2015)

[2] *Ibid*

operational power generation plants and enacted a series of laws and regulations in the last few years triggering substantial development in solar energy projects. The current targets of 20% of electric energy demand from renewable energy sources by the year 2020 are ambitious but can be reached.[3] On the other side, Jordan has taken different steps in this field of energy such as the Cabinet's endorsement of the Energy Strategy 2007-2020 in the year 2004, passing the Renewable Energy and Energy Efficiency Law in early 2012, and implementing a large scale of projects on renewable energy sources.

Moreover, one of Egypt's main challenges is to satisfy increasing domestic oil demand amid falling production due to the fact that the total oil consumption grew by an annual average of 3% over the past 10 years, averaging 775,000 b/d in 2014. Egypt's oil consumption currently outpaces its oil production.[4] The discovery of natural gas in the Eastern Mediterranean in the Exclusive Economic Zones (EEZ) of Egypt might be a game changer in the regional energy-political context. However, this natural gas field is yet to be developed and exploited.

On the opposite of being an exporter country, Jordan is essentially an energy importing country of crude oil, petroleum products and natural gas estimating 20% of the country's budget. In the past decade, Jordan was hit by two major external energy supply shocks that ended the import of cheap energy. First, the US invasion of Iraq in 2003 disrupted the energy supply from Iraq to Jordan. Second, in the wake of the Egyptian revolution in 2011, Egypt

[3] http://www.nrea.gov.eg/english1.html (Accessed on 23rd August, 2015)
[4] "Egypt: International Energy Data and Analysis", *US Energy Information Administration*, updated on June, 2015: http://www.eia.gov/beta/international/analysis_includes/countrieszz_long/Egypt/egypt.pdf (Accessed on 31st August, 2015)

suffered from supply shortages, which led to a disruption of Egyptian gas flow to Jordan. Consequently, the emergence and use of sustainable development in the field of renewable energy help governments that have already cut energy subsidies to provide further relief for their governments' budgets (like Jordan, an energy-importing country, and Egypt, an energy-exporting country) to promote their economic stability.

If anything, the emergence of sustainable development is not new; it is defined, according to the World Commission on Environment and Development, as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs."[5] In this field, the difference of the high cost of renewable technologies is significant, which was considered in the past as an impediment for investors. However, the renewable energy sector is growing quickly, according to Bloomberg New Energy Finance. As a result, installation costs for utility-scale solar PV plants have dropped by over 40% since 2010 and are expected to fall a further 25% by 2020.[6] These developments may help countries meet their growing energy needs, reduce their reliance on imported energy, improve their energy efficiency strategies and secure their energy sectors.[7]

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[5] World Commission on Environment and Development, 1987, http://www.east-ayrshire.gov.uk/PlanningAndTheEnvironment/Development-plans/Planning-LongTermAndAreaPolicies/Planning SustainableDevelopmentPolicy/Sustainabledevelopmentpolicy.aspx (Accessed on 23rd August, 2015)

[6] Marghub, Adil, "Renewables & Clean Energy- No Longer Desert Mirage in 2020," *The Gulf Intelligence,* http://www.thegulfintelligence.com/Docs.Viewer/6d794ce3-9615-428b-b298-fd5ff383bfdc/default.aspx (Accessed on 24th August, 2015)

[7] IEA defines energy security as the uninterrupted availability of energy sources at an affordable price. Energy security has many aspects: long-term energy

Remarkably, the purpose of highlighting the issue of renewable energy sources and their sustainability goes further than the scarcity of non-renewable energy sources, reducing waste and pollution, and minimizing gas emissions. It can be a factor ensuring the socio-economic and environmental benefits of the use of renewable energy sources by reducing unemployment through the improvement of employment opportunities, improving the environment, and promoting just community learning opportunities. Having said this, high determination and a strong political will in the implementation of these reforms in energy policies and strategies are imperative to keep the economic and political balances on a sustainable path that creates inclusive growth. Solutions may not be easy, but nor are they impossible.

In this book, the contributors attempt to provide a thorough study of the stakeholders of the renewable energy sources' projects implemented in the field in both countries. The four authors discuss the status quo in Egypt and Jordan, and explore a future outlook on the transformation in both countries. Furthermore, the book focuses on examining the socio-economic impact of a sustainable renewable energy transition.

This book is organized as follows. The first chapter traces the Egyptian perspective on the status of renewable energy and the energy governance framework by mapping the stakeholders in this field, focusing on government bodies, civil society actors, private

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security mainly deals with timely investments to supply energy in line with economic developments and environmental needs. On the other hand, short-term energy security focuses on the ability of the energy system to react promptly to sudden changes in the supply-demand balance. Further elaboration on the concept of "securing Energy" will be discussed in the chapter four. See: http://www.iea.org/topics/energysecurity/

and international organizations, assessing the current energy strategy in terms of the current energy efficiency program, renewable energy program, and the shift in policy. Chapter two discusses the socio-economic aspect of renewable energy sources from an Egyptian perspective. Moreover, it focuses on energy dependency, energy intensity, and energy pricing and its impact on enhancing the economic situation and alleviating poverty by creating more investment and job opportunities.

As in the Egyptian part, the Jordanian perspective in chapter three discusses the status of renewable energy sources and energy-governance framework in Jordan, maps the different stakeholders, and evaluates the current energy strategy, the energy efficiency program and renewable energy program. Chapter four addresses the potential direct and indirect social effects of renewable energy sources by defining the concept of "Energy Security" and focusing on its dependency, its intensity and pricing, describing its role in enhancing economic activities and alleviating poverty by creating job and investment opportunities ■

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Chapter 1

The Egyptian Perspective:

The Status Quo of Renewable Energies and the Framework of Energy-Governance

Mohamed Elkhayat

NREA

Acronyms

NG	Natural Gas
MMBTU	Million British Thermal Unit
CC	Combined Cycle
EETC	Egyptian Electricity Transmission Company
EgyptERA	Egyptian Electric Utility and Consumer Protection Regulatory Agency
Cabinet	Cabinet of Ministers
BOO	Build-Own- Operate
EU	European Union
TARES	Technical Assistance to support the Reform of the Energy Sector
ktoe	Thousand Ton Oil Equivalent
NUCA	New Urban Cities Authority

1.1 Introduction

Encouraged by ample natural resources and in response to a growing demand and chronic shortages in energy supplies over the past few years, renewable energy is witnessing an increasing interest in Egypt. Among different renewable energy technologies, solar photovoltaic and wind technologies are part of the preferred options for electricity generation mix in Egypt. Unfortunately, other options such as solar water heaters, biogas and biomass technologies are not yet given enough attention, except for some donor-funded activities and efforts of NGOs that try to build some momentum on pilot and local scales, but not yet under a national deployment program.

In the following sections, the status quo of renewable energy in Egypt is presented, including key actors at different levels, i.e. planning, regulation, and execution. The Egyptian energy strategy is analyzed, focusing on renewable energy targets and action plans. The following sections also compare the share of renewable energy to other resources, and present the governing regulatory framework and current achievements in this field. The chapter aims to present a comprehensive picture of the renewable energy sector and energy efficiency in Egypt, the relevant strategy, ongoing actions, offered incentives, and the legal framework. It discusses how the policy and governance changes recently introduced positively affected the sustainable energy market, and how some structural and operational challenges remain to be addressed.

1.2 Mapping of Stakeholders

The Ministry of Electricity and Renewable Energy (MoERE) is taking the driver seat in promoting renewable energy in Egypt, along with the Supreme Council for Energy (SCE), which reports directly to the President and works in full coordination with the Ministry of Petroleum. Since 1986, the New and Renewable Energy Authority (NREA); affiliated with MoERE, has been acting as the national focal point for expanding efforts to develop and introduce renewable energy technologies on a commercial scale. For a long period, NREA has been active mainly in promoting large scale wind and solar energy projects, except during the last two years when some net metering[8] and feed-in-tariff[9] incentives were announced. In addition, around 6000 rooftop PV systems have been erected in remote areas. Hydro-power is not handled by NREA, as this is mandated to a separate Hydro Power Plant Authority. Lately, some dedicated RE and EE units have been created within the transmission and distribution companies affiliated with the Egyptian Electricity Holding Company to handle contracting with the private sector. Furthermore, an increasing number of nongovernmental organizations have been active in promoting the use of renewable energy on both industry and small-scale consumer levels. The Egyptian Electricity Regulatory and Consumer Protection Agency (EgyptERA) is responsible for regulating, licensing, and performance monitoring. The following Table presents some of the key public stakeholders that are active in planning, regulation, and execution of RE programs. Annex 1 provides an indicative list of some NGOs working in the field.

[8] In 2013, EgyptERA, the electricity sector regulator issued Circular No.1 of the year 2013 which includes regulation for metering.
[9] In 2014, the Cabinet issued Decree No. 1947 of the year 2014 for feed-in tariff.

Table 1: Key public stakeholders active in planning, regulation and execution of RE programs

Planning	
The Supreme Council of Energy (SCE)	*It is a ministerial committee established in 1979 under Prime Ministerial decree No. 1093 amended in 2006 with decree No. 1395.* *SCE includes 12 Ministers. The Committee is responsible for developing energy strategies in support of Egypt's economic and social development policies. Also, it guides and oversees the energy sector in Egypt.*
Ministry of Electricity and Renewable Energy (MoERE)	*The First Ministry for Electricity was established in 1964. The main goal of the ministry is to provide electricity to all consumers all over the country.* *Currently, thermal power stations share about 90% of the installed capacities; meanwhile the remaining portion is covered mainly by hydropower and partially by wind and solar energy. Nowadays, the ministry aims to diversify electricity sources.*
Ministry of Petroleum (MoP)	*Securing both oil and natural gas supplies for the national demand lies at the core business of the MoP. Also, maximizing the added value of their resources.*

Regulation	
Egyptian Electric Utility & Consumer Protection Regulatory Agency (EgyptERA)	*Since 2001, EgyptERA has been in charge of ensuring that all activities in the electricity sector are transparent, fair, in compliance with the applicable laws and regulations, and relative costs reflect interests of all designated entities.*
Gas Regulator	*In the context of the major changes in the Egyptian energy market and because of the needs to manage gas sector investments, Egypt decided to establish a gas regulator.* *Law ratification is expected to be issued next year. Such a step will establish an open and competent gas market.*
Execution	
Egyptian Electricity Holding Company (EEHC)	*The mandate of EEHC is to provide electricity consumers with reliable and safe electricity supply.* *The current installed capacities are around 32 GW. Average electricity growth rate is about 7%. EEHC has future plans to meet the increased demand on electricity in Egypt. EEHC coordinates with national energy stakeholders.*

Egyptian Electricity Transmission Company (EETC)	*EETC is affiliated with EEHC. The company manages, operates, and maintains the electricity transmission grid.* *According to the draft law of electricity, EETC will be an independent entity. According to Law 203 of 2014, EETC is mandated with establishing renewable energy projects through Build, Own, and Operate schemes and Feed-in Tariff mechanisms.* *Nine electricity distribution companies and six electricity production companies are affiliated with EEHC across Egypt.*
Hydro Power Plants Executive Authority (HPPEA)	*Almost 2800 MW of different hydropower project capacities have been installed.* *Currently, 2100 MW of pump and storage projects are in the study phase. It is expected that such technology will be one of utmost interest for future plans.*
New and Renewable Energy Authority (NREA)	*NREA was established in 1986. Its core mandate is to promote renewable energy and energy efficiency applications in Egypt.* *About 750 MW of wind energy projects already in operation by NREA. There is a 140 MW integrated solar thermal power plant in operation in Kuraymat.* *Projects of more than 1000 MW are either in development or implementation phases.* *NREA has a main role in shaping the renewable energy market in Egypt.*

1.3 Energy Sources and Regulatory Framework

1.3.1 Energy Sources

Both oil and natural gas (NG) can be considered as the main energy sources in Egypt, meeting around 95% of national energy needs. Production of crude oil and NG, either from Egypt or partners[10] is around 35 and 43 million tons respectively. The Egyptian proven oil reserves are estimated at 4.4 billion barrels and proven natural gas reserves at 78 trillion cubic feet. This Figure does not take into account the natural gas fields discovered in the Eastern Mediterranean at the shores of Egypt in August 2015. According to the current estimations, reserves of crude oil are expected to sustain for 15 years. Meanwhile, around double the period is expected for NG. Although until 2010 Egypt was an exporter of oil and gas, it is now trying to meet the domestic demand despite the increasing rate of daily production.

As a result of rapid urbanization and economic growth, demand for electricity in Egypt has been on the rise over the past few years, with an annual growth rate between 7 to 10%, requiring securing around 2GW of new capacity each year. Figure (1) represents main sources of electricity in the fiscal year 2014/2015. It is clear that around 89% is based on fossil fuels, while renewable energy sources, including hydro, represent 11%.

[10] Oil and gas exploration in Egypt is usually done through an international call for exploration, where national and international companies submit their offers to be evaluated. Oil and gas production is divided between both the State, represented by its "corporations", and the Companies, "Partners". The Egyptian General Petroleum Corporation, EGPC, and Egyptian Natural Gas Holding Company, EGAS, represent the State in oil and gas contracts, respectively.

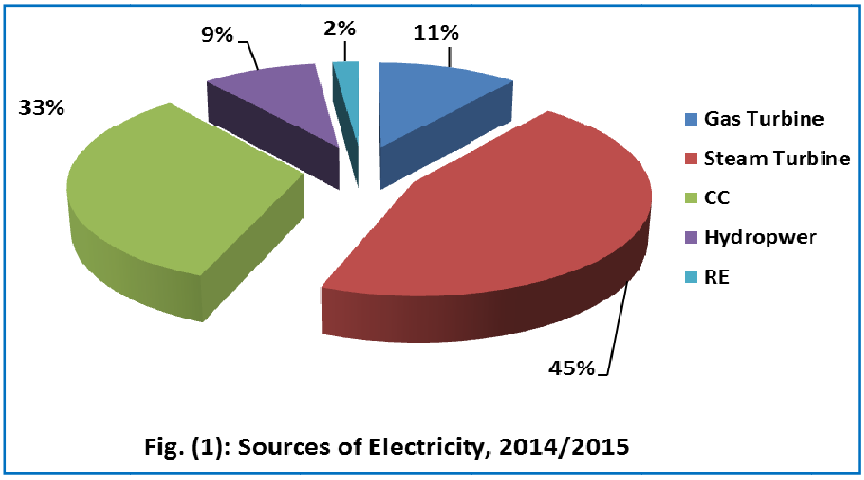

Fig. (1): Sources of Electricity, 2014/2015

As shown in Figure (2), shares of NG and oil are 53% and 41%, respectively. This represents high dependency on fossil fuels. It is necessary, therefore, to diversify energy sources and increase the share of hydropower, coal, and renewable energy.

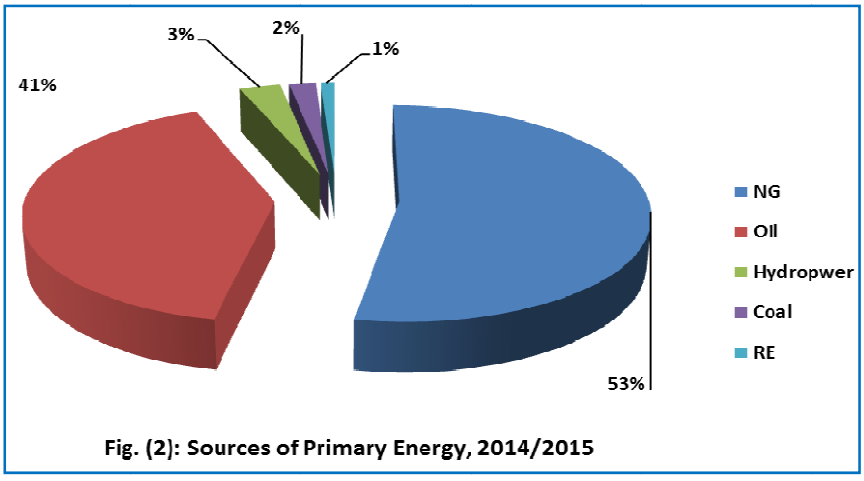

Fig. (2): Sources of Primary Energy, 2014/2015

The contribution of renewable energy sources in Egypt is still non-significant, with only about 2% of the mix. There should be a substantial contribution of biomass, mainly in rural areas; unfortunately, the contribution of this form of energy is difficult to estimate because of the lack of official statistics.

Hydropower supply currently covers between 6 to 8% of Egypt's annual electricity needs. Most of Egypt's large-scale hydropower capacity has already been developed. However, in 2014 Egypt announced plans for a 2000MW of pumped-storage hydroelectric plant to help address challenges related to peak load, and the volatile nature of solar/wind-based electricity.

Egypt's only major operational solar power projects are the Kuraymat 140MW solar thermal combined cycle power plant, of which 20MW come from solar energy, and 10 MW come from Siwa photovoltaic power plant. Distributed small scale photovoltaic systems are estimated at 90 MW cumulative.

Egypt's best-developed renewable resource is wind, where Egypt is in the lead in the Arab region having 750 MW of installed capacity at the Zafarana and Gabel El-Zayt areas. The Zafarana wind farm's total installed capacity is 545 MW, making it one of the largest onshore wind farms in the world.

1.3.2 Regulatory Framework

Egypt has different schemes to promote applications of renewable energy;

1) Competitive Bidding

Around 750 MW of wind energy projects and 140 MW integrated solar thermal power plant have been installed through a competitive bidding scheme. NREA started the bidding scheme in the early 1990s. As a governmental entity, NREA sources of finance come through governmental agreements.

Currently, more than 1000 MW of different technologies are in the implementation and preparation phase. NREA's target is to increase the installed capacity to reach around 2000 MW, mostly from wind energy.

Until now, NREA's prevailing tariff is less than the actual production cost, which needs to be adjusted. According to Law 203, the Cabinet shall issue rules and regulations related to the repositioning of the renewable energy projects already established before this Law became effective. Meanwhile, new projects will enjoy a correlated tariff, which covers project investment, operation and maintenance costs. Such a tariff will be proposed by a Regulator and approved by the Cabinet.

In the same context, Egyptian Electricity Transmission Company (EETC) announced a 250 MW through Build-Own-Operate (BOO) scheme. The received prices are very challenging compared with Feed-in Tariff (FiT) rates; i.e. from US Cents 4.0 to 5.0 per kWh. It is expected that, such prices will pave the way for increased penetration of renewable energy projects in the Egyptian energy market. In August 2015, EETC announced another 500 MW (250 MW Wind, 200 MW

PV, and 50 MW CSP), through BOO scheme. These projects will be installed at West Nile area. Currently, shortlisted developers for each technology have been announced. It is expected to start the implementation phase in the second half of year 2017.

In 2014, EETC announced another 10 PV projects, 20 MW each in Aswan Governorate through BOO scheme. The projects' commissioning is expected by 2017.

2) Feed-in Tariff

In September 2014, Feed-in Tariff (FiT) was announced for both wind energy and solar photovoltaic projects. The Projects' scale varies from small-scale to large-scale. Such a step will help Egypt deal with the increasing demand on energy.

The target of FiT mechanism is to achieve 2000 MW from wind energy and the same capacity from PV. The maximum capacity per project is 50 MW. In addition, another 300 MW from rooftop PV systems are targeted. Power purchase agreements will be valid for 20 and 25 years for both wind and PV, respectively. Further details are attached in Annex (2).

Shortlisted developers for both wind and PV technologies have been announced. Furthermore, the announced tariff attracted national and international developers to invest in Egypt. As a result, the targeted 4000 MW are almost totally booked. Based on the lessons learned from this round, another round is expected.

For rooftop on-grid systems, NREA applies a certification program for PV installers. More than 100 PV installers have already been certified. On the other hand, through governmental cooperation between Egypt and United Arab Emirates, 6000 rooftop isolated PV systems have been erected in remote areas and they are expected to reach around 7000 systems.

3) Independent Power Producers (IPP)

Through Independent Power Producers (IPP), or Merchant scheme, developers are able to either consume the generated electricity to feed their own loads or/and sell it directly to their own consumers.

1.4 Assessing the Current Energy Strategy

The main pillars for the energy strategy in Egypt are: (1) Security of supply, (2) Building competitive markets, (3) Ensuring sustainability, and (4) Developing sufficient supply and energy infrastructure capacity for renewable energy. In February 2008, the Supreme Council of Energy approved an ambitious plan to provide 20% of the generated electricity through renewable energies by 2020, 12% of which is from wind energy.[11]

[11] In the context of its plans and policies to diversify electricity generation, the Ministry of Electricity and Renewable Energy has set a target of 20% as renewable energy share of total electricity generation by 2020, 12% out of this percent is from wind, equivalent to 7200 MW installed capacity. The remaining portion has to be covered mainly from hydro, around 6%, and partially from other sources; solar and others. Based on that, around 7600 km^2 of desert land has been allocated for renewable energy projects.

Recently, a Combined Renewable Energy Master Plan for Egypt,[12] financed by the EU, has been issued. The mandate of this Master Plan is to develop a framework for renewable energy, wind and solar in specific, in Egypt for two future scenarios; 2025 and 2050, in addition to investigating the local capacities to manufacture wind and solar equipment.

The Master Plan's findings assure the ability to increase the share of renewable energy up to 50% by the year 2050. Such a target needs a comprehensive energy subsidy plan and a positive contribution from foreign direct investments.

In the same context, a comprehensive Technical Assistance to support the Reform of the Energy Sector (TARES)[13] is in the final stage. TARES covers three main core business areas: (1) National energy strategy, (2) Gas sector, and (3) Energy efficiency. TARES will set some scenarios for renewable energy shares up to 2035. In

[12] The scope of the project is to prepare a renewable energy framework for large scale grid-connected generation, taking into consideration the optimal use of the allocated lands, wind and solar sources assessment, characteristics of the sites and the industrial capabilities to increase the local components in order to improve the economics of the projects. Different scenarios for energy mix show availability of various contribution of renewable energy; up to 50% by the year 2050.

[13] TARES is a comprehensive project compiling energy sources in Egypt into one model. Mainly, it looks for oil, gas, and renewable energy sources. In addition, it emphasizes potential opportunities in the field of energy efficiency. Regarding renewable energy, the procedure is to define certain targets, then recommend the required policies and actions to support these targets. The main conclusions regarding share of renewable energy in the Egyptian energy portfolio are: (1) Renewable energy is cost effective for almost one third of the fuel- generated electricity in Egypt, (2) Setting cost-effective targets are necessary to ensure economical affordability of the program, (3) Scenarios for renewable energy share indicate ability to reach 30% by the year 2035, and could be doubled based on using specific incentives and actions.

addition, it will propose specific actions and measures to strengthen the existing energy efficiency system in two directions: (i) reinforcement of the institutions, and (ii) providing operational tools. Based on the preliminary findings, different scenarios for contribution of renewable energy indicate the ability to share not less than 30% in the energy system.

Nowadays, the main supply of electricity is based on fossil fuels. Securing a cost-effective and reliable mix of energy sources could be achieved through maximizing the role of renewable energy in both small-scale and large-scale projects.

As for the target of securing a share of 20% contributed by renewable energy-based electricity by 2020, there still are needs for innovative mechanisms and policies to be achieved. FiT is already in place, but a second round including waste-to-energy technologies could enhance the ability of the market to increase the share of renewable energy in the Egyptian energy portfolio.

Also, reverse auctions could attract international developers to install renewable technologies on competition basis. Such a scheme could be more attractive now especially in the light of the received price for the 250 MW BOO project, which is almost two-thirds of its FiT tariff. In the same context, there is a need to strengthen the current infrastructure for the electricity national grid to be able to transfer the generated electricity from renewable energy technologies.

In addition, a comprehensive reform for energy subsidy is needed. Such reform has to include all energy sources, activation of

smart cards for vehicles' fuel and electricity, and enable renewable energy to compete with other sources. Also, energy efficiency measures in all consumption sectors have to be coupled with rational subsidy programs. Currently, total energy subsidy is more than US $20 billion a year. Energy tariffs are regulated and still heavily subsidized. In July 2014, the Government of Egypt[14] announced a five-year-plan to alleviate electricity subsidy by fiscal year 2018/2019. New prices for electricity[15] were estimated based on using NG as a fuel with US $3.0 MMBTU. Also, in the same date, July 2014, a subsidy reform of fossil fuel, gasoline, diesel, and NG, entered into force. Such actions support energy efficiency measures.

Total subsidies were around US$ 24 billion in the year 2013. Such subsidies have a negative impact on the national GDP. For instance, subsidies in the fiscal year 2010/2011 totaled around 25% of public expenditure, while public salaries were 22%.[16] In the same context, the share of the energy sectors is around 11.3% of the national[17] GDP.

Developing a self-sustainable and reliable energy market in Egypt is one of the other challenges facing the market of energy in general, and renewable energy in particular. During the last few years, the Egyptian energy sector faced a significant growth in demand that reached 7% on average. In fact, the main impediments hindering the formulation and realization of a sustainable energy

[14] Official Newspaper, July 3, 2014, Issue 27, Year 57.
[15] Official Newspaper, July 17, 2014, Issue 29, Year 57.
[16] MED-ENEC (August 2013), "Energy Subsidies, A Road Map for Reforms in the Southern Mediterranean."
[17] Ministry of Planning and Follow Up, (May 2015).

policy are the low levels of coordination and synergy among different key stakeholders, slow implementation of policies adopted to reduce energy demand and the lack of implementation of rational and mandatory energy efficiency measures in all sectors. Strengthening the regulatory framework of the energy sector and linking it with relevant sectors; i.e. industry, commercial, residential will be essential. Also, these should be coupled with building a robust awareness of the energy policies. End-users must know in a transparent manner the dimensions of the energy dilemma and the associated different effects. A rational reform of energy subsidy as a process should always consider the poorest among Egyptian citizens.

1.5 Egypt's Current Energy Efficiency and Renewable Energy Programs

Egypt's energy efficiency activities are currently handled by the Energy Conservation Unit (ECU), which is affiliated with the Cabinet. It helped establish dedicated specialized units and departments at different ministries of energy-consuming sectors, such as tourism, electricity, housing and others. In November 2012, Egypt announced its National Energy Efficiency Action Plan 2012-2015 (NEEAP) in the electricity sector. NEEAP's target is to reduce energy consumption by 5% of 2012 consumption.

In 2006, the energy efficiency mandatory code for residential buildings was issued. Meanwhile, two other codes for both commercial and governmental buildings were issued in 2009 and 2011, respectively. Since 2011, Egypt has been facing energy shortages because of the increasing demand on electricity

(amounting to 7% annually approximately), a decrease in power plants' performance resulting from delays in operation and maintenance programs, and shortages in natural gas supplies. In response, new industrial activities are being authorized to import NG directly. A Gas Regulator is to be established to manage the gas market.

A new electricity law was issued in July 2015. The law separates the Egyptian Electric Utility and Consumer Protection Regulatory Agency from the Electricity Ministry, making it an independent body tasked with regulating the market. This step will help create a more liberalized electricity market and will encourage the private sector to invest. The new law designates a section to address energy efficiency in electricity-related activities such as purchasing excess electricity from private cogeneration of electricity and heat, it assigns an energy efficiency manager for facilities of over 500kW, sets programs to manage supply and demand, and expands energy efficiency labeling programs including different household, commercial and industrial appliances.

Current energy prices do not reflect the actual tariffs. According to the announced five-year plan, subsidy will be phased-out. Intensive resource assessment programs were led by NREA during the past two decades; they produced Egypt's wind and solar atlases proving that Egypt enjoys some of the world's best solar and wind energy sources. Wind potentials are mainly in the Gulf of Suez area, with significant additional potential capacity along the east and west banks of the Nile. More than 7000 square kilometers of desert lands have been earmarked for new wind and solar public and private projects in different regions in Egypt. A number of large and medium scale wind and solar energy projects are in the pipeline.

In the same context, a national initiative called "Egypt Sun "has been announced to implement energy efficiency measures for lighting and using renewable energy sources in public buildings. The initiative has already started in a number of public buildings in different areas in Egypt. It provides rooftop PV and efficient lighting systems for the same buildings. The target of the initiative is to implement 100 – 150 projects in public buildings within three years (2014-2016). Implementing such projects will reduce electricity consumption by around 43 GWh annually and will reduce fuel consumption by around 9 ton oil equivalent each year.

Also, NREA is working with UNEP through a grant from the Italian Ministry of Environment, Sea, and Land to disseminate solar water heaters in touristic resorts and hotels located in South Sinai and Red Sea Governorates. The target is to erect around 5000 m2, around 60% of which has been achieved.

Moreover, a regional project called MED-Desire focusing on distributed solar technologies and energy efficiency is under implementation through an EU fund. Eight entities representing five countries (Italy, Spain, Lebanon, Tunisia, and Egypt) are participating in this project. Different energy efficiency measures and capacity building activities are included. In addition, the so-called "Solar Ordinances" are now under discussion between the project and New Urban Cities Authority (NUCA).

1.6 Shifts in Policy

For Egypt, there are great economical potentials for wind and solar energies as proved by many detailed resource assessment studies. Recent renewable energy development is linked to concerns

about exhaustion of fossil fuels and environmental, social, and political risks of extensive use of fossil fuels energy, whereas renewables are considered among the important sources to meet the national energy demand and energy security. In 2008, the first shift in policy was triggered by The Supreme Council of Energy (SCE) adoption of an ambitious target of achieving 20% of the generated electricity by renewable energies by 2020, including a 12% contribution from wind energy, while the remaining will be mainly from hydro and solar energies. A key element of Egypt's vision focuses on tapping solar energy through constructing series of solar power plants according to a long-term plan. At that time, the vision was to diversify energy sources for securing energy for local needs and exporting the surplus via regional interconnection links. Within the efforts exerted to realize the Egyptian strategy, and benefitting from the excellent relations of Egypt with the international community, Egypt succeeded in getting financial support for several new governmental "state-owned" wind farm projects, which are in various phases of preparation.

However, it became clear that the planned growth of the wind and solar energy markets offers good prospects and opportunities for both local and foreign investors. Accordingly, the private sector is currently invited to implement around two thirds of the future projects until year 2020, through the different incentive mechanisms outlined earlier. The implementation of the strategy necessitated the selection of renewable technologies based on the economic and financial maturity. Wind energy (in the 2008 strategy) then solar photovoltaic (in the 2014 FiT) were recognized as the leading renewable energy technologies in the Egyptian energy mix, after hydro power, which can help in tackling the issues of energy security and sustainability along with climate change.

The ongoing and planned projects represent good steps on the track to scale-up the renewable contribution in Egypt's energy mix. Currently, the private sector already has 720 MW of RE capacities under construction, due to the recent establishment of a merchant IPP scheme. Additionally, local and international wind and solar developers showed great enthusiasm after the introduction of FiT; in fact the total capacity of submitted proposals exceeded by 5 times the capacity of the solar and wind plants to be installed, the capacity of each being 2000 MW. After introducing FiT, Egypt experienced a rush from local and international wind and solar developers, offering over 200 project proposals which exceeded for solar projects 69 projects with total capacity 2800 MW, and around 1800 MW for wind energy achieved qualification and are engaged in subsequent actions and agreements for land lease, grid interconnection, power purchases and negotiation with lenders to facilitate satisfactory terms to reach the financial closure. A second procurement round for wind projects is expected in two years.

For the future, it is recommended to keep all policy options open. Possibly, reconsidering the level of FiT and rely more on bidding and direct proposal schemes to secure lower prices. Egypt has to focus on having the energy mix that ensures the satisfaction of development needs in the most economical and environmentally safe way. Such mix will definitely have conventional sources together with tangible contributions of renewable energies.

NREA and leading stakeholders should also expand the technical and financial cooperation activities with local and European partners to include untapped sources of biomass and waste-to-energy. It is anticipated that these efforts, which concern both scientific and industrial application cooperation, will give renewables additional momentum and promote local capabilities. It

is worth noting that that the business and industrial communities are responding rapidly to different programs through relations with international manufacturers and project developers.

Egypt is making good progress towards becoming a significant player in the renewable energy industry. Renewable energy projects already enjoy priority of dispatch, and Egypt's central bank guarantees all financial liabilities of the Egyptian Electricity Transmission Company under the PPAs. The Government recognizes that reforms are necessary to attract private sector investments. Indeed, the new electricity law is making serious attempts to address private sector concerns.

1.7 Conclusions and Challenges

The main conclusion to be derived from the previous sections is that Egypt is really accelerating the pace of adoption in the fields of renewable energy: legal framework, policies, incentives, and implementation.

On the legislative track, the new Egyptian Constitution of 2014 includes a dedicated clear statement to maximize the role of natural resources. We can add to that both Law 203 of the year 2014 and the FiT decree which target 4300 MW from both wind and PV technologies.

Despite these pieces of legislation, challenges such as applying innovative financial mechanisms to achieve the current target still exist; achieving 20% of electricity from renewable energy sources by the year 2020, and consolidating the current incentives and promotion schemes which still need further efforts. That is to say, for FiT, the share of rooftop applications is relatively small and still

needs further consideration. This will support both reducing electricity demand in the residential sector and increasing the share of renewable energy in the electricity portfolio.

In addition, a dedicated National Renewable Energy Action Plan (NREAP) is urgently needed for implementing renewable energy projects from different sources and technologies in different sectors with clear mandates, timelines and financial resources. This will increase both the transparency and confidence levels of the Egyptian renewable energy market. Such plan will support harmonization between the current mechanisms; i.e. international tenders, BOO, and the involvement of the private sector.

Furthermore, as most of the promising sites with high potential resources are spread all over Egypt, a plan to extend the national electricity grid to these sites and to strengthen the current one is urgently needed. Also, FiT could be a unique opportunity to maximize the share of local manufacturing for renewable energy components.

The energy efficiency track is less developed compared to renewable energy. In this regard, an energy efficiency law is needed to support national efforts in applying energy conservation measures. Egypt should focus on strengthening and improving its institutional capacity and specifically work towards improving enforcement procedures.

On the level of institutional framework, new structures for both EETC and the Regulator have to take place based on the new Electricity Law, No. 87 of the year 2015. Restructuring EETC to work in electricity transmission only may lead to change article 2-B in the Renewable Energy Law No. 203 of 2014, which gives EETC

the right to launch BOO projects. Reference to Law No. 87 working in both electricity transmission and generation could be explained as a conflict of interest. Except for renewable energy projects, EETC does not have the mandate to establish any other technology. This seems to be in conflict with the role of NREA and private developers. Avoiding such conflict could be done by both replacing EETC with NREA in the Article 2-B in the Law No. 203 of the year 2014 and transferring dependency of the FiT Unit to NREA.

Chapter 2

The Egyptian Perspective:

Socio-Economic Aspects of Renewable Energy

Maged Mahmoud

RCREEE

2.1 Introduction

This chapter addresses some of the socio-economic aspects of renewable energy in Egypt. It highlights some relevant statistical information and indicators, and discusses Egypt's situation with respect to energy security and dependency. The issues of energy intensity, the energy-bill, and subsidies are discussed in detail and benchmarked against other neighboring countries. The economic activities associated with the renewable energy value chain of significance to Egypt are further analyzed. The chapter then elaborates on the employment effect of renewable energy expansion in view of the progress achieved and the announced plans. In brief, this chapter tries to explore how renewable energy growth in Egypt can be driven by both energy and socio-economic considerations.

As explained in the previous chapter, Egypt is endowed with abundant renewable energy sources, and is moving ahead to more reliance on renewables. With around 90 million inhabitants, and within a challenging political context, it seems that the social structures are becoming more stable; in response to positive state actions to improve the economic situation and to address business development concerns. Egypt's physical characteristics make it suited for RE power scale-up, particularly wind and solar. Egypt's favorable conditions; besides the abundant sunshine and windy locations, include the low number of rainy days, and plenty of unused land close to road networks and electrical transmission grids. The electrical grid is extended, covering about 99% of the

Egyptian population. Over and above, Egypt has the assets of the human resources and the industrial base that can be adapted to serve the renewable industry locally and regionally.

Along with the enhancement of local manufacturing capacities, the implementation of RE projects would lead positive impacts on developing rural and new communities in the vast desert as well as exporting the excess green energy to neighboring countries and Europe via Mediterranean interconnection links. It is important to remember that over 9 GW of solar and wind power will be added to the Egyptian power mix by the year 2020, motivated by ambitious and credible incentive structures mainly through a generous Feed-in Tariff (FIT) announced in September 2014 and a competitive bidding scheme.

The socio-economic impact of RE represents a vital dimension of any development or investment strategy. Until recently, the Egyptian RE development relied mostly on large-scale electricity generation through mega project plans. To ensure the political endorsement, public acceptance, and financiers' interest, it has been vital to focus on the socio-economic dimensions congruent with governments and stakeholders expectations. Several issues are decisive in this respect, such as demography, economic growth and activity structures. In addressing the perceived higher costs of RE investments, political actors and promoters rest on the promise of higher positive socio-economic benefits, such as job and local business development opportunities.

The annual population growth rate in Egypt during the last decade was about 2.2%, with a clear trend towards urbanization. In early 2014, the GDP of Egypt was around $271 billion, with

economic growth of 3% annually.[18] The average income per capita in Egypt in December 2013 was estimated to be around $1,566/capita, which puts Egypt in the category of "middle income countries" in the Arab region. The Egyptian economy is diversified, where the GDP is mainly composed of industrial activities, agriculture and services, which have a significant impact on energy demand. Electricity generation had an annual rate of about 6.6% during the period 2000-2012. Electricity consumption represents a share of 26% of the final energy demand in Egypt. Indicating that, there is a coupling between economic growth and energy demand in Egypt.

Figure 3: GDP Growth in Egypt (2006-2014)

[18] Source: http://www.tradingeconomics.com/egypt/indicators (Accessed on June 2015).

Table 2: Selected Socioeconomic Indicators

Indicator	Last	Reference
Population	90 Million	Dec-15
GDP	272 USD Billion	Dec-13
GDP Annual Growth Rate	4.3 %	Dec-14
GDP Constant Prices	407419 EGP Million	Dec-14
GDP per capita	1566 USD	Dec-13
GDP per capita PPP	10732 USD	Dec-13
Unemployment Rate	12.8 %	Mar-15
Unemployed Persons	3543 Thousand	Mar-15
Employed Persons	24179 Thousand Persons	Mar-15
Minimum Wages	1200 EGP/Month	Feb-14

- *Source: http://www.tradingeconomics.com/egypt/indicators (Accessed June 2015)*

2.2 Energy Security

The energy security can be measured through the indicator of Energy Dependency [19] which can be defined as follows:

$$EDI = \frac{-(\text{Energy production} - \text{Primary energy consumption})}{\text{Primary energy consumption}}$$

The higher the indicator, the more dependent a country is on supply from other countries to meet its energy needs. This ratio is negative for net exporter countries and positive for net importer countries.

During the past five years, the demand for energy has been increasing much faster than energy production, thus reinforcing the tendency towards energy dependence. Egypt is currently in a transitional situation, where it may turn in the near future from independence to dependence; i.e. becoming a net importer of energy which puts the economy in a stressful situation (national energy bill, energy subsidies, etc.). Recently, Egypt has been trying to adapt the energy systems to cope with the situation through a cost recovery energy pricing system. At the same time, it has been managing the social and economic vulnerability to shocks in international energy prices, and preserving the limited hydrocarbon wealth and diversifying the economy. The dilemma here is striking a balance between the need to protect the poorest social classes, and preserving the balance of the public finances against a continual increase in energy demand and prices. The following graph shows Egypt's energy dependency position among different Arab countries.

[19] RCREEE (2014) "Energy Indicators in RCREEE Member States".

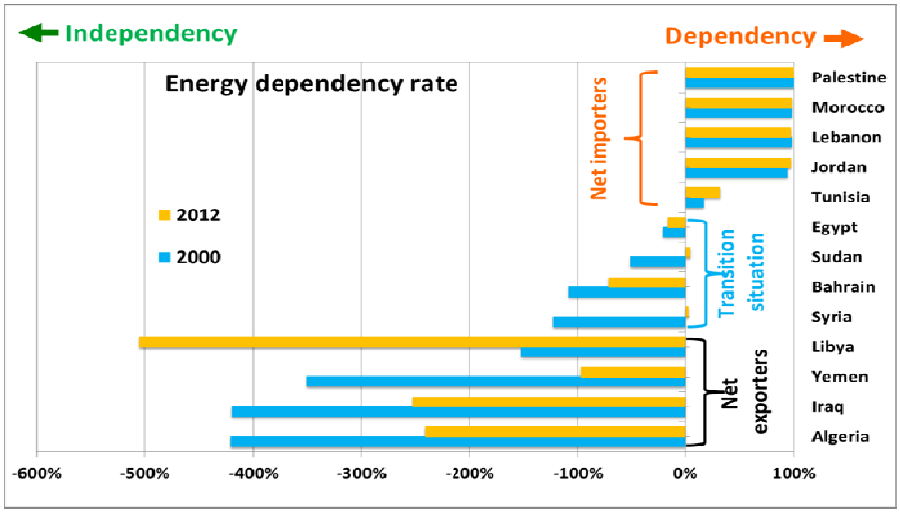

Figure 4: Energy Dependency ratio evolution between 2000 and 2012

- *(Source: RCREEE 2014)*

2.3 Energy Intensity, the Energy Bill and Subsidies

Energy intensity is defined as the primary energy consumption divided by the GDP at constant price. It aims to measure the overall energy efficiency of the economy.

According to RCREEE[20], primary energy intensity has been increased from 0.14 Toe/1000 $2005 to 0.16 Toe/1000 $2005 between the years 2005 and 2010. The energy intensity in Egypt is rather high compared to developed countries; e.g. OECD average of 0.11 Toe/1000 $. This makes the economy less competitive, and implies a huge potential for energy efficiency improvement in the

[20] RCREEE (2012), "Energy Efficiency Country Profile … Egypt 2012".

region. Decentralized RE offers economic activities dominated by services that can provide high value added, but consumes less energy.

The energy bill represents a huge burden on the Egyptian economy. The following Figure shows the evolution of the ratio energy bill to GDP in Egypt compared to other countries in the region.

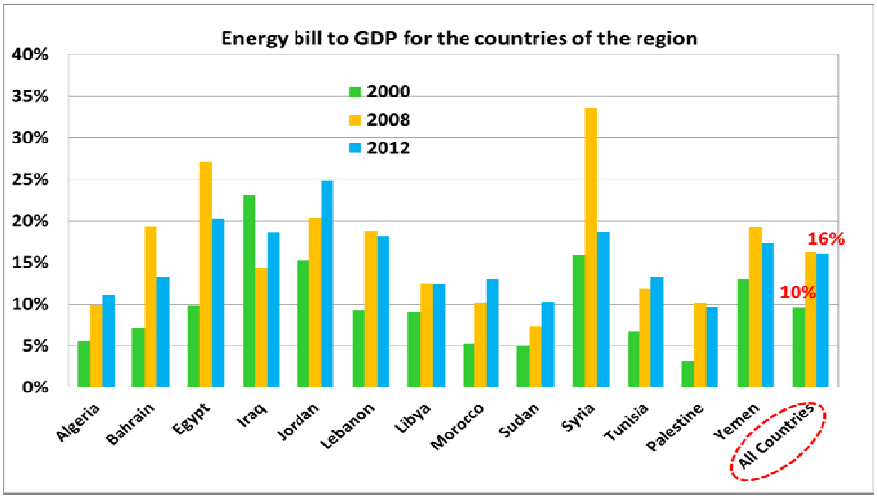

Figure 5: Energy bill to GDP in 2000, 2008 and 2012 (source: RCREEE[21])

In 2013, energy subsidies in Egypt reached approximately USD 24.42 billion, representing more than 10.6% of the GDP, the situation gradually improved in the following years in response to the international drop in oil prices.

The Egyptian subsidy system consists of indirect subsidies to the power sector, direct electricity subsidies and cross-subsidies. Such situation represents a real challenge to the financial

[21] RCREEE (2014), "Energy Indicators in RCREEE Member States".

attractiveness of renewable energy solutions on different levels. However, it also offers opportunities for redirecting part of the subsidies budgetary allocation to state-led incentives programs, while improving the framework conditions through reforms that give the right price signal.

Egypt has recently shown a serious endeavor to increase the share of RE technology, and tried to take the necessary steps to reform, phase out or reduce fossil fuel subsidies, gradually over 5 years. The concerns related to shortage of fuel and power supplies helped in creating public acceptance for the measures applied, with the promise of better, uninterrupted, and reliable supplies. To better explore the indicative margin of subsidy removal, the Arab Future Energy Index (AFEX, 2015)[22] provides an estimate of implied subsidies of electricity with a reference price of Palestine's retail electricity tariffs, which are unsubsidized and therefore represent the approximate true retail cost.

Figures 6, 7 and 8 illustrate an implied subsidy in the residential, commercial and industrial sectors according to the AFEX. The residential sector tariff in Egypt is 81% lower compared to the reference tariff. Electricity tariffs for industrial and commercial customers are higher than for residential customers and the implied subsidy drops down to 73% and 49% respectively.

[22] RCREEE (2015) "Arab Future Energy Index".

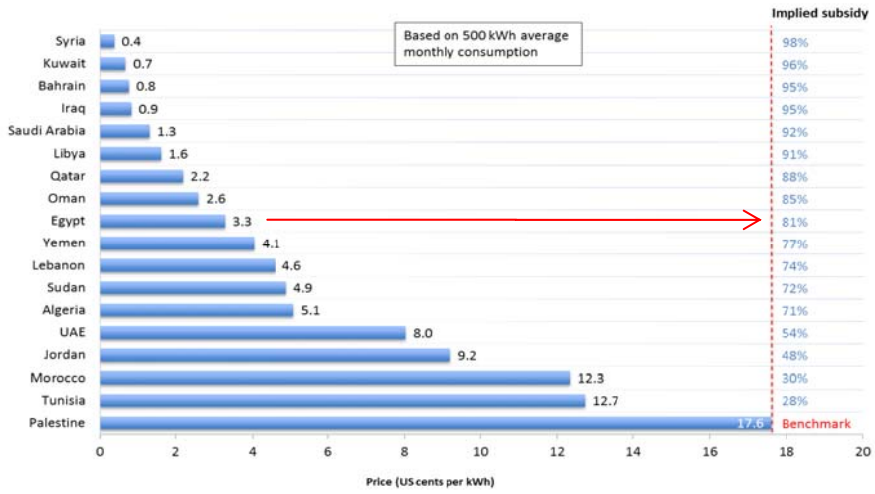

Figure 6: Residential electricity prices and subsidies benchmarked to Palestine (2014)

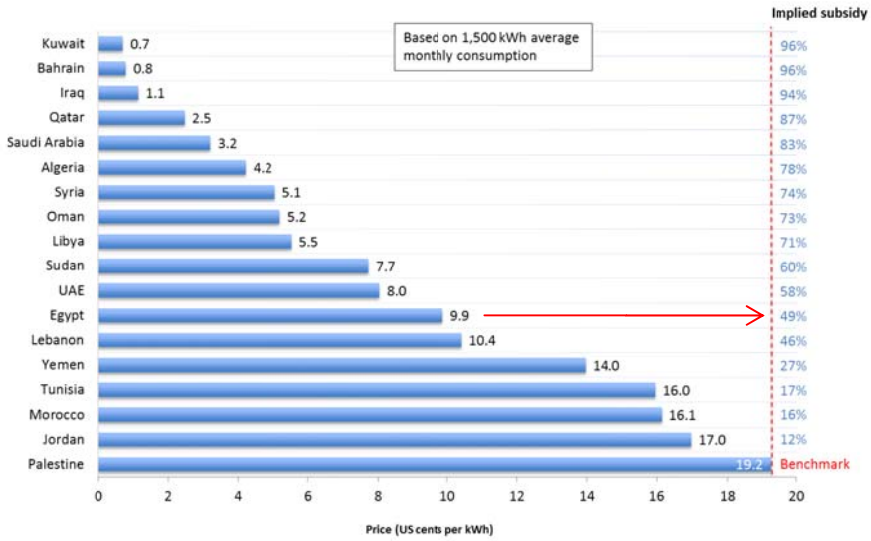

Figure 7: Commercial electricity prices and subsidies benchmarked to Palestine (2014)

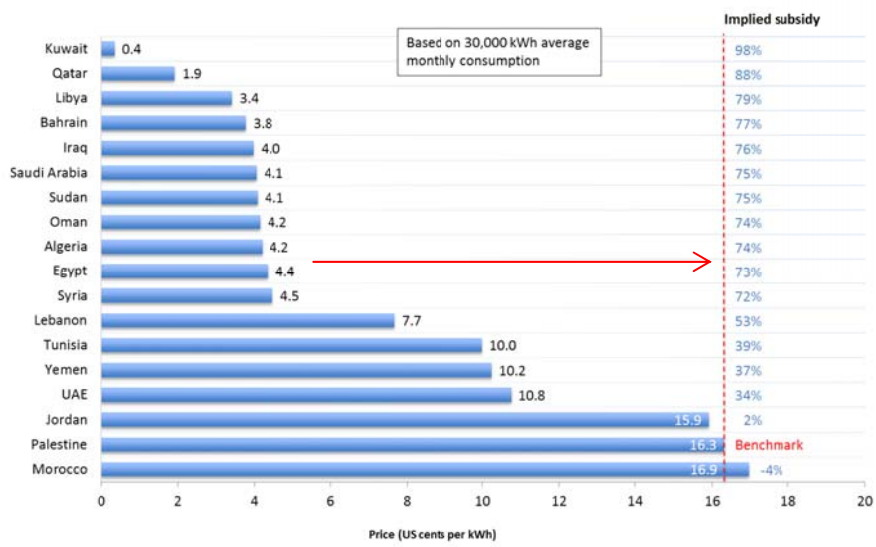

Figure 8: Industrial electricity prices and subsidies benchmarked to Palestine (2014)

In July 2014, the Egyptian government announced a five-year transitional plan to phase out subsidies in the electricity sector. This plan was officially endorsed and a Prime Ministerial Decision was issued on July 17th, 2014. This Decision approved annual tariff increases for most user segments on July 1st each year until 2018. The highest tariff increases will be experienced by some of the extra-high voltage industrial users – more than 20% annually. Moreover, residential customers will see an annual increase of 10-20% and the commercial customers a rise by around 7% per year. A recent presidential statement on electricity tariff reform ensured that the first three categories of the residential sector (lowest consumption segments) will not be affected by subsidy phase-out.

On July 5th, 2014, the Egyptian government also implemented price increases for fuel:

- Gasoline 92 Octane increased from 1.85 LE to 2.60 LE per litre, an increase of 40%.
- Gasoline 80 Octane increased from 0.90 LE to 1.60 LE per litre, an increase of 78%.
- Diesel increased from 1.10 LE to 1.80 LE per litre, an increase of 64%.
- Natural gas for cars increased from 0.40 LE to 1.10 LE, an increase of 175%.

2.4 Enhancing Economic Activity and Alleviating Poverty

Plenty of economic activities are associated with the renewable energy sector. The value chain starts with project development, including any study or preparatory work necessary; e.g. resource assessments, energy yield estimation, environmental impact assessments, planning applications, approval and licensing processes, and infrastructure readiness and upgrade. All these require specialized skills that are relatively available. Within the approval and licensing legal and administrative steps, local authorities are heavily engaged in the process, and different experts and service providers are consulted. Land allocation and land use agreements may also engage land owners that can profit from project income. An example here is the program for allocation of land by NREA for deployment of public and private solar and wind projects; covering a total of more than 7,600 km^2 of desert land. The land will be leased to investors against 2% of the annual electricity

generated. Small solar systems including PV and solar heating/cooling projects do not require intensive project development and simple calculations about the energy yield and best (roof top) location can be sufficient.

Then, in the value chain, comes the manufacturing of the system components. The Egyptian renewable energy deployment model relied for long on large scale projects. Decentralized renewable energy solutions received sporadic attention. For example, solar water heaters were promoted in the late 1980s and early 1990s, but then programs stopped due to several technical and administrative problems.

Several attempts of knowledge and technology transfer appeared during the past three decades, aiming for indigenization of technologies. According to IPCC,[23] "technology transfer encompass the broad set of processes covering the flows of know-how, experience and equipment for specific technological application amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research/education institutions. The broad and inclusive term "transfer" includes diffusion of technologies and technology co-operation across and within countries. It comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose and adapt to local conditions and integrate it with indigenous technologies." To achieve a real value added to the national economy, the market volume should encourage investors to develop, expand or even initiate local industries, either through joint

[23] Andersen. S. et al, "Methodological and Technological issues in Technology Transfer", Intergovernmental Panel on Climate Change, http:/www.grida.no/climate/ipcc/tectran/504.htm

ventures, manufacturing under licenses, acquisition of shares in existing companies, or developing their own product through engineering houses.

In Egypt, wind projects' tenders encourage bidders to use the existing local industrial capabilities, and provide lists of qualified industrial firms for different project components. From an economical point, it is lower in price to utilize the Egyptian capabilities, and the recorded local industry share of large-scale renewable wind projects in Egypt ranged between 20 to 40%. Sourcing raw material or components locally offers good opportunities for related domestic industrial branches to get into the sector. For example, developers used the existing metal industry to manufacture wind turbine towers that were even exported to other countries. Similarly, many of the electrical components of solar and wind projects are often supplied by local electrical engineering companies. As a matter of fact, Egypt is characterized by the availability of local companies in electrical engineering and manufacturing that can easily be adopted to serve the RE sector. The solar and wind energy sectors can be a driver for innovation and motivate the society to be at the forefront of innovative technologies.

This is not only relevant to the industry, but also to the service sector, which benefits from such project investments. For example, these local contents in wind projects include turbine tower manufacturing, civil and electrical works, as well as inland transportation, and any other local activities. However, it should be noted that the local components do not include some major wind turbine components such as blades, nacelles, gearboxes or generators. It is anticipated that it would reach 50 to 70% with the

growth of demand on wind turbines in Egypt associated with the realization of the ambitious plan of 2020, prompting more reliance on local components. The signs of such transition are noticed as some of the major private industrial firms have already initiated local manufacturing activities, with the objective of serving the expanding national and regional markets. As for Concentrated Solar Power (CSP) projects, there is also very good potential for local industries. For the first Egyptian ISCC of 140 MW including a solar field of 20 MW, about 50% of the solar field was locally manufactured. This includes the solar field steel structure, cables, and civil, mechanical, and electrical works. There is a good possibility also in the future to adapt the existing industrial capabilities for the manufacturing of the most important components of the CSP technologies, such as mirrors and receivers. PV systems assembly factories and workshops are gaining increasing interest lately, after the introduction of the FiT. The PV market is expanding fast where over 100 companies are currently registered at the Egyptian NREA to provide services of supply, installation and maintenance of PV systems. Some donor-supported programs also piloted decentralized PV and biogas systems within developmental projects, targeting rural and poorer areas.

The installation and connection of RE systems to the grid represents a low hanging fruit for local firms. On site, most of the added value comes through the involvement of local subcontractors. Local companies can deliver most of the civil and infrastructure works, such as foundations, access to the plant, road construction, cable-laying, erection of foundations, etc. Later, the project is operated and needs to be operated and maintained (O&M) offering opportunities for creation of value added, independent of the industry development status. Local staff is required from the

beginning of operation of renewable energy projects. Since RE projects are normally operated over a lifetime of 20 to 25 years, the jobs created are thus sustainable.

Relevant and important economic activities involve access to appropriate finance, the development and the enforcement of the necessary regulatory framework, the legal advisory services, R&D, education and other consulting services needed to complement the measures taken for project realization.

Noting that most of RE development zones are in desert areas, the added value of establishing RE projects exceeds the value of electricity and jobs created. As a matter of fact, wind projects at Zafarana paved the way for an overwhelming development on the coastal areas in the vicinity of the wind farm site. These areas were in the late 1960s and 1970s war zones and remained with war's dangerous leftovers including mines and destroyed tanks until the late 1990s, when wind projects development required launching a successful campaign for mines clearance and helped in creating the necessary infrastructure (roads, electricity grid, water pipelines, etc.) that attracted investors to establish dozens of magnificent hotels and resorts, now considered favorite destinations for Egyptian and foreign visitors.

It is worthy to note also that the Egyptian approach to development is relying on clustering several wind or solar projects close to each other; covering an extended resource-rich region. Such clustering entails large numbers of employees and their families to reside in the site, which in return triggers establishing relatively modern settlements including educational and health care facilities that are being used by both the power plant staff and the citizens

living in nearby villages and cities. The previous examples showcase how RE deployment brings social added value on top of economic value. Another example is the off-grid rural solar electrification program funded by UAE covering several villages. This program improves access to electricity and provides new possibilities of learning improvement through evening house lighting and provision of appliances and household solutions fostering improved health conditions. Adding to that, increased well-being can be created through securing local high quality jobs.

The increased access to business opportunities, employment, training and education, coupled with the enhanced access to and from the renewable energy development regions and the availability of funding, e.g. through developers' corporate social responsibility programs, are all contributors to improving the standard of living and the social infrastructure.

The beauty of renewable energy deployment; on national, regional and local levels, is that it influences positively and respects the relationships between economic activities, people's social and cultural particularities and biophysical environment. There is much overlap between different impacts, and there are many valued socio-economic components that interact; for instance health and well-being, sustainable land access and traditional/alternative use, protecting heritage and cultural resources, equitable business and employment opportunities, adequate services and infrastructure, and adequate sustainable income and lifestyle.

Unfortunately, in Egypt, no study has researched in sufficient detail the impact of existing and proposed renewable energy developments on different valued socio economic components, and

it is highly recommended to initiate such research, that would highlight, among others, how the standard of living has improved, in terms of the level of wealth, comfort, material goods and necessities available to different socioeconomic classes in specific geographic areas. This analysis would look into factors such as income, quality and availability of employment, poverty rate, quality and affordability of housing, hours of work required to purchase necessities, affordable (or free) access to quality healthcare, quality and availability of education, life expectancy, incidence of disease, cost of goods and services, infrastructure, national economic growth, economic and political stability, environmental quality, climate, safety and others.

2.5 Investment Opportunities and Job Creation

One of the key valued socio-economic factors is employment, where renewable solutions offer significant opportunities. Egypt enjoys a wide and diversified labor market, which can be considered an important technological asset, notably with respect to large wind power projects. For other technologies, the capacity building activities for manpower vary from one technology to the other, and vary from being diligently pursued through structured courses in few cases, to being ad-hoc on the job random and infrequent in other cases. Even for the wind power projects, satisfying the manpower needs for achieving the announced targets and ambitions may represent a challenge.

There is clear evidence that RE&EE sectors are increasingly contributing to worldwide job creation. The RE value chain phases with the highest labor intensity involves installation, production maintenance and operation, whereas for EE, this holds true for the

building sector, which is booming in Egypt and is labor intensive. If SMEs account for 90% of global economic activity and at least 50% of employment, the same logic applies to clean energy jobs, for which SMEs are currently primarily responsible, especially in the RE&EE sub-sectors. According to REN21's (Table 3[24]), an estimated 6.5 million people worldwide work directly or indirectly in the RE sector, and as SME creation in the supply and demand of energy solutions becomes more mainstream, the share of clean energy employment is set to become even more significant. An interesting illustration comes from the results of the MENA CSP Scale-Up Investment plan, developed by the World Bank and the African Development Bank. Results showed that if Concentrated Solar Power (CSP) projects of up to 5GW are to be installed in Algeria, Egypt, Jordan, Morocco and Tunisia by 2020, it is estimated that, in case of 60% domestic manufacturing of the CSP value chain, these five countries could create between 64,000 and 79,000 local renewable energy jobs by 2025. Of these jobs, 45,000 to 60,000 would be in construction and manufacturing sectors, and 19,000 in operation and maintenance.[25]

In terms of Energy Efficiency (EE), contributions to global job creation have been difficult to estimate. A recent study by MEDENEC[26] shows that by 2030, between 1.2 million and 1.6 million jobs could be created in the energy efficiency sector provided the right policy support is present.

[24] Source: REN21 (2013), Global Status Report 2014, p. 63.
[25] World Bank (2011), "Assessment of the Local Manufacturing Potential for Concentrated Solar Power (CSP) Projects", Middle East and North Africa Region.
[26] MED-ENEC (2013), "Energy Efficiency and Employment: a Win-Win opportunity in the Southern Mediterranean", MED-ENEC.

Table 3: Estimated Direct and Indirect Jobs in Renewable Energy Worldwide, by Industry

	World	China	Brazil	United States	India	Bangla-desh	European Union[m]		
							Germany	Spain	Rest of EU
	Thousand Jobs								
Biomass[a,b]	782	240		152[h]	58		52	44	210
Biofuels	1,453	24	820[f]	236[i]	35		26	3	82
Biogas	264	90			85	9.2	49	0.5	19
Geothermal[a]	184			35			17	1.4	82
Hydropower (Small)[c]	156		12	8	12	4.7	13	1.5	18
Solar PV	2,273	1,580[e]			112	100[k]	56	11	153
CSP	43			143[j]			1	28	0
Solar Heating / Cooling	503	350	30[g]		41		11	1	31
Wind Power	834	356	32	51	48	0.1	138	24	166
Total	**6,492[d]**	**2,640**	**894**	**625**	**391**	**114**	**371[l]**	**114**	**760**

Data source: IRENA

- *Source: REN21 (2013), Global Status Report 2014, p. 63.*

SMEs are the principal economic actors and employers in the world. This is not different for Egypt. In fact, they represent over 90% of registered companies and employ over 70% of the labor force in most of the Arab economies, including the informal sector.[27] SMEs can boost their energy efficiency and introduce renewable energy technologies, which are often local and small-scale by nature.

The Global Wind Energy Council estimates that employment in regular operations and maintenance work at wind farms contributes

[27] World Bank (2013), "SME Contributions to Employment, Job Creation, and Growth in the Arab World", Middle East and North Africa Region, Financial and Private Sector Development Unit.

0.33 jobs for every megawatt of cumulative capacity.[28] Accordingly, about 17 Jobs should be sufficient for each 50 MW. However, the local context should be taken into consideration. The wind farms are located in arid desert areas, with a high capacity factor (more operating hours per year), high temperatures, high turbulence and sandy weather, which result in an accelerated wear and tear of components and higher rate of failures after few years. Such an issue urges more employment in O&M activities. To date, considering only the announced plans in Egypt for additional capacities, large wind farms capacities would exceed in total 7 GW by the year 2020, with a possibility to further increase. Realizing such plans will require within the next few years preparing about 2,500 of qualified staff only for the O&M, and this workforce has to be at the level of quality consistent with international standards in this field to ensure the sustainability of the business. Qualified human resources are required not only for O&M, but also for all stages of development: resource assessment, project engineering, and installations. Over and above, qualified human resources are needed for the manufacturing of plant equipment and components, as developing local industries is one of the objectives for developing renewable energy projects. The case is similar for solar electricity generation. According to a survey by ESTIA, for solar thermal power plants, every 100 MW installed will provide 400 full-time equivalent manufacturing jobs, 600 contracting and installation jobs, and 30 annual jobs in O&M. [29] The approach of ad

[28] Global Wind Energy Council and Green Peace, "Global Wind Energy Outlook 2008", October 2008.

[29] Estela Solar. 2008. Solar Thermal Electricity Report. Online. Available at: www.estelasolar.eu/fileadmin/ESTELAdocs/documents/2008.05.28_ESTELA_DisseminationDocFull.pdf

hoc on the job training can no more be implemented if large-scale sustainable renewable energy projects are intended.

With reference to the current installed capacities, the total investments for both solar and wind energy projects currently exceed US$ 1.3 billion. Such investments have been assigned through governmental agreements between the Egyptian and donors' sides. Although this sum represents 25 years of investments in renewable energy, in the first half of the year 2015 NREA signed contracts estimating about US$ 500 million to install around 400 MW, mainly from wind (340 MW) and partially from PV. Over 6000 employees are engaged in establishing these projects. Direct and indirect jobs are around 3500 and 2600, respectively.

Based on the current positive momentum in the Egyptian renewable energy market, thanks to FiT and relevant legislation, investment opportunities in renewable energy have been increasing. Currently there are around 5000 MW from both wind and PV in the development phase, as shown in Table (4).

Around 116 local and international companies[30] are already qualified to install the FiT utility-scale projects; totaling 4000 MW. In the same context, more than 100 PV rooftop companies have been certified to work in the Egyptian market. Based on a IRENA report[31] issued in 2014, job opportunities generated due to these activities would be around 29000 divided between direct and in-direct opportunities (22000 and 6000, respectively). Potential direct

[30] Lists of nominated companies are available through the following link; http://nrea.gov.eg/arabic1.html

[31] IRENA (2014), "Renewable Energy and Jobs, Annual Review 2014".

job opportunities[32] will include around 13000 jobs in the manufacturing sector, 8500 jobs for erection, and 1000 in operation and maintenance. It is well known that achieving these numbers will take a lot of effort, but the benefits will be enormous, as it is said "climbing the hill is difficult, but the view from there is magnificent."

Table 4: Renewable Energy Projects in Development Phase

Capacity (MW)	Technology	Scheme	Scale
Wind	2000	FiT	Utility
Wind	250	BOO	Utility
PV	2000	FiT	Utility
PV	300	FiT	Rooftop
Wind	200	EPC	Utility
Wind	200	EPC	Utility

[32] NJPIRG Law and Policy Center, Emily Algoso and Emily Rusch (Renewables Work), 2004.

2.6 Conclusions and Challenges

This chapter reveals that renewable energy growth in Egypt can be driven by socio-economic considerations alongside with energy supply and security drivers. Key socio-economic aspects of renewable energy in Egypt have been highlighted. Egypt's statistical information and indicators show that the country is in a transitional phase with respect to energy security and dependency. A significant step in 2014 was the launch and implementation of gradual reform of energy subsidies, through a cost recovery energy pricing system, whereby it substantially decreased subsidies for gasoline, diesel, and natural gas and adopted a five-year plan to phase out subsidies in the electricity sector, while managing the social and economic vulnerability to shocks in energy prices and preserving the limited hydrocarbon wealth, diversifying the economy and improving ability of renewable and sustainable energy technologies to reach grid parity cost.

In addressing the perceived higher cost of sustainable energy investments, political actors and promoters rest on the promise of higher positive socio-economic benefits, such as job and local business development opportunities. The economic activities associated with the renewable energy value chain can be among the main drivers for increased rates of deployment. Egypt has the assets of the human resources and the industrial base that can be adapted to serve the renewable industry locally and regionally. In particular, the solar and wind energy sectors can be a driver for innovation and motivate the society to be at the forefront of innovative technologies. The implementation of renewable projects would also contribute to developing rural communities, through improved access to electricity and provide new possibilities of learning

improvement through evening house lighting and provision of appliances and household solutions fostering improved health conditions. Adding to that, increased well-being can be created through securing local high quality jobs.

The Egyptian renewable energy deployment model is heavily based on large scale projects, while decentralized renewable energy solutions received sporadic attention. Even when a FiT pricing scheme was adopted, small scale decentralized systems had a small share of 300MW compared to 4000MW for medium and large scale projects. The decentralized systems are identified to be of higher value on local levels and promote higher business and employment opportunities. Among different renewable energy technologies, PV market is taking the lead, where over 100 companies are currently providing the services of supply, installation and maintenance of PV systems. Some donor-supported programs also piloted decentralized PV and biogas systems within developmental oriented projects, targeting rural and poorer areas. However, a key challenge facing Egypt is to increase the public appetite and subsequently the market volume for decentralized renewable energy solutions in different sectors, such as solar pumping for irrigation, hybridization of renewables with diesel for electricity and heat generation in industry and tourism sectors, etc.

The added value of establishing RE projects exceeds the value of electricity and jobs created. For example, wind projects at Zafarana triggered an impressive development of resorts and hotels on neighboring coastal areas after creating the necessary infrastructure (roads, electricity grid, water pipelines, etc.). However, such developments were not planned in advance, but were due to several overlapping conditions and circumstances, and

the question remains if the newly allocated areas for RE projects would create a similar positive impact.

There is a clear need to research, in sufficient detail, the impact of existing and proposed renewable energy developments on different valued socio economic components, such as health and well-being, sustainable land access and traditional/alternative use, protecting heritage and cultural resources, equitable business and employment opportunities, adequate services and infrastructure, and adequate sustainable income and lifestyle. It is highly recommended to initiate such research.

The employment effect of renewable energy expansion is one of the key valued socio-economic factors, with an estimate of around 29000 job opportunities based on the currently announced pipline of projects. The educational and vocational training activities for providing the needs of skilled human resources vary from being diligently pursued through structured courses in few cases, to being ad-hoc on the job random and infrequent training in other cases. Even for the wind power projects, satisfying the manpower needs for achieving the announced targets and ambitions may represent a challenge. Accordingly, it is of high importance to address this issue through standardized curricula delivered by dedicated service providers subject to highly efficient quality schemes.

Annex (1)
Indicative list of some NGOs working in the field

Name	Scope
NGOs for Society Development and Environment Protection	*A full list of local, regional and national NGOs registered in Egypt* http://www.moss.gov.eg/
Ice Cairo	*Innovation and green business support* http://www.icecairo.com
AlshanekyaBalady	*Entrepreneurship and capacity building* http://www.ayb-sd.org/en/#about
Middle East Council for Small Business and Entrepreneurship (MCSBE)	*Small Business & entrepreneurship support* http://mcsbe.net/
Green Prophet	*Sustainable voice for green news on the Middle East* http://www.greenprophet.com/
Nawaya	*Green agriculture capacity building* http://www.nawayaegypt.org/Nawaya_Egypt/Nawaya.html

Beeie	*Environmental platform to share knowledge* http://www.bee-ie.org/
Egyptian Energy and Environment association	*Renewable energies and environment* http://www.eaee-eg.com/
Injaz Egypt	*Entrepreneurship and development* http://injaz-egypt.org/
NahditElmahrousa	*Social entrepreneurship* http://www.ayb-sd.org/
Ashoka Arab World	*Social entrepreneurship* http://ashokaarabworld.wordpress.com/
Silatech	*Entrepreneurship support* http://www.silatech.com/home
Misr El Khair	*Social Development* http://www.misrelkheir.org/index.html
Gesr	*Social entrepreneurship* http://gesr.net/ar/home-page

Annex (2)
Feed-in Tariff Scheme in Egypt

A) Photovoltaic

Residential	84.4 P.T./kWh
Installed Capacity ≤ 200 kW	90.1 P.T./kWh
200 kW ≤ Installed Capacity < 500 kW	97.3 P.T./kWh
500kW ≤ Installed Capacity < 20 MW*	13.6 $.cent/kWh
20 MW ≤ Installed Capacity ≤ 50 MW*	14.34 $.cent/kWh

The PV projects' FiT for installed capacities more than 500 kW is being paid with Egyptian pounds according to the following equation:

*PV Projects' Feed-in Tariff (L.E.) = [15% of Feed-in Tariff ($.Cent) X 7.15 (L.E.)] + [85% of Feed-in Tariff ($.Cent) X exchange rate on the bill issuance day, as stated in the contract]

Annex (2)
Feed-in Tariff Scheme in Egypt

B) Wind Energy

Full Operating Hours (FOH)	Feed-in Tariff for the 1st tariff segments (5 years period) ($.cent/kWh)	Feed-in Tariff for the 2nd tariff segments (15 years period) ($.cent/kWh)
2500	11.48	11.48
2600		10.56
2700		9.71
2800		8.93
2900		8.19
3000		7.51
3100	9.75	8.93
3200		8.33
3300		7.76
3400		7.23
3500		6.73
3600		6.26
3700		5.81
3800		5.39
3900		4.98
4000		4.6

Chapter 3

The Jordanian Perspective:

The Status Quo of Renewable Energy and the Framework of Energy Governance

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3.1 Introduction

Energy demand and consumption continues to increase year after year to cover the needs for necessary development of all the countries. As the world's supply of fossil fuel shrinks, there is dire need for affordable renewable energy sources in order to meet the growth of energy demand. Until today, most of the energy is produced using fossil fuels. This, however, brings about a set of downsides including scarcity of fuel resources, generated pollution, severe health and environmental problems, global warming caused by greenhouse emissions and risks to energy security posed by unstable conditions in many countries where raw fossil fuel reserves are located. Shifting to a model that includes renewable technologies would help mitigate those downsides, by promoting more ecologically friendly systems and fostering the countries both economically and socially, as many related jobs would be generated. Despite these positive effects, changing the model is not an easy issue, since the incumbent non-renewable energy technologies are currently well established options that have benefited from a long time of development, compared to the more recently evolving renewable energy options.

There is universal agreement on the need to reduce greenhouse gas emissions. To this end, different policies are evolving both locally and internationally. Moreover, the world now is facing an energy crisis, defined by significant decreases in the supply of energy available, coupled with rises in energy prices, resulting in shortages of crude oil and other natural sources of non-renewable

energy. The need for alternative sources such as renewable energy is becoming increasingly urgent.

Jordan is considered a low-middle income country, with an approximate average income of 448 JD per month in 2012, and a population of 6.388 million capita, and its population reached 9.5 million capita at the end of 2015. Jordan suffers from a lack of natural resources including water, fossil fuels and other commercial minerals. Thus, Jordan depends heavily on imports of crude oil and natural gas from neighboring Arab countries as its main sources of energy. The country's economy depends mainly on tourism and the business services sector, in addition to some industries such as fertilizers and medicines. Jordan's economic growth accelerated in recent years, which in turn led to an increase in the demand for energy in all its forms. A clear shift towards using natural gas as a primary source of energy has been observed in recent years.

Demand and need for energy are only growing, and Jordan has abundant sunshine. The non-renewable energy technologies developed in the last few years enhance welfare, efficiency and progress but cause high levels of pollution and raise concerns for the environment. Also, the increased demand on energy strains available resources and poses a challenge to sustainability. Opportunities for using renewable energy can be seized through promulgating policies and legislation, which can have positive effects on consumers and producers and help achieve sustainable development.

The increased demand on energy, the effects of regional conditions on Jordan, and the lack of energy sources are all factors

that adversely affect the Jordanian economy. These factors add to the urgency of needing to invest and develop alternative and renewable energy sources. Moreover, the country does not have sufficient, clear and long-term future plans in the field of energy. This chapter addresses the issues of energy sources and the energy efficiency sector in Jordan. It also examines the shifts in policy that are needed to enhance energy efficiency.

The demand on primary energy increases in Jordan by almost 5% annually, while the increase in the demand on electricity is about 7% every year. Jordan, just like other MENA countries, depends on fossil fuels, which cause greenhouse gas emissions. These emissions are expected to grow 20% by 2035 compared to 2010.

Jordan has not met its rapidly increasing energy demand with renewable sources. In fact, Jordan is importing more than 97% of its energy needs from outside. The energy bill consumes more than 21% of the national GDP. In the last 15 years, Jordan witnessed a massive increase in energy demand which was met with fossil fuels (crude oil and gas), while the use of renewables remained constant at around 1%. Only in the last two years, the share of renewable energy started to increase above that level, and the absolute use of renewable energy in the country also slightly increased. Yet it remains that the growth in energy demand is faster than the pace of renewables utilization, both in Jordan and also on a global level.

This chapter also discusses how renewable energy can be promoted in Jordan. Beyond environmental benefits, the use of renewable energy can bring about long-term economic benefits.

This chapter discusses the status quo of renewable energy in Jordan, highlights the potential and the advantages of renewable energy, and explains how a transition towards a renewable energy supply may be achieved. It also discusses the country's renewable energy strategy and the policy instruments used for the deployment of renewables, Renewable Energy sources includes solar, wind, hydro, geothermal power, and biomass energy. The last two forms have a particularly significant potential in Jordan.

The world is dependent upon energy. Supplying people with energy is probably one of the most pressing problems humanity is facing today. Developing countries in particular create an urgent need for simple and cheap energy supply (Boutammachte and Knorr, 2012). People's energy use directly correlates with levels of health care, life expectancy and education. These are important factors that determine a person's quality of life (Dascomb, 2009). Increasing access to modern energy services in developing countries requires strong and immediate actions. Energy access is crucial to enhance economic and social development, reduce poverty, and contribute to international security. One quantitative measure of life quality is the Human Development Index (HDI), which is a composite statistic of life expectancy, literacy, education and Gross Domestic Product (GDP) per capita for different countries. Figure 1 displays the HDI compared with electricity use for different countries, revealing a clear correlation between electricity consumption and HDI.

Figure 1 shows that world average HDI equals 0.741 and the world average annual electricity consumption per capita is 2,490 kWh. A small amount of electricity can dramatically change the life of a

person who has had none. It is estimated that the power requirement for basic healthy functioning in rural communities is about 0.08 kWh/day/person (Brenton and Anjaneyulu, 2007). This is less than 1% of an average person's usage in the United States, yet many people cannot afford or have access to it. Future energy demands can only be met by introducing an increasing rate of alternative fuels.

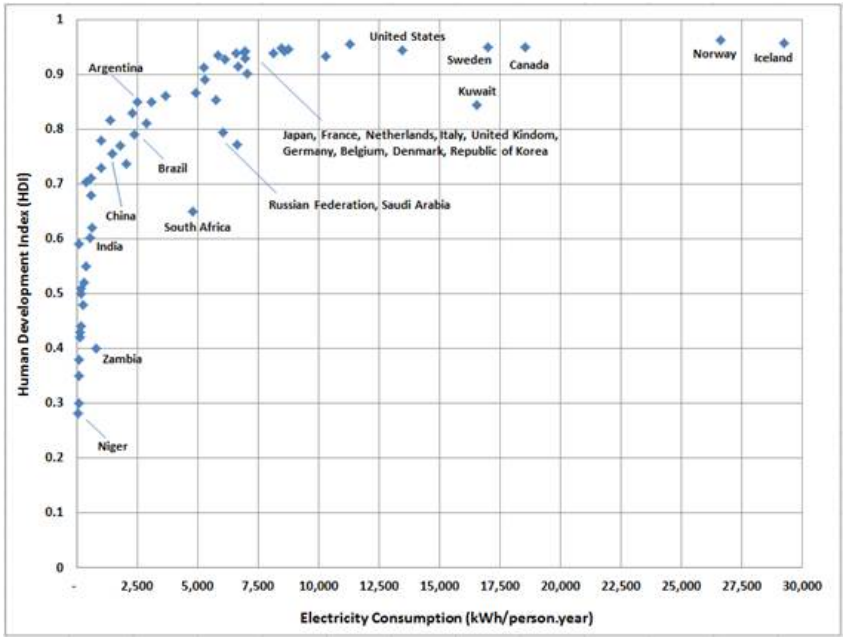


Figure 1: Relationship between Human Development Index (HDI) and electricity consumption per capita.

Unfortunately, traditional fossil fuel energy has had serious and increasing negative environmental effects, such as CO_2 emissions, global warming, air pollution, deforestation, and overall global environmental degradation. Additionally, fossil fuel reserves are not infinite or renewable; the supply is limited. A future mix that

includes sustainable energy sources will contribute to our prosperity and health. Our future energy needs must be met by a mix of sustainable technologies that have minimal environmental impacts (Foster, 2010). Solar energy, as an example of renewable energy, is clean, inexhaustible and an environment-friendly option among other options of renewable energy systems. Photovoltaic (PV) power system is a technology that meets a significant need in supplying electricity and avoiding the external environmental costs associated with traditional electrical generation technologies. Moreover, solar PV panels are easy to fit, guaranteed to last and require minimal maintenance.

3.2 Mapping of Stakeholders and Energy Sources

Jordan has one of the greatest potential for renewable energy in the world. Jordan is located within the sun-belt zone, which has the highest solar radiation in the world. Unfortunately, the present share of renewable energy to the country's primary energy mix is only about 1%. In addition to environmental and other benefits, renewable energy has a long-term economic advantage over non-renewable energy.

Jordan has the biggest incentive in the Middle East to develop and expand the renewable energy industry. There are no indigenous oil and gas reserves or production. The energy mix is supplied by gas that is secured through the Arab Gas Pipeline from Egypt. The unreliability and recent unavailability and interruptions of this supply resulted in national energy bills that reached unprecedented Figures. Jordan has enough renewable energy sources to cover 100% of its electricity need in the future. These sources can give

over 60 times more electricity than the country's projected demand in 2050.

Renewable Energy is expected to become cost-competitive energy sources over the short, mid and long term because as the technology develops, its cost drops thanks to mass production. Renewable Energy has a clear cost advantage compared to fossil fuels. Even if the environmental costs were disregarded, renewables would very likely achieve cost-advantages compared to non-renewables because there is an enormous potential for developments in the technology. Furthermore, the emergence of economies of scale will eventually reduce costs (Jalilvand 2012).

The Jordanian government liberalized its energy market and fuel prices were modified according to the international price market as of November 14th, 2012 after having stabilized them on November 12th, 2011 in the wake of the Arab Spring. Gasoline prices are now modified every month according to the international price. Jordan's decision to remove subsidies on fossil fuels works to encourage the deployment of renewable energy. As the International Energy Agency highlights, Energy subsidies cause several negative effects. Subsidies encourage the overconsumption of energy, hasten the decline of exports, threaten energy security by increasing imports, drain state budgets for importers, discourage investment in energy infrastructure, distort markets, create barriers to clean energy investment, increase CO_2 emissions and exacerbate local pollution, inhibit the effect of international high prices in decreasing demand encourage fuel adulteration and smuggling, and they disproportionally benefit the middle class and the rich (Jalilvand, 2012).

3.2.1 Energy Sources

The demand on primary energy sources in Jordan has been growing by an annual average of about 5% over the past ten years. It is expected to continue growing by 3% during the next decade. However, the demand on electricity-generating energy is growing much faster, and has increased around 7%.

The Risha gas field, which was discovered in 1987, is currently the only source of hydrocarbon fuel in Jordan. Jordan also has enormous sources of oil shale deposits, and is blessed with high potential for solar, wind, geothermal, and bio-fuel energy sources. These sources are clean and do not produce negative effects on the environment. Lying in the sun-belt area, Jordan has a high potential for solar energy. The annual average of global solar energy is approximately 1800 kWh/m2, where the daily average solar irradiance on a horizontal surface has a range between 5-7 kWh/m2 (Al-Salaymeh, 2006). To date, solar energy is mainly used in Jordan for domestic solar water heating. More than 100 photovoltaic systems are used in remote areas throughout the country, and they cover different applications such as water pumping, telecommunications, schools and others. Recently, after the issuance the Renewable Energy Law, PV units are being installed on rooftops of all newly-constructed buildings, both residential and commercial.

Jordan is also blessed with rich wind energy sources. The Jordan Wind Atlas indicates that some areas in the northern and western regions of the country have wind speeds that exceed 7 m/s (Al-Salaymeh, 2006). This speed has a major potential for

generating electrical power. There are two operating wind farms in Jordan: one with a capacity of 320kW, established in 1988 in cooperation with a Danish firm and is considered a pilot project, and the other with a capacity of 1.2 MW, established in 1996 in cooperation with the German government. Both wind farms are fully operational. Wind Energy is also used for water pumping in Jordan, using a locally manufactured mechanical windmill. Recently, a wind farm project with a capacity of 117 MW has been launched in the city of Tafileh in the southern part of the country.

Jordan, which is considered as part of the Ring of Fire, is tectonically active and could be considered as a potential region for generating geothermal energy. Jordan has geothermal energy resources in two main forms, medium and low energy with variations in temperature that range from 110-114^{o} C and 30-65^{o} C respectively. Many houses in Jordan use the shallow geothermal for heating purposes.

There are also many projects in Jordan that use biomass energy for production of electricity since it is a clean and renewable energy. Examples include the Russaifa Biogas Plant with a capacity of 3.5 MW and the Samra Biogas plant with a capacity of 6 MW, in addition to domestic projects such as Al Khaldieh, which is a small animal farm that produces 3.5 KW, whereby animal waste contributes 42% of the total capacity. Biomass energy is concentrated in three important regions in Jordan; Mafraq, Zarqa, and Irbid. It can produce more than half a million cubic meter of biogas.

3.3 Stakeholders, Key Institutions, and Regulatory Framework

The energy sector in Jordan is currently supervised by the Ministry of Energy and Mineral Resources (MEMR), which is responsible for policy and strategy formulation, regulation of oil and gas, contracting of private independent power developments, and imports of energy. MEMR aims to provide all forms of energy required for sustainable development through the enhancement and implementation of proper policies, legislation and programs; to diversify sources and forms of imported energy; and to boost local and renewable sources of energy and efficiency in various sectors. MEMR creates the laws providing for the abolition of customs duties. Sales tax is decreased for all items related to renewable energy in order to encourage investment in this sector. The Electricity Regulatory Commission (ERC) has the responsibility of electricity sector regulation as stated in the Electricity Law. The other key ministries involved in this sector are the Ministry of Planning and the Ministry of Finance.

The Jordanian government set with the Master Strategy of the Energy Sector (2007-2020) (the Energy Strategy), the target to obtain 1,800 MWs, or 10% of the country's energy supply, from renewable sources by the year 2020. According to the Energy Strategy, about 1,200 MWs will come from wind energy, 600 megawatts from solar power, and between 30 and 50 MWs from waste-to-energy facilities. Studies by Jordan's Natural Resources Authority have found medium and low geothermal waters along the Dead Sea rift valley. The Energy Strategy aims to reduce Jordan's dependence on imported oil products from 97% and increase renewables' supply up to 10% of energy demand by 2020. Since the

2003 invasion of Iraq, Jordan's main source of imported oil has been Saudi Arabia, followed by Kuwait and the United Arab Emirates.

In May 2011, Jordan's MEMR called investors to submit Expressions of Interest (EOIs) for installing 1,800 MWs of renewable energy plants. In these EOIs, the Jordanian government sets out general guidelines and instructions to investors. The government's key focus is to develop an initial 50-100 MW concentrating solar power plant that uses existing concessional funding and any additional concessional funding that can be secured by the relevant project developer. The approved project will be developed through a competitive tender, and depending on the availability of further concessional funding, the government may tender additional projects. Also, priority will be given to photovoltaic projects from 5 to 10 MWs and solar thermal projects from 25 to 50 MWs. Larger projects will be considered, but they will need to demonstrate their clear superiority in technical and financial areas in order to be accepted, they also need to demonstrate their ability to fully comply with the Law. Also, projects which generate energy for domestic consumption will be given priority over export projects. Projects based on exports will be considered on a case-by-case basis, and in this case, priority would be given to export projects that come as part of regional and international initiatives (Ministry of Energy and Mineral Resources, 2011).

The Law sets out a number of measures for the use of renewable energy in Jordan including the establishment of a scheme whereby private companies with renewable energy projects can

bypass the competitive government bidding process and negotiate directly with MEMR. The Law permits an unsolicited or direct proposal submission, where investors can identify and develop renewable grid-connected electricity projects and propose these to MEMR. Developers are required to set a fixed tariff in their proposal before being approved. In addition, the National Electric Power Company shall purchase all electricity produced with renewable energy sources and cover the cost of grid connection for developers. The Law provides that the tariff that the project developer sets out in their proposal shall be within an acceptable range according to the Reference Price list. The reference price list is prepared by Jordan's Electricity Regulatory Commission together with relevant bodies. It defines the mechanism of pricing electricity from renewable energy sources. The lack of a tariff regime may act as a disincentive to the development of renewables in Jordan, as project developers may be discouraged by the lack of transparency and the limits placed on investment returns (Ministry of Energy and Mineral Resources, 2011).

In terms of consumption, factories must bear responsibility in saving energy since they rank second in electrical consumption after households; their share of consumption is 24%. Many people don't recognize the problem of energy and the importance of renewable energy. Therefore, educating the citizenry to be conscious about renewable energy and its importance will guide and direct the stakeholders and businesses towards developing this sector rapidly and efficiently, locally with less reliance on outside investors.

Appendix (1) includes a list of the most important stakeholders and actors in Jordan's energy field.

3.4 Assessing the Current Energy Strategy

Jordan faces different challenges in the energy sector, due to population growth, increased consumption of energy per capita, and drop in fuel supplies. Since it imports 97% of its oil and gas, the rising cost of importing energy sources has forced the government to reconsider its energy consumption policies and address the issue of reliance on international energy markets for direct imports.

A renewable energy supply comes with a variety of benefits beyond the satisfaction of energy needs. On top of the environmental benefits, a renewable energy supply has long-term cost advantages. Furthermore, additional export earning can be generated through the export of abundant renewable energy. Renewable energy can also increase energy-supply security, create a substantial number of jobs in Jordan and the MENA region, and contribute to the electrification of rural areas. However, many costs and effects associated with the use of fossil fuels are not reflected on the consumer price. This is particularly the case for environmental costs of energy consumption. The non-renewables contribute substantially to climate change, which is both economically and socially costly and detrimental for the region. The costs of adaptation measures to climate change are generally not reflected on the consumer price for energy and even less so in subsidized consumer prices. Renewable Energy is not only the most environmentally friendly energy sources; but in the long-term also the most economically viable. The other benefits of renewable energy range from job creation to enhancing energy security.

The vast potential for renewables in Jordan remained unexploited for decades, as only 1% of Jordan primary energy mix

is supplied by renewable energy. However, the share of RE is expected to increase in the near future as the potential of RE in Jordan has been exploited in the last two years especially after the grid parity for renewable energy sources has been reached. Given that Jordan has no fossil fuel reserves, this encourages the utilization of RE. Like other countries, Jordan should respond to the fundamental global energy and environmental challenges including greenhouse effects and climate change which resulted from the massive increase in global energy demand by the upgrade of RE projects.

Jordan depended on importing natural gas from Egypt for electricity generation; in fact, more than 80% of its power stations were supplied with imported gas. In the decade from 1999 to 2008, natural gas demand grew by some 80% in the MENA region, while the overall energy consumption grew by 66%. The natural-gas-powered plants provide an economically and environmentally attractive way to meet the massively increasing energy demand in Jordan and the MENA region. By importing gas, Jordan tried also to diversify its energy mix so that it would include energy sources other than oil. Recently, Jordan started to import natural gas by sea in the form of liquefied natural gas. The Gulf of Aqaba was prepared to receive the ships carrying the LNG; with the first ship arriving in Jordan in May 2015.

Jordan's goal of achieving energy security may only be reached by increased dependence on renewable energy sources. Renewables can greatly advance energy security, since energy-supply security is commonly defined as the access to reliable and affordable energy. Dependency on imported non-renewable energy sources has affected Jordan's energy security tremendously, particularly in the

past few years. For example, after the Arab spring, the Egyptian-Jordanian pipeline, which provides fuel supplies to 80% of Jordanian electricity power stations, was attacked and exploded more than 14 times, causing major disruptions to gas imports. Therefore, the quantities of imported gas were reduced dramatically due to shortages in gas reserves in Egypt. Similarly, Jordan's imports of oil from Iraq were severely affected due to the unstable political conditions in Iraq. Such shortages of natural gas and fossil fuels posed major challenges particularly to the electricity-generation sector.

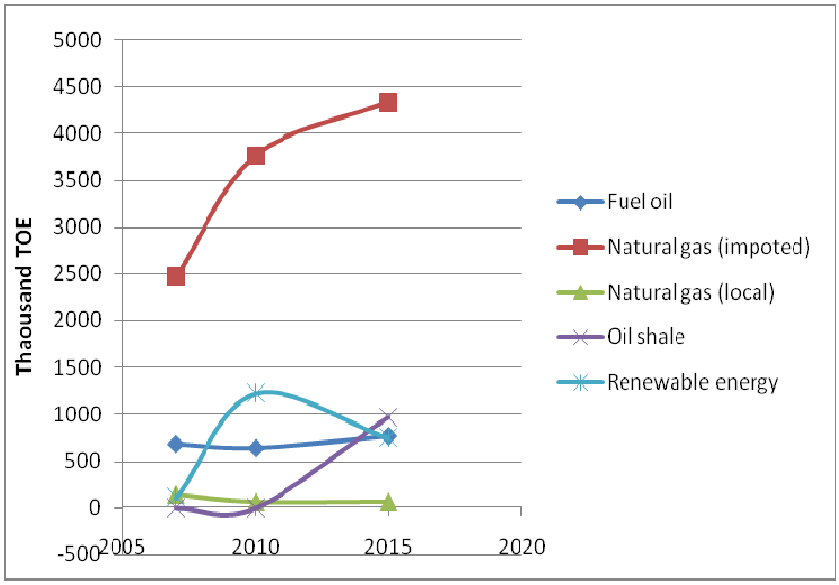


Figure 2: Primary Energy Demand (2007-2020) in Ton oil equivalent

Figure 3 shows the electrical distribution in Jordan by sector. It is clear that households represent the highest electricity-consuming sector in Jordan. Figure 4 shows primary energy consumption for 2013, where, crude oil represents 82% of the primary energy mix, while natural gas represents 11%.This low percentage of natural gas

contribution to the energy mix maybe attributed to the disruption of gas supply from Egypt. The share of Renewable Energy in the total energy mix is less than 2%.

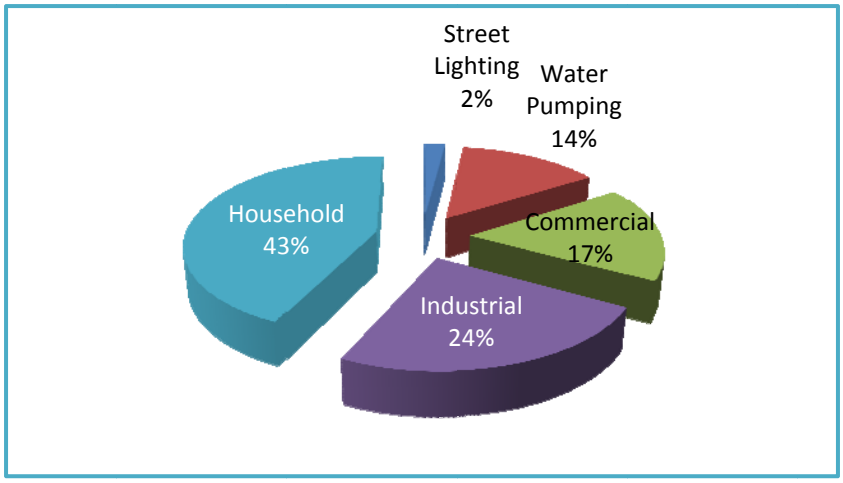


Figure 3: Electrical Energy Consumption by Sector in Jordan in 2013.

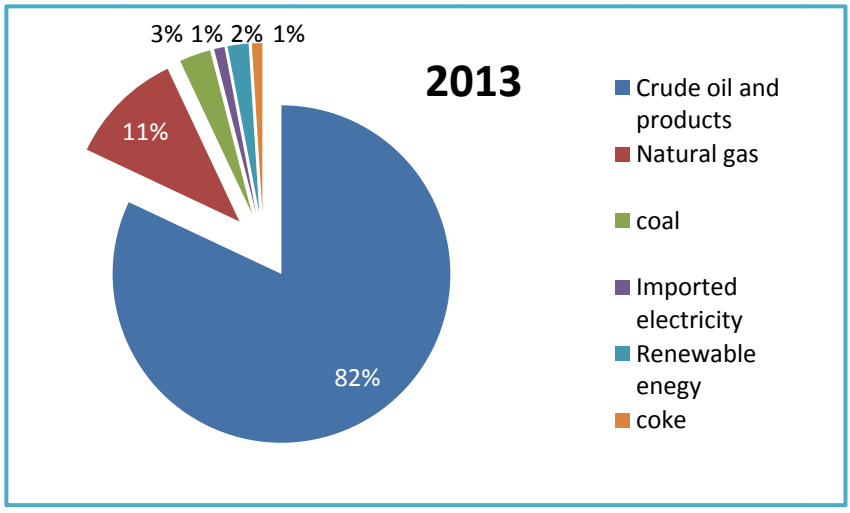


Figure 4: Primary Energy Consumption in Jordan in 2013

Figure 5 shows electricity consumption in Jordan between 2000 and 2012. The main consumer of electricity in Jordan is the residential sector (including government buildings), which accounts for 43% of the total consumption, followed by the industrial sector (24%). The overall consumption has been steadily increasing in recent years. The growth in electricity consumption per sector is outlined in Table 1.

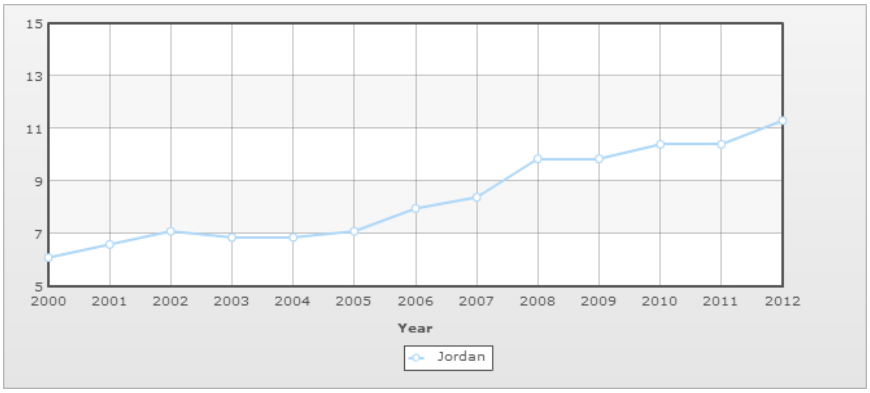


Figure 5: Electricity Consumption in Jordan between 2000 and 2012 in billion kWh

Table 1: Electricity Consumption by Sector (in GWh) 2008-2013

Sector	2008	2009	2010	2011	2012	2013
Domestic (incl. government buildings)	4.459	4.888	5.225	5.667	6.126	2.265
Industrial	3.128	3.006	3.262	3.486	3.461	3.517
Commercial	1.925	1.980	2.187	2.173	2.427	2.414
Water Pumping	1.713	1.772	1.868	1.899	1.955	2.076
Street Lighting	284	310	315	310	305	291
Total	11.509	11.956	12.857	13.535	14.277	14.564

The cost for energy imports to Jordan increased in 2009, amounting to 13% of the GDP, followed by another substantial increase of 20% because of the disruption in the Egyptian Gas supply. The energy supply mainly comes from fossil fuel, and is growing by 5.5% annually, while it is growing by 7.4% annually for electricity. The demand on energy is increasing steadily, and therefore there is a need to utilize other sources of energy.

Jordan has one of the highest rates in the world in terms of the amount of radiation per area; hence, the solar energy generated would be cheaper than the power generated in other countries, because energy generation will continue for times longer than what is possible in other countries. Several Studies indicate that Jordan is characterized by the existence of high-quality of sunshine throughout most days of the year. In a typical year, Jordan has more than 320 days of sunshine characterized by high-quality brightness without clouds, and with direct and excellent radiation angle suitable for generating electricity. Figure 6 illustrates the average annual direct normal irradiance on Jordan in kWh/m²/a.

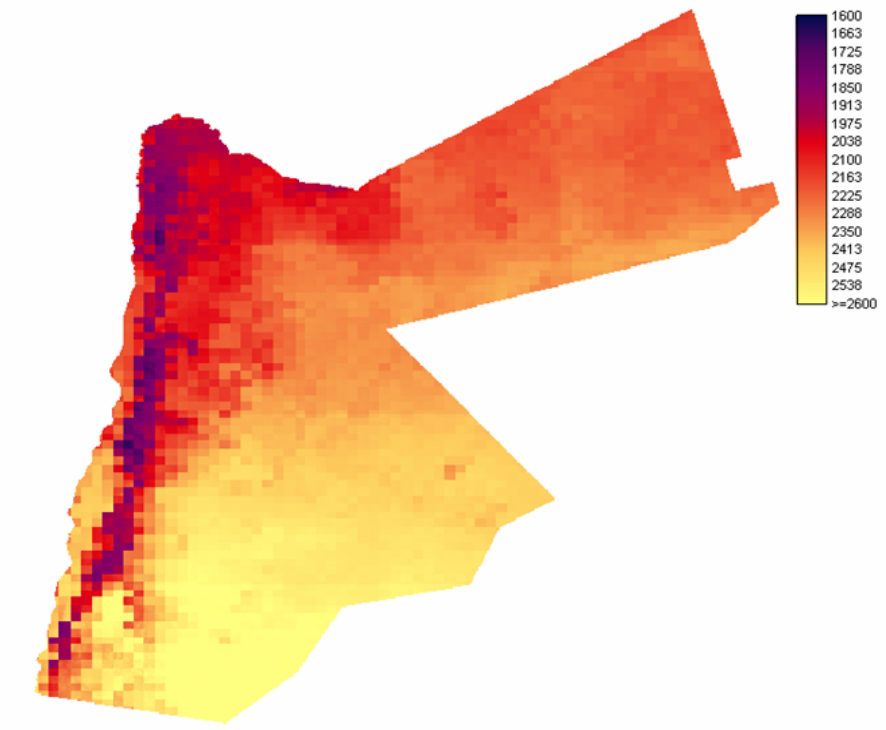


Figure 6: Average Annual Direct Normal Irradiance in kWh/m²/a.

The major challenges facing Jordan's energy sector, and in turn the government's energy strategy, include difficulties in expanding the crude oil refinery since the Jordan Petroleum Refinery Company's cannot attract a strategic partner. Moreover, electricity generation capacity is limited, and Jordan faces difficulties securing the necessary investments to meet the growing demand for electricity resulting from population growth, which is further exacerbated by the influx of refugees from neighboring countries. This was even made more complicated after the disruption of the imported natural gas from Egypt. Other challenges are the continuously changing legislation regulating renewable energy projects. Furthermore, the current law of the Natural Resources Authority (NRA) needs to be updated and restructured to reflect the country's efforts to transition towards utilization of renewable energy. And finally, there are risks that oil shale investment companies may not succeed in developing the necessary technologies to utilize oil shale to promote energy supply.

Nonetheless, the energy sector has strong prospects for investment in the Jordanian economy. Despite the challenges, most notably securing financing during the downturn and keeping up with the pace of demand, the sector should see major growth in the next two decades. The Jordanian interconnected power grid was supplied with an installed power station capacity of 3.193 MW in 2013. The generated and imported electrical energy amounted to 17,643 GWh in the same year. Table 2 shows the development of available capacity by type of generation since 2010.

Table 2: the Development of Available Capacity by Type of Generation (in MW) 2010-2013

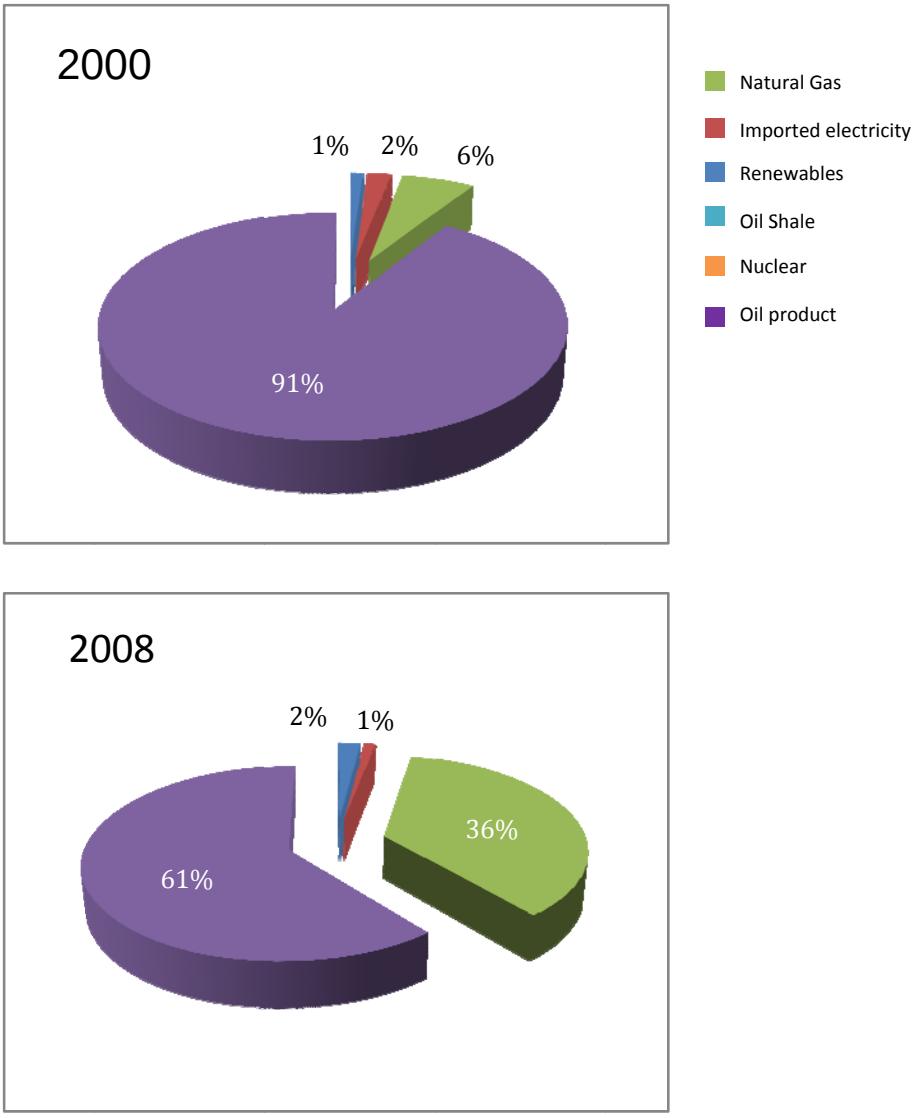
Year	2010	2011	2012	2013
MW				
Steam	925	925	925	791
Gas turbine (diesel)	149	134	134	27
Gas turbine (natural gas)	600	499	499	621
Combined cycle	1,317	1,737	1,737	1,737
Hydro	12	12	12	12
Wind	1.4	1.4	1.4	1.4
Biogas	3.5	3.5	3.5	3.5
TOTAL	**3,008**	**3,312**	**3,312**	**3,193**

3.5 Jordan's Current Renewable Energy and Energy Efficiency Program

The overall strategy for Jordan's energy sector aims at diversifying energy sources and reducing reliance on energy imports. It states that renewable energy will contribute 7% of the overall energy mix by 2015, and 10% by 2020. To achieve these values many projects were proposed, and some of these projects are still under study. Some projects have been under consideration since 2009, yet are still not implemented. The current share of renewable energy to the total energy mix is less than 2 per cent, which is not compared to the 7% targeted in the country's energy strategy by 2015. The Ministry of Energy and Mineral Resources issues laws that encourage the private sector to participate in developing and investing in the renewable energy sector. While the government has received many project proposals since initiating its renewable energy strategy, some of which have been approved and implemented, various other projects are yet to be considered, however.

In accordance with the Renewable Energy and Energy Efficiency Law provisions, the Government of Jordan has searched for qualified investors who are interested in investing in renewable-based electricity generation projects. 34 of the received proposals have been shortlisted for projects with a total capacity of 1000 MW. Successful applicants received a Memorandum of Understanding from the Government, which allows them to proceed with preparing proposals for their projects. As part of its overall strategy, the Jordanian government established the Renewable Energy and Energy Efficiency Fund, which provides a financial framework to support energy efficiency programs. This includes awareness

raising campaigns and training related to renewable energy projects. The Fund's resources include annual budget allocations, investment revenues, and foreign donations. Figure (7) below shows the breakdown of the energy mix components, and gives an idea about the government plan for 2015 and 2020.



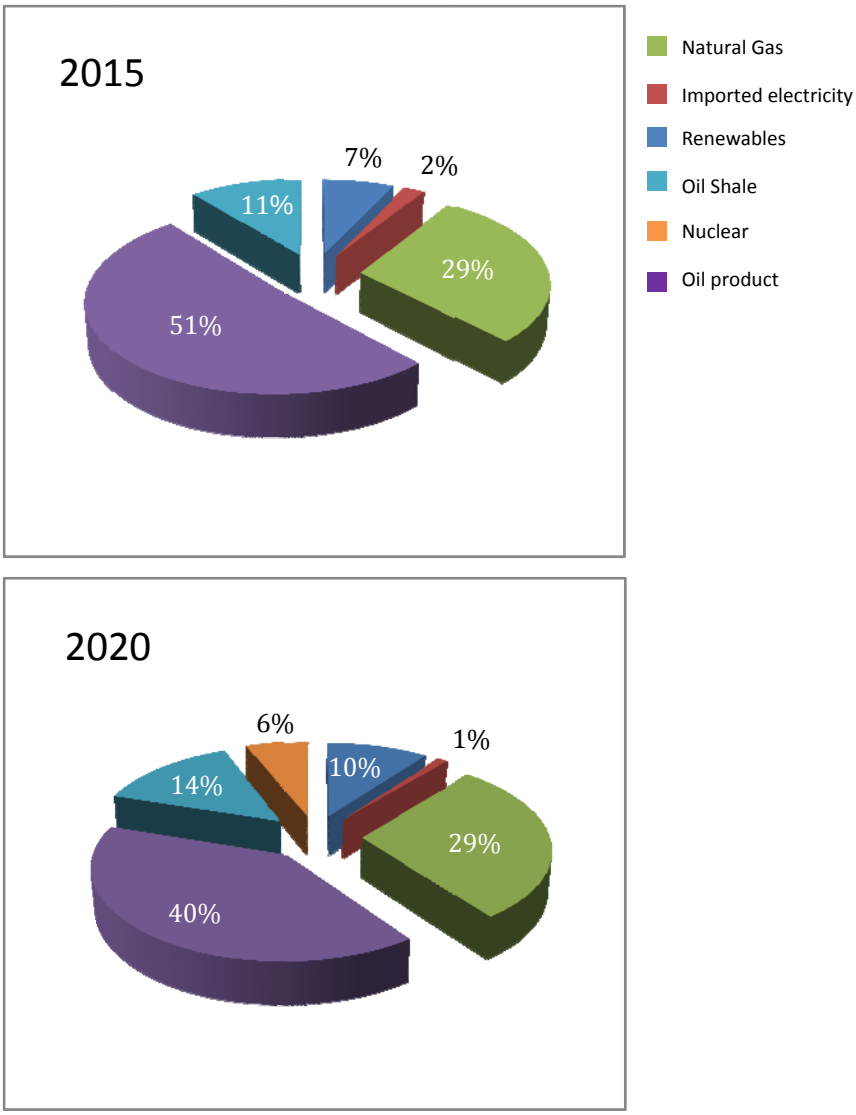


Figure 7: Energy mix breakdown for the years: 2000, 2008 and projections for 2015 and 2020 according to the Energy Strategy of Jordan

Increasing energy efficiency, introducing more energy saving technologies, and expanding the share of renewables in the energy mix are key to the transition towards sustainable energy in Jordan, the MENA region and worldwide. In Jordan, the Master Energy Strategy 2007 to 2020 provides several recommendations concerning energy efficiency, including the implementation of energy consumption efficiency programs in different sectors, broad awareness raising campaigns on the energy consumption rationalization, tax exemptions for energy saving equipment, thermal insulation of buildings, and designating a national award in the energy consumption rationalization domain. Jordan also introduced a National Energy Efficiency Action Plan (NEEAP), which is in the process of adaptation. The NEEAP sets a national indicative target of 20% energy consumption reductions by 2020 and six other sectorial targets.

Following on the National Energy Strategy, the government has started moving towards implementation. Jordan's Energy Minister announced in 2014 that the government expects to commission about 1,800MW of solar and wind power projects by 2018. Power purchase agreements have already been signed for more than 200 MW of solar power projects. A 117 MW wind farm is also under development. As part of its keenness to develop both wind and solar power projects, the Jordanian government is preparing to accept offers for additional wind project sat a capacity of 250 MW. In the last months of 2014, there was a series of ambitious solar PV projects announced including a 52 MW plant and two 10MW PV plants all located in Ma'an, in southern Jordan.

3.6 Shifts in Policy

Jordan's evolving energy policy can have a positive impact on electricity and energy consumers, and also on the ability to meet the demands of the clean energy sector, which is enjoying more financing opportunities in a rapidly developing promising market. The concerns over global warming have led to considerable interest in reducing carbon dioxide emissions from the electricity industry. Climate change is likely to have a number of effects on the economic environment for energy production, including new investments in renewable energy technologies that are becoming increasingly important. .

Jordan's utility and infrastructure sectors such as electricity and gas were predominantly state-owned in the 1970's prior to liberalization. In most countries, these sectors operated as state-run monopolies without direct competition from rival private sector firms. Private sector participation increased in the 1990's in the utility sector in developing countries after capital markets opened up. In Jordan, the privatization of the electricity sector started in 1999 and ended the state monopoly over generation, transmission and distribution sectors. Introducing competition into natural monopoly industries proved to be challenging and more difficult than anticipated.

The concept of regulatory governance is relatively new, and is the product of the economic liberalization reforms introduced in the 1980's. It is clear that the discussion of regulation cannot be limited to economic issues. Not only are thematic issues involved, such as the competing opinions on the most appropriate relation between the state and the market, but processes of policy-making are also

relevant, since it is the governments that promote and design these reforms. This requires an understanding of bureaucratic, political and policy processes. Both the intentions and the outcomes of reforms are determined by a combination of economic, political, social and legal-technical factors. It is within this broader framework that many energy sector reforms need to be viewed and analyzed.

Over the last decade, the energy sector in Jordan has been undergoing significant development with the government's program for economic reform. Accordingly, the private sector is expected to play a leading role. The government's energy policy aims to improve the efficiency of operations and to develop the energy sector to meet the energy needs of the country in an economically and environmentally sustainable manner. In addition, it seeks to develop the local energy resources, including renewable energy sources, in order to reduce the costs of imported energy.

Jordan started its activities in renewable energy in the late 1970's. The government established the National Energy Research Center (NERC) in 1998 to coordinate all research and development activities related to renewable energy and energy conservation in the country.

The liberalization and market reforms in Jordan embraced a wide set of policy actions in relation to trade and exchange rates, public enterprises and privatization, monetary and fiscal policy and pricing mechanisms in the agricultural and industrial sectors, amongst others. Jordan is unique in the Middle East due to the fact that there is a policy in place that requires from the government to cover the costs of grid connection for developers. Jordan's almost

complete dependence on imported fossil fuels has significantly altered the discourse on renewable energy. In many cases, the relatively high cost of renewable energy is still lower than that for energy from fossil fuels, and as a result the government is willing to pay for feasible projects even if at prices equal to those of fossil fuels. New regulations and the lower inherent risks in solar projects are likely to lead to more investor confidence and raise the "bankability" of projects.

Under its 2007-2020 National Energy Strategy, renewables are to transform the Kingdom into a net exporter by 2030. The aim is to increase the renewable energy share in the energy mix to 7% by 2015 and to 10% by 2020, a substantial increase from the 1% it currently represents. In terms of capacity, this equates to some 600MW by 2015 and to double this capacity by 2020. Under this Strategy, developers can submit their proposals for projects directly to the government. Known as the Direct Proposal Process, the government has received many letters of interest from developers so far.

Further reforms have been introduced in the energy sector in Jordan in recent years. The country is considered one of the leading reformers of energy policy in the region, with promising prospects for further development and sustainability. It can be said that the progress, improvements, continuity, and survival of any society depend on three key elements: energy, technology and water. These elements are dramatically overlapping, especially technology and energy, through which water issues and problems can be dealt with in better, more efficient, and cleaner ways. In fact, improving and enhancing these three elements can gradually transition Jordan from a developing country to a developed one. Also, improving these

elements especially in Jordan is necessary; because the issues of water, technology and energy are reaching alarming levels. Applying these technologies will enhance economic and environmental sustainability and can provide high-value and clean power.

Due to the high cost of electricity, the need to find alternative energy sources has become more urgent than before. There is therefore growing interest in investing in solar-generated electricity. Growth in population and living standards raise the demand on limited traditional energy, which is detrimental to the environment. Solar energy is environmentally friendly, renewable, and will continue to shine for millions of years as a source of free energy.

Embracing the benefits of renewables and deploying them require the adoption of appropriate policies at the national level. The transition towards a renewable energy supply requires some form of government intervention so as to overcome market distortions favoring fossil fuels. Subsidies for fossil fuels pose a significant barrier to renewable energy, and thus ought to be phased out. Jordan is on the path of implementing various measures to promote the introduction of renewable energy, which allow for flexible designs according to the respective needs of the country.

Fortunately, Jordan started to remove subsidies on fossil fuel for a few years now, and the government reapplied the free market price of oil products mid November 2012, after having frozen it in the wake of the Arab spring. The removal of subsidies on fossil fuels and the development of renewable energy technology make the utilization of renewables more economically-feasible than conventional energy. Despite contributing only 1% to the energy

mix from renewables, Jordan is nonetheless a leading country in the MENA region, ranking second after Morocco in utilizing renewable energy, and second to Tunisia in enhancing energy efficiency. The MENA region, including Jordan, substantially lags behind the world average in utilizing renewable energy. In 2008, the world average for the share of renewables in the primary energy mix was 12.9%, which is substantially higher than the MENA average of 1% .

Essentially, the existing markets for renewable energy today were all created through political measures. Unlike many countries in the world, renewables in Jordan are cost-competitive in the market. Governments are asked to facilitate the introduction of renewable energy until the market drivers are fully developed. The government of Jordan adopted measures to promote the deployment of renewable energy carriers. The Renewable Energy Law was issued in 2012 and is considered the first RE law in the region.

Subsidies appear to be the best-suited instrument to promote the introduction of renewables. Subsidies for renewable energy are aimed at reducing the consumer's price for renewable energy so as to make them economically competitive. The intention is usually to facilitate both the deployment of renewables and the improvement of research and development. Thereby, the costs of renewable energy are expected to decrease over time, which makes renewables more cost competitive (Jalilvand 2012). Recently, Jordan's Ministry of Energy and Mineral Resources received offers for the second round of PV projects with a total capacity of 200 MW. The PV price ranges between 43 and 62 Fils/kWh; this price is considered very low and less than the price of fuel-generated electricity; it is even lower than the cost of nuclear-based electricity. In fact, it is the lowest PV cost in the world.

Unlike fossil fuels and nuclear energy, there is still massive potential for cost reductions in the renewable energy industry. As the industry has just started to develop, the potentials for learning effects, technology leaps, and mass production are yet to be exploited. If these potentials are realized, renewables will not only be the most environmentally friendly energy sources, but they will also be the most economically viable (Jalilvand 2012). Phasing out fossil fuel subsidies has played a significant role in promoting renewable energy; in fact, doing so eliminated a significant barrier to the introduction of renewable energy in the country.

There is a variety of instruments through which renewable energy can be subsidized, and different types of subsidies may be implemented to promote the utilization of renewable energy around the world.

The introduction of renewables can be best promoted by designing national energy strategies, the implementation of which would be observed by competent national authorities. If renewable energy deployment policies are to be successful, they should not conflict with other energy policies. As mentioned above, the promotion of renewable energy does not heavily depend on a particular policy instrument; rather it counts on the stability and predictability of the instrument chosen. It is therefore important to integrate any renewable energy policy into a broader national energy policy framework. Having a national authority responsible for coordinating all energy affairs is certainly an effective way to ensure a coherent overall policy design.

Most countries in the region have already adopted renewable energy targets, but generally these goals are not being sufficiently supported by the needed agencies and appropriate strategies.

Jordan's energy situation is very critical and unstable ; there is, however, a very high potential for solar and wind energy to help stabilize the situation. Jordan has significant short-term energy challenges. From adversity, a golden opportunity arises wherein RE can take its rightful place in the energy mix at no added cost to Jordan. Beyond 2020, a vision for a nuclear free Jordan is possible, and a bold vision for 100% renewable energy utilization is attainable by 2050. Not only is it attainable, but also it will significantly contribute to the local economy, creating more than 100,000 direct and indirect jobs, and secures savings of more than $19 billion in costs by 2050.

In order to realize this vision, the following strategies need to be implemented:

- A commitment to a phased approach involving an investment program that exploits the cost and technical potential of each RE technology option.

- Removing obstacles and providing on-going facilitation for projects.

- Developing a national RE master plan that is both logical and measurable, and ensuring the buy-in of the various stakeholders in the sector.

- Picking the lowest hanging fruit by way of starting with projects that eat away peak demand, and also with energy distribution projects that can yield immediate employment opportunities.

- Engaging and benefiting rural communities as the key beneficiaries of the renewable energy program.

- Encouraging technology innovation by way of using pilot projects, competition, research and development and community based projects.

- Engaging the national and international community to build a support network of policy makers and financiers that are genuinely interested in the future of RE in Jordan.

3.7 Conclusion

Jordan has limited domestic fossil fuel sources, and most of its energy needs are met by imports. Jordan's native energy sources are its modest gas reserves, oil shale deposits and tar sands. It also has a small hydropower and biogas potential. The Jordanian government began phasing out subsidies for gasoline, diesel, fuel oil and kerosene in 2005. This was driven in part by a strategy to liberalize Jordan's energy markets, as well as by the need to alleviate the financial burden on the country's economy caused by soaring oil prices.

The Energy Strategy underscores the Jordanian government's commitment to the large-scale development of renewable energy

projects; commitment that was clear from the law promulgated, committing to the development of specific wind and solar projects, and the announcement of the creation of a Renewable Energy Fund. Also, Jordan has introduced a number of regulatory measures that form part of its Nationally Appropriate Mitigation Action plan to reduce GHG emissions.

By seeking to increase the share of renewable energy projects' contribution to primary energy supply in Jordan, the government hopes to decrease the Kingdom's dependence on international fuel prices, to enhance security of supply and to shift patterns of energy supply and demand into a more sustainable direction. Experts have warned that the Kingdom faces severe water shortages in the coming years. Desalination projects that were intended to meet Jordan's water supply needs will increase energy demand. Recently, the influx of Syrian refugees increased the pressure on natural resources, infrastructure, water and energy.

For Jordan, having limited fossil fuel sources and being exposed to the vagaries of the price of imported fuel, the need to supply energy from renewable sources is critical. Unlike some of its oil rich MENA neighbors, Jordan has taken clear steps towards encouraging the development of renewables by commencing the implementation of a program devoted to the regulation of the renewables sector. However, more work needs to be done, not least by providing more clarity on the tariffs for electricity produced from renewable sources, i.e. by allowing for the payment of a green tariff to producers of renewable energy, considering that the law allows a project developer to negotiate a tariff directly with the Ministry of Energy.

Renewable energy sources throughout the world still contribute a very limited amount of the total energy supply. Currently, the world energy trends are rapidly shifting toward the use of renewable energy as the ambitious technology that may replace the conventional fossil fuel and nuclear sources. However, developing countries such as Jordan currently have little local capacity to assess, design, develop, implement, operate and maintain large-scale renewable energy projects, or to appropriately implement renewable non-electric power projects. The number and capabilities of scientists who may contribute to the global research community remain limited. As a result, there is an urgent need to support appropriate regional research efforts, technical skills, and management capacity development in this field. Furthermore, to ensure long-term sustainability, it is essential that an appropriately skilled workforce is permanently available, implying a need for continuity of training based on local training institutes and trainers while minimizing the need for external technical assistance.

The new opportunities of utilizing renewable energy maybe achieved through policies and legislation. A range of direct and indirect entirely positive effects for this reflect on consumers and producers, while maintaining the expected human resources to achieve the so-called sustainable development. Jordan has not met its rapidly increasing energy demand despite the fact that it is importing more than 97% of its energy need from outside, and the energy bill exceeds 21% of the GDP. During the last two decades, Jordan witnessed a massive increase in energy demand, which was covered by fossil fuels, while the use of renewables remained constant and around 1%. Only in the last two years, the share of renewable energy started to increase slightly to above the 1% contribution to the energy mix.

As opposed to other countries in the world, renewables in the Jordanian market are cost-competitive. The government of Jordan adopted various measures promoting the deployment of renewable energy carriers. Jordan's Renewable Energy Law, issued in 2012, is the first of its kind in the MENA region. As a means to promote the renewables sector, subsidies for renewable energy appear as the best-suited instrument. The costs of renewable energy are expected to decrease over time, making renewables increasingly more cost competitive. Removing fossil fuel subsidies is another important factor in promoting renewable energy. By removing fossil fuel subsidies, Jordan removed a significant barrier to the introduction and promotion of renewable energy in the country.

The PV market continues to grow in Jordan. More than 69 MW of PV installations above individual rooftops were completed in the first half of 2015. The tendering for PV field power stations was given to qualified companies with a capacity of more than 300 MW. PV installations are indeed expanding.

In addition to government policies, other factors are important contributors to the growth of solar markets, including lower costs for PV installations and the availability of capital for third-party ownership of systems. The PV price ranges between 43 and 62 Fils/kWh and this price is considered very low and less than the cost of the electricity generated from both fossil fuels and the nuclear power plant. In fact, the cost of PV installations in Jordan is the lowest in the world.

Jordan started late in its efforts to utilize renewable energy sources, and it is clear that the economic element was the main driving force behind the government's move to adopt new

regulations and formulate a national renewable energy plan. However, and since then, the RE sector has been growing steadily and the country is beginning to reap the economic and environmental benefits of transitioning towards renewable energy. Hence, Jordan, which is considered a leader among MENA countries in adopting RE projects, is on the path of increasing the share of RE in total energy mix in the next few years to achieve the national energy strategy targets, aiming to secure a contribution of 10% to the energy mix from renewables by 2020.

Appendix 1

The Ministry of Energy and Mineral Resources (MEMR) has adopted a comprehensive planning process for the regulation policies and implementation procedures to fulfill mandated functions. The most important function is to provide the required energy by all forms needed for the purposes of comprehensive development at the lowest possible cost and best quality. Through the Comprehensive Development Plan, MEMR attracts the capital needed for investment in various energy sectors such as generating electricity, producing oil products, and utilizing domestic energy sources particularly the renewable ones. However, the ministry also supports studies to improve energy efficiency in various sectors and helps secure loan guarantees for renewable energy and energy efficiency projects through the Renewable Energy and Energy Efficiency Fund.

The Electricity Sector

Institutions responsible for regulating, generating, transmitting and distributing electricity all over the country are as follows:

I. Electricity Regulatory Commission (ERC)

An independent commission established in 2001, ERC's mandate is to identify electricity tariffs, subscription fees and costs of electricity services, and to issue licenses for companies for transmission and distribution of electricity. ERC also oversees

compliance with license terms and conditions and handles complains and hears disputes that arise between electricity companies and consumers, and also between companies, in a manner that best serves the public interest. It also extends any consultancy or advice needed concerning any subject or situation related to electricity.

II. National Electric Power Company (NEPCO)

NEPCO is a public shareholding company owned by the Jordanian government. Its mandate covers the construction, operation and maintenance of the transmission systems within the borders of the country. It also handles the electric transmission system, which connects the national system with that of other neighboring countries. It moreover secures the country's power supply through expanding generation units.

III. Central Electricity Generating Company (CEGCO)

GEGCO is a public shareholding company founded in 1999. It is responsible for power generation and wholesale sales to the National Electric Power Company. The generating capacity of the company reached 1687 MW at the end of 2013.

IV. Samra Electric Power Company (SEPCO)

SEPCO is a private shareholding company founded in 2004 and is fully owned by the government. The company is responsible of generating electricity and selling it to NEPCO. The generating capacity of the company reached around 887.9 MW at the end of 2013.

V. AES-Jordan. PSC

The Amman East Power Project is a private company owned by the American AES Company and the Japanese MITSUI Company. Founded in 2009, it is responsible for generating electricity and selling it to NEPCO. AES-Jordan. PSC owned the first private project in Jordan to generate electricity in East Amman power plant/Al-Manakher, which started generating electricity on May 26th, 2009. The generating capacity of the company reached around 370 MW at the end of 2013.

VI. Qatraneh Electric Power Company

Established in 2010, QEPC is a private company owned by the Korean KEPCO Company and the Saudi XENEL company. The company's mandate is to generate electricity and sell it to NEPCO. The generating capacity of the company reached around 373 MW at the end of 2013.

VII. Electricity Distribution Companies

They include three companies:

1. **Jordan Electric Power Company (JEPCO):** A public shareholding company responsible for distributing electricity in the Amman, Zarqa, Ma'daba and Balqa governorates.
2. **Irbid District Electricity Company LTD (IDECO):** A public shareholding company, responsible for distributing electricity in Irbid, Mafraq, Jerash and Ajloun governorates.

3. **Electricity Distribution Company (EDCO):** EDCO is a public shareholding company; responsible for distributing electricity outside the concession areas of JEPCO and IDECO; namely the Southern, Eastern and Jordan Valley areas.

IIX. Petroleum, Gas, and Mineral Ores Institutions

Institutions carry out operations of prospecting for oil, gas and mineral ores inside the country along with refining and selling crude oil and oil products. The institutions include:

1. **The Natural Resources Authority (NRA)**
2. **The National Petroleum Company (NPCO)**
3. **The Jordan Petroleum Refinery Company (JPRCO)**
4. **The Jordanian Egyptian Fajr for Natural Gas Transmission & Supply Co. Ltd**
5. **Oil Products Marketing Companies:** Three companies that distribute oil products.
6. **Central Gas Distribution Companies:** companies that distribute gas tanks.
7. **Gas Stations** for selling fuels. The number of operational gas stations reached 473in 2013.
8. **Gas Agencies:** companies that distribute gas cylinders. The number of working agencies reached 1096at the end of 2013.

IX. Jordan Nuclear Regulatory Commission (JNRC)

A commission established in 2007 as a successor to the former Jordan Nuclear Energy Commission which had been established in 2001. JNRC is an independent Regulatory Body.

X. Jordan Atomic Energy Commission (JAEC)

The Jordan Atomic Energy Commission was established in early 2008 as a successor to the Jordanian Nuclear Energy Commission.

XI. Jordan Bio-Gas Company Ltd.

A joint-stock company founded in 1998 and owned by the CEGCO and Greater Amman Municipality (GAM). The Company works to convert organic waste into methane gas to generate electricity. The generating capacity reaches 3.5 MW.

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Chapter 4

The Jordanian Perspective:

Socio-Economic Aspects of Renewable Energy

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4.1 Introduction

One of the most challenging issues in the effort to improve our understanding of the possibilities and needs of today's societies is exploring the socio-economic impact of sustainable renewable energy. Many countries around the world are working on developing the renewable energy sector in an effort to motivate social and economic growth. Investment in renewable energy is expected to produce a new basis for growth, enhance the balance of trade, generate jobs, develop the industrial sector and increase income.

Jordan faces a multi-faceted set of domestic and external challenges. It has to confront the political, economic and social challenges posed by the potential threats of unrest in neighboring countries, in addition to addressing domestic challenges that include the continuous government budget deficit, high unemployment, inflation and alarming poverty rates. This chapter aims to shed light on Jordan's renewable energy (RE) sector from a socio-economic perspective, and discusses the status quo and initiatives taken by the country to address the above mentioned challenges.

Jordan is one of the developing countries with a market oriented economy and estimated population size of 6.7 million in 2014, and a GDP of US $35,826 million – a per capita GDP of US$ 5,347.[33] The country's economic strategies have focused since 1991 on

[33] Department of Statistics, Jordan Statistical Year Book, 2014 http://www.dos.gov.jo, 26/8/2015.

market liberalization, economic stabilization, and reducing the government role in economic activities. Accordingly, this restructuring has resulted in a significantly growing international trade, foreign direct investment as well as increased rates of economic growth.

The aim of this chapter is to explore Jordan's socio-economic potentials for RE and analyze the scope of the RE sector improvement and its effects on the different economic aspects. The chapter also discusses the reality of the energy sector in Jordan, specifically the RE and the factors and variables related to this sector. To serve these objectives, the chapter has been structured into four sections; the first section tackles the significance of energy security and the related measures in Jordan's economy. The second section gives an overview of measures to enhance economic activity and alleviate poverty, focusing on the one hand on the relationship between economic growth and RE, and on the other hand on how it affects the poor strata of society. In the third section, we use a descriptive analysis to explore investment opportunities and job creation possibilities that RE may generate. Finally, section four reviews the conclusions and some recommendations.

4.2 Energy Security

"Energy security is one of the main targets of energy policy. However, the term has not been clearly defined, which makes it hard to measure and difficult to balance against other policy objectives."(Christian Winzer, 2011) One of the main pillars of energy security is the security of energy supplies and their sustainability. Indeed, a lack of natural resources, accompanied with regional insecurity, has put pressure on Jordan's government to

expand and diversify its sources of energy. The energy security in this context may have two dimensions in the case of Jordan; the first is the dependency on foreign energy supplies, and the other is the high cost of those resources. Figure 1 shows the primary energy consumption, revealing the high rate of crude oil and production consumption. 82% of energy supply in Jordan is totally imported, thus heavily contributing to the government budget deficit.

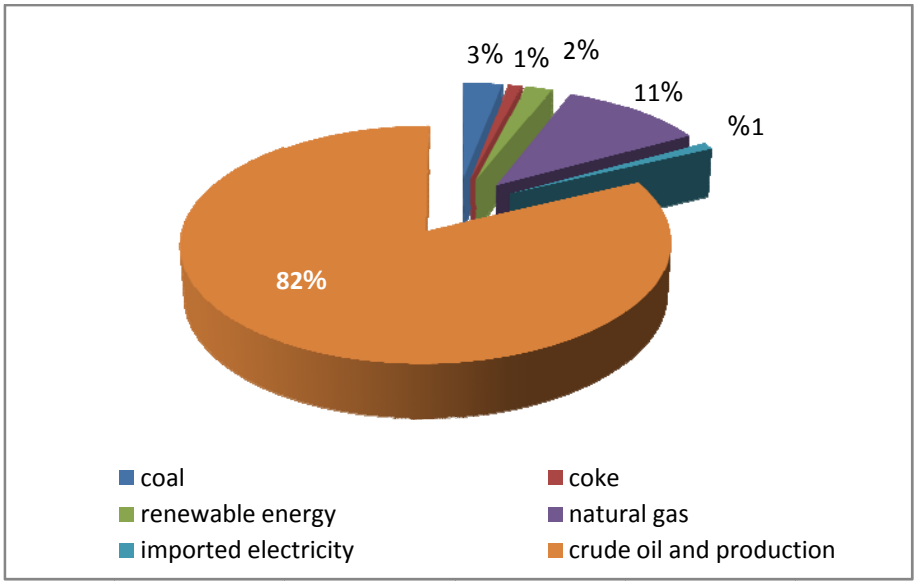

Figure 1: Primary Energy Consumption 2013

- *Source: Ministry of Energy and Mineral Resources, http://www.memr.gov.jo/Default.aspx?alias=www.memr.gov.jo/english*

4.2.1 Energy Dependency

Energy security and energy dependency indeed pose tough challenges for Jordan. The country imports the overwhelming majority of its energy requirements. The shortage of regular commercial energy resources imposes a burden on the government

budget because of the high price of imported oil. The cost of imported energy consumed was about US$ 5.7 billion in 2013.[34] Table 1 shows some energy indicators, which indicate energy dependency (ED) on external resources, which seems to increase over time rather than decrease. The net energy imports are estimated as energy use minus production, both measured in oil equivalents. The combustible renewable and waste as a percentage of total energy is very small during the period of 1993-2011. Domestic energy production stands for just about 3% of Jordan's total energy needs.

Given Jordan's dependence in energy sources on imports, it is apparent that any problem or crisis in energy supply can be detrimental to domestic economic growth. Thus, it is essential to implement strategies that promote energy supply security. Indeed, this is particularly critical because of Jordan's geographic and geopolitical location. There has not been much change in the energy dependency ratio during the period between 2000 and 2012. The development of renewable energy (RE) sector will help diminish the dependence on foreign energy sources and the fluctuation of oil and natural gas prices in international markets. In addition, it mitigates the long-term environmental deterioration associated with carbon and greenhouse gas emissions.

Renewable energy includes wind, solar, hydro, geothermal, tides, waves, and biomass. Jordan's energy strategy forecasts the RE generated power will cover one-fifth of its energy demand by 2020. The Jordanian Renewable Energy and Energy Efficiency (EE) Fund (JREEEF) was established in 2012 by Law No 13, with the purpose of financing RE and EE projects.[35]

[34] https://www.iea.org/media/training/presentations/egypttrainingoct2014/pdf/JordanPresentationcairo2014.pdf.

[35] RECREEE, Country Profile, http://www.rcreee.org/sites/default/files/jordan_ee_fact_sheet_print.pdf. 14/6/2015.

Table 1: Some Energy Indicators in Jordan (1993-2011)

Year	Fossil fuel energy consumption (% of total)	Energy imports, net (% of energy use)	Combustible renewable and waste (% of total energy)	Alternative and nuclear energy (% of total energy use)
1993	98.45	95.00	0.06	1.59
1994	98.47	93.26	0.06	1.47
1995	98.55	93.50	0.06	1.39
1996	98.59	93.77	0.06	1.36
1997	98.57	93.59	0.06	1.37
1998	98.56	93.68	0.06	1.38
1999	98.54	93.85	0.07	1.41
2000	98.46	94.12	0.06	1.41
2001	98.00	94.17	0.09	1.43
2002	97.98	94.81	0.09	1.38
2003	96.96	94.46	0.10	1.33
2004	97.67	95.27	0.08	1.15
2005	97.90	96.17	0.07	1.08
2006	97.89	95.76	0.08	1.45
2007	98.41	96.16	0.09	1.46
2008	98.01	96.10	0.09	1.64
2009	97.96	96.07	0.08	1.68
2010	97.35	96.17	0.09	1.82
2011	95.99	96.10	0.09	1.91

- *Source: The World Bank Indicator, http://data.worldbank.org/indicator/EG.*

Jordan has a high potential for self-sufficiency in RE sector; forms of RE include wind, solar, bio and geothermal. Jordan has rich wind energy resources. Currently, there are two operating wind farms in Jordan, with a total capacity of 1.445 MW.[36]

The solar energy potential in Jordan is massive; since it is one of the sun-belt countries where the annual average of solar energy is about 1800 kWh/m2/year. Solar energy is still underutilized in Jordan, but decentralized photovoltaic units in rural and distant villages are presently used for lighting, water pumping and other social services (1000KW of peak capacity). Moreover, Jordan has adopted a special program for Bio-energy by which pre-feasibility studies for the utilization of Municipal Solid Wastes for electricity generation were prepared since 1993 through cooperation with GEF. The outcome of these studies resulted in implementing the first biogas project in Jordan and in the region with a capacity of about 1 MW of electricity. This project is owned, operated and maintained by the Jordan Biogas Company (JBCO), and would be expanded up to 5MW by the year 2005. The total energy generated by Jordan Biogas Company Ltd. reached 78.945 GW during the period 2000-2011. Jordan is blessed with many thermal water resources spread along the Rift, in addition to thermal wells in the Eastern Plateau. The solar and wind projects in 2015 are expected to generate 1500 to 2000 Gig Watt-hours.[37]

[36] F. Abdulla, M. Widyan, Z. Al-Ghazawi, S. Kiwan, H. Abu-Qdais, M. Hayajneh, A. Harb, M. Al-Nimr, Status of Jordan Renewable Energy Sector: Problems, Needs and Challenges, by the US Department of State, Office of Citizen Exchange, American University of Beirut, Beirut, Lebanon, 26-30 April, 2004.

[37] Ibid.

4.2.2 Energy Intensity

Energy intensity measures the energy efficiency (EE) of a country's economy. It is a measure of the amount of energy a country needs per one unit of economic output. High energy intensities imply a high price or cost of turning energy into GDP. The average primary energy intensity in the region and Jordan measured in toe per 1,000$ 2005 (PPP), has decreased. Jordan's energy intensity decreased by 16.27% in 2011, but remains above the average primary energy intensity in the European Union and it is higher than the world average. This implies a disadvantage for producers of goods and suppliers of services in Jordan, as generating economic value requires a higher energy input. Therefore, high primary energy intensity implies a great potential to increase energy efficiency and renewable energy technologies and achieve a considerable improvement with initial investments.[38] Figure 2 below shows the primary energy intensity of Jordan, which experienced a decline during the period 1980-2011, yet it is still higher than the world average energy intensity. Jordan ranks second in the region after Tunisia in establishing auspicious environment for energy efficiency investments.

[38] Arab Future Energy Index™(AFEX) Energy Efficiency 2015, Regional Center for Renewable Energy and Energy Efficiency (RCREEE).

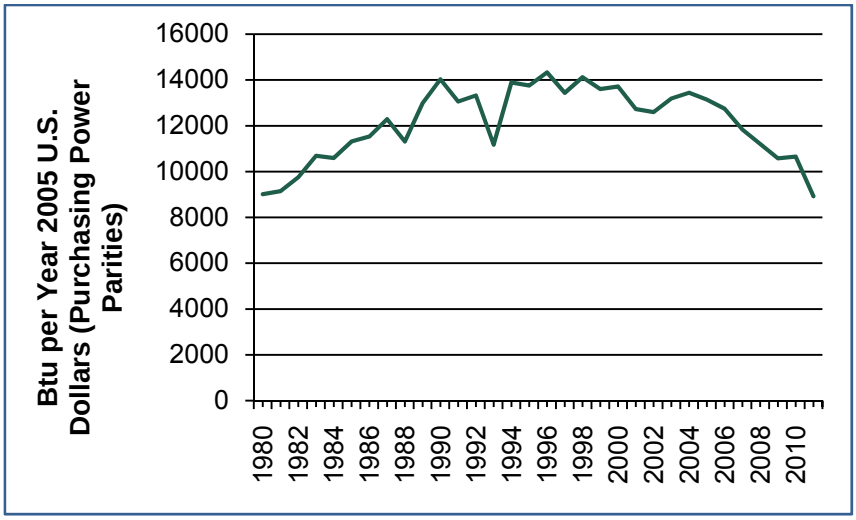

Figure 2: Energy Intensity of Jordan (1980 - 2011)

- *Source: International Energy Statistics, Feb, 2015.*

4.2.3 Energy prices

The Energy Pricing category considers the level of demand for efficiency energy services in the Arab countries. This category consists of two aspects: (1) energy subsidies; and (2) electricity price structure.[39] Jordan is one of six countries[40] that has implemented energy subsidy reforms in the electricity sector and increased prices of oil products. Jordan's Performance is one of the best in the region in both energy pricing and energy efficiency policy framework according to the RECREEE reports 2015. The subsidies for commercial and residential sectors have been reduced to reach just 12% and 48% respectively, and these are among the lowest rates among countries in the region, at prices of 16.1 and 9.2

[39] Ibid, pp 24.
[40] The countries are Jordan, Egypt, Morocco, Tunisia, Sudan and Yemen.

US cents per KWh respectively.[41] Jordan's commercial sectors pay the highest electricity tariff rates compared to other Arab countries, and the rates are expected to increase by 15% annually until 2017 per the Jordanian government's new electricity tariff rates, which will not, however, apply to residential consumers with a monthly consumption lower than 600 KWh.

In the period between 2003 and 2013, Jordan experienced peak demand increases by over 100%. Its peak time was in winter night, and in order to reduce the peak load, Jordan used a time-of-use (TOU) pricing policy. It is one of the most widespread forms of time-differentiated price structures. One of the main factors in managing the growth of demand on energy is to make sure that the price of energy, including electricity, reflects the complete cost of producing and delivering it.

4.3 Enhancing Economic Activity and Alleviating Poverty

Most countries are now considering ways to promote social and economic growth through the development of the renewable energy sector. Investment in renewable energy reduces energy dependency, creates jobs, alleviates poverty, stimulates economic growth and decreases the cost of economic development. Such socio-economic benefits are increasingly gaining importance in the global renewable energy debate. RE has increased its share in electricity creation in most developed economies due to its harmless environmental impact and its security of supply.

[41] Arab Future Energy Index™(AFEX) Energy Efficiency 2015, Regional Center for Renewable Energy and Energy Efficiency (RCREEE).

Economic growth needs sustainable and high standard commercial energy sources, especially considering that the relatively high cost of imported oil and high-energy investment requirements put a burden on the national economy. The renewable energy contribution to the energy mix in Jordan is projected to rise from 1%in 2007 to reach 7%by 2015 and 10% by 2020. Renewable energy production will be composed of 600 – 1200 MW from wind, 300– 600 MW from photovoltaic, and 30 – 50 MW from waste.[42]

4.3.1 Renewable energy and Economic growth

Jordan's economy grew by 3.1% in 2013 compared with 2.7% in 2012 and 2.6% in 2011.[43] It is dominated by the services sector, which contributes a share of about 67% of GDP.Manufacturing is the second important sector, contributing about 20% of GDP, while agriculture's contribution is around 4%.

The supply of modern energy helps the enhancement of human living standards, and promotes the productivity of sectors. The renewable energy sources, if effectively employed, could increase and improve energy access particularly in poor rural areas.

To this end, Jordan plans to reduce its import dependency from 97% to 61%. The National Energy Strategy envisions that by 2020, 29% of Jordan's primary energy will come from natural gas, 14% from shale oil, 10% from renewables, and 6% from nuclear. Economic development and growth sustainability need to be

[42] Jordan: building a green economy tapping into natural advantages and developing clean technologies, The Jordan Investment Board (JIB), Economic and Commerce Bureau, Embassy of Jordan, U.S. www.jordaninvestment.com.

[43] Country Report, https://www.gfmag.com/global-data/country-data/jordan-gdp-country-report.

achieved along with clean and secured sources of energy; for this is one main driver of social development. The social and economic aspects of renewable energy can be explored in two levels of analysis; macro and micro levels. Most research in this context shows that the increased input of conventional carbon-based energy reduced the economy's technical efficiency, whereas the increased consumption of renewable energy improved the technical efficiency.[44]

Sustainable energy systems based on RE sources provide the possibility of tackling the challenges associated with pursuing economic growth and environmental security. The continuous increase in energy demand (at high growth rate of primary demand equaling 5.5% per year, and high growth electricity capacity at 7.4% per year) emphasizes the needs for finding indigenous energy sources. As mentioned before, Jordan actually has a vast potential for renewable energy use (wind and solar). Solar radiation is 5-7 Kwh/m2nper a day and wind speed ranges between 7-11m/s. This potential for renewable energy utilization will significantly contribute to covering the ever growing rates of energy demand and consumption.

The population growth rate in Jordan was last measured at 2.21% in 2013. It is an important factor that shows how such population growth constitutes a great burden on a country, and how it alters national needs for infrastructure and resources such as hospitals, housing, transportation, water, electricity and jobs.

[44] Peter Yang, Green Energy Intensity: Development of Renewable Energy Generation and Consumption in Major Economies, Journal of Economics and Development Studies, March 2014, Vol. 2, No. 1, pp. 31-49.

Jordan's population was 6.46 million in 2013, the rural population represented 17% of the total population, with GDP per capita 5,213 US dollars in 2013. Given the continued increases in energy demand, which reflects both population and economic growth, the renewable energy sector could make a significant contribution to sustainable development and poverty alleviations, especially in rural areas.

Jordan Authority has already signed an agreement for the first wind-generated electricity project of 117 MW in Tafilah with a consortium of Jordanian and international companies - Jordan Wind Project Company (JWPC) - with a total investment of $205 million.[45] Also, 12 bidders are expected to submit their proposals for an electricity generation project using photovoltaic systems (PV) with a total capacity of 200 MW. Moreover, evaluation is underway for companies' offers to proceed with a project of wind-generated electricity in Ma'an with a capacity of 65-75 MW at a cost of $150 million, funded by the Kuwait Fund for Arab Economic Development. The wind energy tender in Alfujeij-Shoubak, with 90 MW of capacity, is projected to start by the end of 2015. The PV solar power project at Azraq will be implemented with the winning company through a Spanish-Jordan Debt Swap at a cost of $5 million and a capacity of around 2 MW. After the issuance of Renewable Energy and Energy Efficiency Law No (13) of 2012, a 2554 kw was connected and operated through 430 requests of connecting renewable energy systems with 12,352 kw of capacity.

With all these actual and potential projects, there is no doubt that economic growth will improve since utilizing RE will reduce

[45] The Ministry of Energy and Mineral Resources, Annual reports 2013.

social cost and increase the social benefit. The dependency on about 95% of fossil fuel energy consumption causes pollution, and raises operating and investment costs, which increases the negative externalities of using such energy sources. On the other hand, energy production, particularly from renewables, has direct and indirect benefits which improve living standards and maximizes revenues from selling energy.

In conventional energy production, the social cost is more significant than benefits; that is to say, the cost of production is high, and the resulting environmental pollution is significant (CO_2 and methane emission). Whereas in RE energy production, the social benefits potentially outweigh social costs according to the same criteria. Reducing the usage of fossil fuels will save foreign currencies; Jordan's current account deficit was about $2439.8 million in 2014;[46] and it will reduce the import bill, which has increased in the last few years, hence decreasing the fiscal burden on the national economy.

The authorities have introduced a "fast track" to streamline procedures, and evaluated and pre-selected bidders for construction of solar and wind farms under a framework agreement that included a pre-determined Feed-in Tariff (i.e., the tariff on which the new power plants will sell electricity to the National Electric Power Co. (NEPCO)).[47]

[46] Monthly statistical Bulletin, Central Bank of Jordan, http://www.cbj.gov.jo/pages.php.

[47] IMF Working Paper, Middle East and Central Asia Department, New Energy Sources for Jordan: Macroeconomic Impact and Policy Considerations, Prepared by Andrea Gamba, May 2015.

Therefore, the import savings may reach about 1% of GDP per year by 2020, and NEPCO's savings could increase as the share of renewable energy creation increases. NEPCO is actually making a long-term obligation to purchase all electricity generated by renewable energies at a price being currently under negotiation. So the Feed-in Tariff should take into account any unexpected changes in cost to avoid any future liabilities the government could bear. The energy grid needs to be upgraded in order to cope with an expected 1.8 GW additional generation capability from RE energies in the next 10 years. Indeed, a critical investment will be needed to convey power from solar farms locations (the south) to where energy demand is most concentrated (in Amman and the north). The estimated required upgrading costs about $150 million and represents 0.5% of the GDP. It would take place over three years during the period of 2014–2016.

Table 2 shows Jordan’s GDP growth rate, which declined in the last few years by 2.5% and 2.8% in 2012 and 2013 respectively, compared with previous years, due to the national and international economic recession and the general political situation. The total energy demand growth experienced a negative growth rate of 0.6% in 2013 against a growth rate of 10% in the year 2012. As noticed, there is a decrease in energy demand growth accompanied with low GDP growth, which implies the strong correlation between the energy sector and economic growth issues.

Table 2: Gross Domestic Product (GDP) and Energy Demand in Jordan

Year	GDP in Current Price (Million US dollar)	Cost of living Index (%) (2008=100%)	GDP Growth in Real Terms (%)	Total Energy Demand (Fuel) (T.T.O.E)	Total Energy Demand Growth (%)
2008	21986.7	100	12.8	7335	-1.4
2009	23846.2	99.3	9.2	7739	5.5
2010	26454.6	104.3	5.6	7357	-4.9
2011	28871.7	108.9	4.5	7457	1.4
2012	30971.4	114	2.5	8206	10
2013	33630.8	120.4	2.8	8157	-0.6

- *Source: National Electric Power Company, Annual Report, 2013.*

Figure 3 shows Jordan's and Egypt's GDP per capita, which noticeably increased over time reflecting positively on the living standards in both countries. Standards of living are closely associated with the energy sector development.

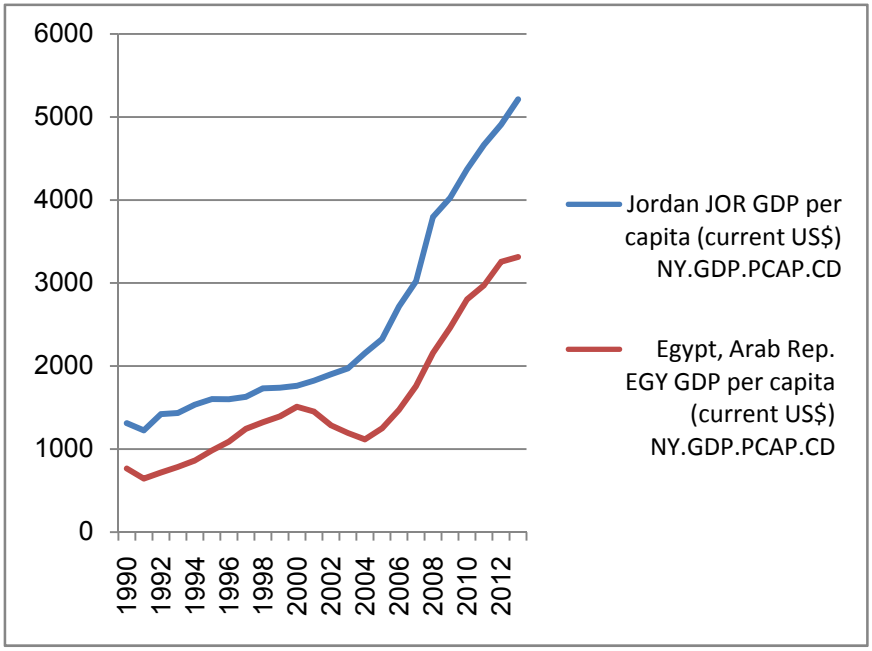

Figure 3: GDP Capita Per for Jordan and Egypt. (1990-2013).

4.3.2 Renewable Energy and Poverty

RE could significantly contribute to poverty alleviation in terms of improving the general welfare of households, as well as developing productive activities to create jobs. Jordan has high levels of solar radiation, and an established manufacturing infrastructure for solar water heaters and wind energy. These sectors can contribute to a reduction in greenhouse gas (GHG) emissions, and their manufacturing and installation can contribute to job creation and skills development, especially in rural areas, which otherwise have limited opportunities for economic growth. RE can therefore help reduce poverty in rural areas and alleviate pressures of urban migration. As previously mentioned, a good and improved energy sector will lead to a sustainable economic development,

which in turn yields social improvements and poverty alleviation. Figure 4 shows that the poverty rate is not evenly spread within Jordan's governorates. Poverty rates are highest in the governorates of Mafraq, Ma'an, and Tafileh. Despite the fact that the capital Amman, which is the center of business activities, has the lowest poverty rates; there are more poor people in Amman than in other governorates, considering the population concentration. In general, poverty rates are higher in rural areas than in urban areas. It is estimated that 19% of the rural population in Jordan is poor, compared to 12% of the urban population.[48] One of the challenges that face Jordan's economy is that GDP growth has not been accompanied with a considerable decline in unemployment. The explanation for this might be on the account that growth was not employment-intensive or/and the economic activities create employment opportunities that were not consistent with the skills and requirements of Jordan's labor force.

RE resources in the country are to be found primarily in the areas of wind and solar energy, which are mainly in the north and the south of the Kingdom. Two wind farms were built and connected to the grid in Jordan in the 1990s, and recently in 2013 a contract was signed for Tafileh wind farm at a capacity of 117 MW. Another wind farm has been established in Ma'an and is expected to operate by mid-2015.[49]As solar energy projects have been installed; this may alleviate poverty and open up a new horizon for development and growth, especially in rural areas.

[48] Mahmoud A. T. Elkhafif, Sahar Taghdisi-Rad, MutasimElagraa, Economic and Trade Policies in the Arab World: Employment, Poverty Reduction, Routledge, May 4, 2012.

[49] http://www.memr.gov.jo/LinkClick.aspx?fileticket=B495BBqcNs4%3d&tabid=111.

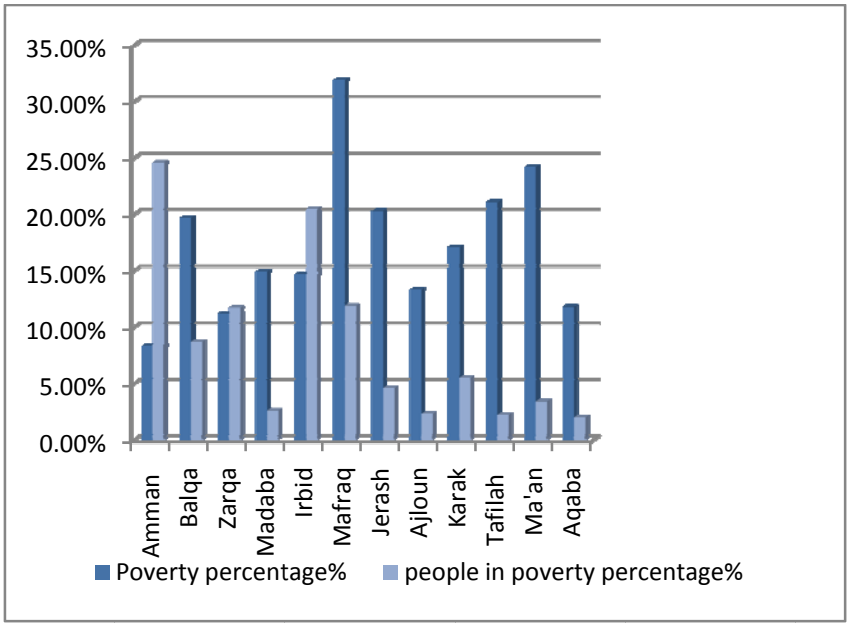

Figure 4: Poverty Rate and Percent of People in Poverty in Jordan's Governorates (2008)

- *Source: Poverty Situation in Jordan Report, Department of Statistics, Amman, Jordan, July, 2010.*

4.4 Investment Opportunities and Job Creation

Jordan's RE Potential Market

Despite neighboring a number of oil-rich Arab countries, Jordan's energy supply is impacted by the international market and political conditions, in addition to the continuous growth in population and the increasing demand on electricity. Therefore, the country endeavored to secure its resources of energy especially with continuous volatility of oil prices and the unrest in some key energy supplier countries. A great share of its budget is consumed by the costs of importing oil from various countries. It is struggling to stimulate a sustainable economic growth and industrial

development, which requires more fuel consumption, and continuous operation of its power plants on very costly imported oil. For that, the government started to shift the patterns of energy demand and supply into more sustainable patterns by becoming one of the first countries in the region to take serious steps toward RE sector and by applying a legal framework to utilize renewable energy sources.

The government promulgated the Renewable Energy and Energy Efficiency Law (REEEL) in 2012, which encourages the private sector to invest in RE sector with stipulations whereby the cost of grid connection is to be covered by the government, electricity is to be generated by RE projects, and purchased by the National Electric Power Company (NEPCO) and regional distribution companies. Jordan's Energy Commission adopted a Feed-in Tariffs (FiTs) energy-supply policy for RE projects, which is one of the most widespread national RE policy instruments available for scaling up RE. This was the first FiT scheme to be implemented in the Middle East, and is focused on supporting the development of new renewable power generation.

Irrespective of the fact that Jordan's market is relatively small for RE investment and the fact that this may generate some disadvantages in terms of economies of scale, and the high cost of equipment and infrastructures, the new law overcomes these unfavorable market conditions and allows for unsolicited or direct proposal submission, whereby investors have the opportunity to identify and develop renewable grid-connected electricity production projects such as wind parks, solar systems or others on

their own and propose these to the Ministry of Energy and Mineral Resources (MEMR).[50]

With the country having an enormous potential for renewable energy utilization (wind, solar), Jordan's virtual center allows free market access for over 1 billion customers through its investment and trade agreements. It plays major role connecting oil, gas and electricity networks across the region, with five attractive factors; economic stability, trained and capable human capital, political stability, rule of law, and finely linked infrastructure.[51]

Jordan's geopolitical position adds to its capability for energy generation and transmission, which contributes to maximizing the energy market potentials and gives opportunity for growing; promising the business sector with more profitability. According to the Renewable Energy Attractiveness Index (REAI) 2014, RE markets in Latin America, MENA and Southeast Asia present excellent natural resources, offer high generation efficiency and greater site selection, but remain broadly unexploited. Jordan's RE market is one favorable and persuasive market in the region for various factors, including:

- **The environmental and geographical factors** where the grid parity for solar when the sun is shining make the RE market rewarding (300-320 days of full sunshine). Jordan is perfect for PV and concentrator photovoltaic (CPV) as well as concentrated solar power

[50] Investment Opportunities in Renewable Energy Projects "Direct Proposals Submissions" Request for Expression of Interest, May2011, Government Policy Statement on Developing Renewable Energy Projects through Direct Proposals Submission, MEMR.

[51] Bashar Al-Zu'bi "Jordan Renewable Energy Projects & investment Opportunities", Jordan Investment Board, 2010.

(CSP) generation in addition to a great scale of wind potential, about seven meters per second (MPS), which is above the world average speed needed for wind energy generation.

- **Plentiful Human capital,** indeed over 74,000 registered engineers allows Jordan to become a regional hub in terms of technical knowledge. It is a lead partner in renewable research, sending abroad its expertise all over the region. The National Energy Research Center (NERC) is conducting training programs in Lebanon, Saudi Arabia, Yemen, and Sudan.[52]

- **The Renewable Energy Law** provides the legal framework for the sector. This law mainly endeavors to facilitate domestic and international projects and streamline the investment procedure. It allows and persuades with the utilization of renewable energy sources at any geographical location in the country. Moreover, the law created a Renewable Energy and Energy Efficiency Fund offering good financial framework in order to support energy efficiency programs and renewable energy projects and to help accomplish the targets set in the Energy Strategy; 10% renewable and 20% energy savings by 2020. The funds come from the annual allocations and foreign donation budget.

According to the new Energy Master Plan, the required investment in the energy sector is around $14-18 billion over the

[52] Jordan: Building a Green Economy Tapping into Natural Advantages and Developing Clean Technology, The Jordan Investment Board (JIB), Economic and Commerce Bureau, Embassy of Jordan, U.S.

period 2007-2020, the RE share is about $1.4-2.1 billion. This energy strategy plan is looking for new investment opportunities in order to increase the share of RE in national primary energy production. The infrastructures for such sector necessitate an investment package that includes Build-Operate-Transfer (BOT) and Build-Own-Operate (BOO) agreements for wind and solar energy innovations. This law permits competitive biddings, direct proposal submission, energy net–metering applications, and electric power wheeling applications and self-generation applications, where investors have the opportunity to determine and develop renewable grid-connected electricity production projects such as wind parks, solar systems or others on their own and propose these projects directly to the MEMR.

The Master Plan allows home-produced energy to be sold to grid, thereby speeding up the embracing of clean energy technologies at both residential and business levels[53]. Furthermore, the strategy is promoting investment in RE by exempting all systems and equipment for renewable energy projects from customs duties and sales taxes, and by granting exemptions to energy-saving vehicles, and implementing building code regulations that conserve energy.

Jordan has a huge capability of energy sources and renewable energy utilization, but RE sources are essentially different from fossil fuel, oil shale or nuclear power plants because of their extensive occurrence and abundance. Also, among the many other benefits of renewable energy sources is their lack of greenhouse gas and other emissions compared with fossil fuel incineration. Generally, renewable energy sources do not produce any extra carbon dioxide and don't bring in any danger such as nuclear litter.

[53] Ibid.

This issue is adding an environmental dimension to the RE investments. It creates a clean and sustainable energy generation process and opens opportunities for new investments in green economy products such as the manufacturing of photovoltaic cells, wind turbines, solar water heaters and PV inverters which can be sold locally and regionally, and can contribute to broadening Jordan's RE market.

Moreover, as a member in the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), Jordan ensures a secure environment for innovations and a protection of industrial property patents, trademarks, copyrights and industrial designs, which encourages private-sector investment in RE, and may attract more skilled human resources into this promising sector.

4.4.1 RE Investment Opportunities and Projects' Status

One can argue that the recent decline in oil prices may influence Jordan's enthusiasm for RE, and could impact the sector negatively because of the competitiveness of oil. Despite this fact, the fluctuations in oil prices and the uncertainty in the international fuel market could serve to intensify Jordan's efforts for a strong renewable sector in order to create a self-sustaining local energy supply. Still, RE is cheaper than the country's current energy mix. Moreover, renewable energy opportunity costs are declining over time, while the costs of sporadic fossil fuel supply are rising.

Table (3) shows the growing utilization of renewable energy during the period of 2009 and 2013, with noticeable decrease in other energy resources in 2013. This implies the increasing importance and utilization of RE.

Jordan's National Energy Strategy (2007-2020) seeks to reformulate the energy mix, so that by 2020, 29% of Jordan's energy needs are met by natural gas, 14% from oil shale, 10% from renewable energy sources and 6% from nuclear energy.[54] The demand for primary energy is expected to increase to 15 million tons of oil equivalent in 2020 compared to 7.6 million tons of oil equivalent in 2007.

Table 3: Primary Energy Consumption during (2009-2013) (Thousand toe)

year	Type of Primary Energy						Total
	Crude Oil and Oil Products	Coal	Pet Coke	Natural Gas	Renewable Energy	Imported Electricity	
2009	4454	-	-	3086	120	79	7739
2010	4774	-	-	2289	124	168	7355
2011	6141	-	-	873	130	313	7457
2012	6992	226	-	659	140	188	8205
2013	6689	204	116	907	145	96	8157

- *Source: The Annual Report, 2013, The Ministry on Energy and Mineral Resources.*

[54] Nada Abdul Rahim, Renewable Energy Prospects in Jordan, invest-export, Brussels, 2014.

Shams Ma'an plant is one of the most advanced RE projects in the country investing in new generation of capacity. It will save 160.000 tons/year of CO_2 emissions in the atmosphere. The extensive technology transfer into Ma'an will have a spillover effects in the southern governorate of Ma'an and the surrounding areas, with employment opportunities for more than 500 people during the construction phase, and 100-120 people during the operation phase. Potential investment reaches $300 million. The project will sell electricity to the government at a price of $0.169 per kWh, a major reduction on the $0.24 per KWh generation cost from heavy fuel and the $0.28 per kWh for diesel-based generation.

Jordan currently has the most preferential grid access conditions for RE projects among the Arab countries. It made significant progress in attracting private investments for RE development, and successfully completed the first round of its direct proposal submission plan. It signed 13 power purchase agreements with different private associations to expand more than 200MW of PV projects, and an agreement to improve the country's largest wind project of 117 MW in Tafileh. It is fully financed to its expected cost of $290 million. This project will meet some 3% of the country's energy needs.

As mentioned previously, Jordan has set the necessary policy and regulatory frameworks for RE to attract and obtain commercial investments. Its endeavors to utilize the global renewable energy are on the right track; through developing a clear road map and schemes and well-defined infrastructure provisions.[55]

[55] National Electric Power Company Renewable Energy Transition In Jordan and MENA Region, Mohammad Ameen Abu Zarour, May 2015.

The Energy Authority declared in mid-2014 that the government expects to commission about 1,800 MW of solar and wind power capacity by 2018. Some of these power purchase agreements have already been signed for 200 MW of solar power projects. In the last few months of 2014, there were a series of ambitious solar PV projects announced including a 52 MW plant and two 10 MW PV plants, all located in the southern Ma'an region.[56] Table 4 below summarizes the status of about 31 RE projects in the country:

Table 4: RE Projects' Status as of Jan 2015[57]

Status	Number of PV projects	Number of Wind projects	Number of CSP projects	Number of Solar Thermal projects
Complete	1	1	-	-
Execution	12	3	-	-
Main Contract PQ	1	1	-	-
Bid Stage	3	-	-	-
Study	2	-	-	-
Cancelled	1	2	1	1

[56] Michelle Davies and others, "Developing renewable energy projects a guide to achieving success in the Middle East", 2nd edition, Eversheds, 2015.
[57] Ibid.

More details about RE projects' status can be found in appendix 1. A significant number of local and international companies have expressed their interest in establishing further wind and solar plants in Jordan. Over 60 expressions of interest were submitted within the past couple of years to the MEMR.

The Ministry of Energy had set three "Rounds" to increase the locally produced renewable energy input. A first call for expressions of interest was launched in 2011. In this first Round, 12 solar projects were approved with a total capacity of about 200 MW, and most of Round One projects are now approaching financial close. They were expected to be completed and linked to the grid in 2015. Regarding Round One wind projects, the bidding process closed on September 2014 with four submitted qualifying bids for up to 250 MW of wind projects.

A second Round for Expressions of Interest Stage (EIS) was started in the summer of 2013 and bids were submitted in November 2013. This stage involved only solar and wind projects with a precedence given to projects that will be installed in the north and east of the country. Among the 47 bidders, 23 companies were prequalified and 24 were consented under specific conditions. The deadline for submitting applications was extended from September 2014 to the end of the same year. The Ministry of Energy and Mineral Resources (MEMR) is expected to endorse Round Two projects with total capacity of 200 MW. Round Two wind projects' call has been cancelled by MEMR.

In February 2014, the third Round was launched for wind and solar projects with aggregate capacity of 100 MW each. This Round has been cancelled by MEMR because of failing to obtain the

funding required to expand the national power grid to accommodate the projects.[58] It is apparent that a clear tendency regarding the PV sector has come out; each round has declared bigger but fewer projects, therefore attracting large international investors but also introducing fewer market opportunities.[59]

All these RE projects have to sell the electricity it generates at prices posted by the Electricity Regulatory Commission (ERC) with ceiling tariffs appointed to each RE technology; the ceiling tariff for selling electricity from solar PV and wind Plants was set at $0.169 and $0.12 per kWh respectively, with also a 15% extra for projects of "fully Jordanian origin." This is one way of encouraging and stimulating equipment and technology innovations manufactures in the RE sector.

4.4.2 Competition between Energy Sectors

Undoubtedly, the current political unrest in the neighboring countries and worldwide competition for the residual fossil fuels have prompted the country to seek new sources of energy to reduce its dependence on susceptible power supplies. Jordan tried to find alternative natural gas suppliers after the repeated attacks on the gas pipelines in Egypt, but some options were publically rejected and confronted with wide opposition. These factors keep the country under uncertain and volatile options about importing natural gas from specific known sources.

[58] Ibid.
[59] Ilias Tsagas,1/2015, "Jordan's Solar PV Spring", PV Magazine, retrieved from: http://www.pv-magazine.com/archive/articles/beitrag/jordans-solar-pv-spring. (On August 14,2015).

Besides other choices of energy sources, the nuclear program was and still is part of Jordan's efforts to diversify its energy sources by 2030. The government set out a program for nuclear power to provide 30% of electricity by 2030, and to provide power for exports.[60]

The Jordanian government, through its endeavors of establishing the country's Nuclear Power Plant (NPP), signed in September 2014 with Russia's Rosatom State Atomic Energy Corporation the agreement to develop a nuclear power plant construction project near Zarqa, northeastern Jordan. The document determines the parties' responsibilities in relation to the implementation of the first stage of the project. As mentioned by Jordan's Energy Ministry, The Russian *Atoms Troy Export* Company will supply the nuclear technology and Rosatom will operate the one giga watt plant, which aims to produce 12% of Jordan's energy needs by 2020. The construction agreement is to be concluded by 2016. Investment in the NPP building is expected to reach $10 billion.

Accordingly, on March 24th, 2015, the Government of Jordan and the Government of the Russian Federation signed an intergovernmental agreement on cooperation in construction and operation of a nuclear power plant on Jordanian territory. During the pre-investment stage, the company will have to complete such primary tasks as examination of the out-of-site structure for the NPP construction, study of the Jordan power system, selection of the customer-engineer and consultant for development of the draft

[60] Invest-export, Brussels, "Jordan Infrastructures Projects", Economic and Commercial Section Embassy of Belgium Beirut – Lebanon, 2014.

bankable feasibility. The contractors for these works will be defined during international tenders.[61]

Regardless of the high cost of such energy projects that may exhaust the funding recourses, two problems may face the Jordanian authority in its executive process of nuclear power projects; the first is related to the water supply, as the challenges to the projects in Jordan are weather conditions and limited water resources; while the second problem is the opposition of most of the public to the NPP especially environmental protection activists in the country.

Among plans of other forms of power production in the country, RE appears as suitable, economic and affordable energy sources. Given that the country's annual daily average solar irradiance is one of the highest figures in the world, power from solar PV is a reasonable choice, and may attain a sustainable competitive advantage in the long run.

4.5 Opportunities and Challenges

Globally, there are more than 5 million jobs in RE industries, and the potential for job creation continues to be a main driver for renewable energy policies (Wilson Rickerson UNEP, 2012). According to the Green Jobs Report 2008,with strong RE policy, the optimistic scenario, up to 2.1 million people could be employed globally in wind energy industry and 6.3 million in solar PV industry by 2030, and around 12 million in bio-fuels-related agriculture and industry. Solar PV presents the highest employment

[61] Communications Department of ROSATOM, 25/3/2015, "Russia and Jordan signed Intergovernmental Agreement on NPP construction in Jordan". http://www.rosatom.ru/en/presscentre/highlights/a2689f8047c4f233ae2bfefd303c2ae3.August 24, 2015.

rate, with about 7 to 11 jobs per megawatt of average capacity, which partly explains the high costs of this technology at present. This employment rate is likely to decrease alongside PV costs.[62]

Table 5 shows a mixed picture with respect to jobs created in operations and maintenance and in fuel processing. Coal and natural gas-fired plants need more employees to operate than relatively low-maintenance wind turbines. Solar PV systems, on the other hand, are more labor intensive.

Table 5: Estimated Employment per Megawatt for Energy Plants

Average Employment Over Life of Facility (Jobs per MW of Average Capacity)			
	Manufacturing, Construction, installation	Operation & maintenance/ fuel processing	Total
Solar PV	5.76-6.21	1.20-4.80	6.96-11.01
Wind power	0.43-2.51	0.27	0.70-2.78
Biomass	0.40	0.38-2.44	0.78-2.84
Coal-fired	0.27	0.74	1.01
Natural gas-fired	0.25	0.70	0.95

- *Source: Green Jobs Report, (UNEP, ILO, IOE and ITUC), (2008).*

[62] Envision Consulting Group (EnConsult), "Towards a Green Economy in Jordan", UNEP & MEJ, 2011.

As discussed earlier, many projects in the RE sector located throughout the country have been signed and others are in process. The solar and wind projects, which will generate between 1,500 to 2000 gigawatt hours, are expected to generate between 2000 to 3,000 jobs for the installation, maintenance and operation of renewable energy facilities by 2020.[63]

The Renewable Energy and Energy Efficiency Law is expected to deliver a sustainable stream of investment in environmental technology in Jordan, and increase employment and the added value in the sector, which highlights RE impacts through backward and forward linkages to segments of the economy and to jobs. Based on that, the RE sector requires developing training programs to facilitate installation of photovoltaic technology in the region. Some institutions in Jordan have started providing solar energy educational programs, which offer the knowledge of how to design a complete photovoltaic system and teach the technology that converts solar energy into electricity, heat and solar fuels and electricity generation.

Edraak, an initiative of the Queen Rania Foundation (QRF), is one of these institutions that provide courses in solar energy technology through a massive open online courses (MOOC) platform at no cost to the learner. This helps and empowers a large number of employees with the necessary knowledge and technology needed in RE projects, one thing which develops in-country RE and EE-related expertise. Also the Jordan-German University provides

[63] Mohammad Ghazal, (Feb 10, 2015.), "500-megawatt renewable energy projects to begin operations this year," The Jordan Times. Retrieved from: http://www.jordantimes.com/news/local/500-megawatt-renewable-energy-projects-begin-operations-year%E2%80%99. (Accessed on 14th June, 2015).

advanced competences in technologies and techniques in water and energy conservation for young people, which may nourish the labor market with appropriate competence for RE industry.

Yet, a clear and ingenious plan has to be introduced regarding education and training on the installation of green technology to overcome any skills and knowledge shortages, especially in rural areas. Many of the developers and engineers in this sector have minimum knowledge of the equipment, structures and production methods needed for energy efficient structures and buildings. Hence, The Ministry of Environment is implementing a rural solar electrification micro project program by building the technical capacity of Bedouin women to train, build and maintain solar energy.[64]

Jordan's economy still has many opportunities that allow for nurturing a successful and promising RE sector. Applying the RECAI methodology of measuring the market attractiveness is useful to evaluate the situation of Jordan's market, which needs further research. One can notice though that Jordan made great strides toward the three drivers' categories; Macro, Energy market and Technology-specific drivers, each of which has a set of sub-drivers. The main sub-drivers in the macro category are somehow met. Jordan is economically and politically stable, attracting the Western countries' support and funds. The energy market drivers and its sub-drivers; prioritization and bankability of RE, are in some way on the right track. Each of these sub-drivers has its parameters and data set, and the same goes for the third technology-specific drivers which can be shown as follows:[65]

[64] Ibid.
[65] Ben Warren and Others, "Renewable Energy Country Attractiveness Index", RECAI, issue 44, 2015.

- **Macro drivers:**

  1. Macro stability;
  2. Investment environment (ease to do business).

- **Energy market drivers:**

  1. Prioritization: energy supply and demand, level of political support, competitiveness of renewables, and importance of decarbonization;
  2. Bankability: cost and availability of finance, power infrastructure and ability to connect renewable energy, energy market accessibility, and liquidity of transactions market.

- **Technology-specific drivers**: attractiveness Project; (strength of natural resource, technology maturity, anticipated growth, pipelines, and strength of local supply chain).

These RE drivers are essential for opening new opportunities in the RE sector in political, economic and institutional terms. Currently, the related public institutions have succeeded in accumulating the necessary knowledge and experience from the first round of tenders, which will promote more efficiency for future processes. Also, networks of local consultancies have sprung up, granting a range of services such as engineering, legal advice, accounting and others.[66]

[66] Ilias Tsagas, 1/2015, "Jordan's solar PV spring", PV Magazine, retrieved from: http://www.pv-magazine.com/archive/articles/beitrag/jordans-solar-pv-spring. (Accessed on August 24, 2015).

Another dimension can be added to the opportunities opened to the RE sector, as Jordan is a member in nearly 42 bilateral investment treaties (BITs). These treaties are currently in force and included BITs with countries such as France, Germany, United States, China, United Kingdom and others.

The aim of these investment treaties is to provide an auspicious environment for incoming investments, cross-border economic collaboration, and mutual protection of the foreign and national investments. These treaties provide investors with certain concrete rights and protections, which can reduce the business risks associated with cross-border investments, and improve an investor's position in any consequent dispute related to those investments. In addition, Jordan is a member in the World Trade Organization and in several regional investment agreements; all these agreements seek to further promote the development of business in the country. Jordan BITs present diverse degrees of investor protection, and set different requirements for investors and their investments in order for them to qualify for protection. Investors who wish to take advantage of investment protections for a clean energy investment in Jordan should consider the provisos of the potentially applicable treaty or treaties to assess whether their investment will be covered by one or more of these treaties. The cautious arrangement of an investment can allow an investor to maximize its protection under international investment protection instruments.[67]

With all these advantages and opportunities, some challenges still linger. One of the main challenges in Jordan is that investors strive to obtain land that can connect to the electricity grid, and if

[67] Michelle Davies and others, "Developing renewable energy projects a guide to achieving success in the Middle East", 2nd edition, Eversheds, 2015.

they found the appropriate land, the price skyrockets. Transmission and distribution companies have restricted availability for connecting new capacity to their grids and only for certain locations. Consequently, it is rather complicated to find a good match between available land, the right land size, and accessibility to connect it to the grid.[68]

The electricity distribution sector consists of three medium voltage distribution networks; each company supplies consumers with electricity under their allocated distribution and retail supply areas; (JEPCO) in the middle, (EDCO) in the south, and (IDECO) in the north. Under Jordanian Electricity Law, the PV investors are required to build their projects where their energy is going to be consumed. This can be considered as one of the obstacles, since this will put a pressure on RE development, considering that most developers and investors prefer to develop their investment in the central zone, where most of the residents live, and at the same time build their facility in the rural area where land is available and affordable. Usually the projects in the IDECO and EDCO networks are deserted because the produced energy cannot be consumed within the network's geographic coverage.[69] What actually may solve the problem is to consider building high voltage electricity linking the north to the south.

[68] Ilias Tsagas,1/2015, "Jordan's solar PV spring", PV Magazine, retrieved from: http://www.pv-magazine.com/archive/articles/beitrag/jordans-solar-pv-spring. (Accessed on August 23, 2015).
[69] Ibid.

4.6 Conclusion

Jordan faces critical energy challenges as the country imports most of its energy needs, which exhausts the government's budget. This energy dependency threatens the security and sustainability of energy supplies. Although Jordan's primary energy intensity decreased, it remains above the world average. Such a decrease implies a disadvantage for producers of goods and services, since they require a higher energy input. Therefore, Jordan took serious strides towards developing the renewable energy sector as one of the significant energy alternatives, since investing in renewable energy also bears socioeconomic dimensions. Such investment in RE reduces the energy dependency, creates jobs, alleviates poverty, and above all, stimulates economic growth and reduces the cost of economic development by sparing financial resources devoted to importing energy. It also cleans the environmental pollution caused by the conventional energy sources and other related industries.

The government endeavors to decrease the country's dependence on imported energy, to secure energy supply, and to change the patterns of energy supply and demand into a more sustainable direction.

The adoption of new RE energy regulations by the government opens wide opportunities for RE projects and encourages and stimulates huge potential investments, some of which already entered the market.

In spite of these positive improvements on the legislative and institutional levels, Jordan still has some major steps to take and

obstacles to overcome. Based on the above discussion, some of the recommendations are:

- Jordan needs to augment the capacity of its grid in order to absorb new and considerable energy projects.
- Eliminate all obstacles and assist current projects to be a story of success.
- Monitor the net economic and social impact of policy measures (FiTs, ceiling price), in order to prevent boom - bust cycles.[70]
- Promote technology innovation through pilot projects, competition, research and development and community-based projects.[71]

These steps taken in Jordan could continue its endeavor towards a renewable energy transition, and also create social benefits from such transition.

[70] Ben Warren and others," Renewable Energy Country Attractiveness Index", RECAI, issue 44, 2015.
[71] Nada Abdul Rahim, Renewable Energy Prospects in Jordan, invest-export, Brussels, 2014.

Appendix 1: Jordan's Current Renewable Energy Projects as of January 2015

Project Name	Technology	Status	Size	Location
Jordan Solar One	PV	Execution	20 MW	Mafraq
Falcon Ma'an for Solar Energy	PV	Execution	21 MW	Ma'an
Foursan Capital Partners/Shamsuna Power	PV	Execution	10 MW	Aqaba
Adenium Energy – Zahartal Salem	PV	Study	10 MW	Ma'an
Adenium Energy – Ward Al Joury	PV	Study	10 MW	Ma'an
Adenium Energy –Al Zanbaq	PV	Execution	10 MW	Ma'an
Adenium Energy Capital	PV	Execution	30 MW	Ma'an
MEMR– Wadi Araba	Wind	Main contract bid	25-30 MW	Wadi Araba
Greenland Alternative Energy/EJRE/Scatec JV	PV	Execution	10 MW	Ma'an

Project Name	Technology	Status	Size	Location
Scatec/Quest Energy Investment/ Kingdom Electricity JV-Oryx	PV	Execution	10 MW	Amman
MEMR- Ma'an	Wind	Execution	66 MW	Ma'an
MEMR-Al Harir	wind	Cancelled	-	Al Harir
Jordan Wind Renewable Energy LLC-Tafila Wind Farm	Wind	Execution	117 MW	Tafilah
SunEdison / MEMR-Ma'an Development Area	PV	Execution	20 MW	Ma'an
Trina Solar-Amman	PV	Cancelled	2 MW	Amman
MEMR-Fujeij	Wind	Execution	70-90 MW	Amman
Shams Ma'an Power Generation	PV	Execution	52.5 MW	Ma'an
MEMR-Azraq Grid Connected PV Solar Plant	PV	Execution	2 MW	Zarqa
MEMR-Jordan Renewable Energy Round 3	PV	Cancelled	-	Ma'an
MENA Cleantech GmbH- Joan 1	CSP	cancelled	-	Ma'an

Project Name	Technology	Status	Size	Location
First Investment Co for Clean Energy/ MEMR-Ma'anbDevp Area	PV	execution	23.8 MW	Ma'an
MEMR-Al Kamshah	wind	cancelled	30-40 MW	Ma'an
MEMR-Wadi Rum	Solar Thermal	Cancelled	-	Aqaba
Shams Ma'an Power Generation PSC-Shams Ma'an	PV	Cancelled	-	Ma'an
Hofa Wind	wind	complete	1 MW	Hofa
Royal Hashemite Court-grid Connected Solar Power Plant	PV	Bid Stage	6 MW	Ma'an
MEMR-Roun2 of Direct Proposals for Renewable Energy	PV	Bid Stage	200 MW	Ma'an
Hashemite University-Grid Connected PV	PV	Bid Stage	5 MW	Zarqa

- *Source: Michelle Davies and others, "Developing renewable energy projects a guide to achieving success in the Middle East", second edition, Ever sheds, 2015.*

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Conclusion

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Conclusion

As discussed throughout the first two chapters, Egypt is moving forward towards renewable energy sources through a legal framework, policies, incentives, and implementation. Egypt's legal framework related to the renewable energy field includes the establishment of various institutions to regulate the energy sector, including the New and Renewable Energy Authority (Est 1986), the Ministry of Electricity and Energy (MOEE), the Supreme Council for Energy (SCE), and the Egyptian Electric Utility and Consumer Protection Agency (EEUCPA), and others. According to the adopted resolution of SCE in February 2008, Egypt's current energy strategy aims to meet and increase the renewable energy's share to the primary energy mix to 20% by 2020. Different steps have been adopted in Egypt to utilize renewable energy sources through the implementation of the new law, which is expected to attract foreign investments in the renewable energy sector in order to meet its target. Although Egypt has made good progress in the renewable energy industry, many challenges remain to be tackled in order for Egypt to meet its energy targets.

In Egypt, the renewable energy industry faces many challenges on the ground, including the need to apply more innovative financial mechanisms to achieve the country's energy targets. Egypt needs to enhance its national renewable Energy action plan for implementing renewable energy projects in different sectors by

addressing clear mandates, timelines and financial resources. In order to develop and improve energy efficiency, it would be relevant to support national efforts in applying energy conservation measures to focus on strengthening Egypt's institutional capacity. At this juncture, it is worth mentioning that Egypt connects the socio-economic considerations with factors of energy supply, and security drivers with the renewable energy growth.

The chapters highlighted the positive socio-economic benefits of the use of renewable energy including creating jobs, stimulating local businesses and investment opportunities, and diversifying development opportunities. This shows that Egypt is in the transition phase towards renewable energy and improving the technologies of sustainable energy. Such developments indicate Egypt's notion and vision for energy security with its large scale projects and decentralized renewable energy solutions. Still, it is crucial for Egypt to raise the appetite of the market and the public towards research for various renewable energy projects to cover different sectors. Such efforts would improve communities with better health, sustainable income and well-being, protect the cultural and heritage resources, create equitable business and job opportunities focusing on the educational and vocational trainings, and secure adequate services and infrastructure.

Jordan, on the other hand, is considered one of the first countries in the Middle East to adopt a renewable energy plan, and currently stands second to Morocco in renewable energy contribution, and second to Tunisia in energy efficiency measures. Jordan's path towards renewable energy began with the launching of the 2007 Energy Strategy, followed by the Renewable Energy Law in 2012, which underlines the government's commitment to

the development of the renewable energy sector. Moreover, Jordan has introduced various regulatory measures to form its national mitigation action plan, to reduce the country's dependence on imported fuel, to shift into sustainable trends, and to enhance the security of energy supply. Yet, despite promulgating renewable energy strategy, laws and policies, Jordan continues to face major challenges in the renewable energy sector.

Jordan suffers from the lack of local capacity in assessing, designing, developing, operating, maintaining and, implementing sustainable renewable energy projects. Rectifying this situation could help ensure the long-term sustainability in the workforce and boost momentum in implementing the projects. The needed skilled workforce in this sector needs to be properly trained to minimize the need for external technical assistance. Furthermore, the energy sector needs urgent rebalancing to alleviate the burdens on the government's budget and its dependency on imported energy sources. Enhancing the socio-economic factors and securing energy supplies are main motivations to shift to more sustainable energy Sources. Focusing on the socio-economic factors would make the sector more attractive for Jordanians and help reduce unemployment rates.

Since Jordan started its investment in renewable energy, it has opened a wide door for significant energy alternatives and projects. Such development reduces Jordan's dependency on imported energy sources, opens the markets for new investments, creates job opportunities, stimulates economic growth and alleviates poverty. Most importantly, enforcing renewable energy strategies could also have the added benefit of energy security, which in return enhances Jordan's profitability on the socio-economic level, encourages

economic growth, and diminishes the cost of economic development.

In sum, a more inclusive implementation of the renewable energy strategy in both Egypt and in Jordan is necessary for the viability, sustainability, and profitability of the sector. Although the two countries 'success in the renewable energy sector is not beyond reach, further measures, such as technology innovation through local research, competition, development and community based projects should be adopted as a collective approach in order to monitor the economic and social impact of the transition towards renewable energy dependency.

List of Contributors

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Jordan and Egypt are considered good examples for other countries in the MENA region as they stand up to the many challenges in the field of energy supply, which is still a burden to governments and a barrier for social and economic development in both countries. The high demand and consumption of energy, population growth, limited non-renewable sources (with their negative impact on the ecosystems), human health and economic development have all prompted these governments to find alternative energy sources, revise their energy strategies and take a major regulatory shift in perspective to increasingly turning to renewable energy.

Jordan and Egypt are both, with different speed, on the way towards an energy transition leading to an increased renewable energy penetration. However, difficulties can be discovered in both countries and different barriers and drivers for change can be assessed. In this book, the contributors attempt to provide a thorough study of the stakeholders of the renewable energy sources' projects implemented in the field in both countries. The four authors discuss the status quo in Egypt and Jordan, and explore a future outlook on the transformation in both countries. Furthermore, the book focuses on examining the socio-economic impact of a sustainable renewable energy transition.

In 2015, FES in the MENA region created a regional sustainability-project, working on Renewable Energy and Climate Change. The office of FES Amman serves as a regional link for MENA activities under this sustainability project. The establishment of this project is in line with the needed energy-political shift within the region. The project supports and encourages a transition towards an energy supply based on renewable energy sources and the search for suitable policies to promote energy savings and energy efficiency measures.

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