Economic and Social Commission for Western Asia

UNITED NATIONS
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ESCWA

Analysis of Energy Policy Trends in the Arab Region

Distr.
GENERAL
E/ESCWA/SDPD/2015/5
31 December 2015
ORIGINAL: ENGLISH

ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA (ESCWA)

Analysis of Energy Policy Trends in the Arab Region

United Nations
New York, 2015

15-00568

Abstract

The present publication provides an analysis of the past domestic policy trends that shaped the evolution of the domestic energy situation in the Arab region, as well as the present policies and institutions that are in place and their ability to reverse the unsustainable domestic energy situation in the Arab region. An assessment of the ability of current and foreseen energy policy trends to meet the present and future economic and social challenges, in the Arab region, with respect to sustainable development and energy security, is sketched. Moreover, recommendations are made on how to enhance the efficiency and effectiveness of good policy practices, including possible regional cooperation to promote the development of new sustainable energy systems in the Arab region.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AFEX	Arab Future Energy Index
AMF	Arab Monetary Fund
ANME	Tunisian National Energy Conservation Agency
ALMEE	Lebanese Association for Energy Saving and for Environment
AUE	Arab Union of Electricity
Bcm	Billion cubic meter
BOO	build, own, operate
CDM	Clean Development Mechanism
CNG	Compressed natural gas
CNNC	China National Nuclear Corporation
COMENA	Commission of Atomic Energy
CSP	Concentrated Solar Power
DEWA	Dubai Electricity and water Authority
EE	Energy Efficiency
EETC	Egyptian electricity Transmission Company
EMRC	Energy and Minerals Regulatory Commission
ENEC	Emirates Nuclear Energy Corporation
ESCO	Energy Service Company
ESCWA	Economic and Social Commission of West Asia
FANR	Federal Authority of Nuclear Regulation
FE	Fuel Element
FIT	Feed-in-Tariff
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GW	Giga watt
GWh	Gegawatt hour
HRD	Human Resource Development
HVAC	Heating, ventilation, and air conditioning
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IMF	International Monetary Fund
IPP	Independent Power Producers
IRENA	International Renewable Energy Agency
JAEC	Jordan Atomic Energy Commission
JNRC	Jordan Nuclear Regulatory Commission
JREEEF	Jordanian Renewable Energy and Energy Efficiency Fund
KA-CARE	King Abdullah City of Nuclear and Renewable Energy
KSA	Kingdom of Saudi Arabia
kgOe	Kilogram oil equivalent
KWh	Kilowatt hour
LAS	League of Arab States
LNG	Liquefied Natural Gas
LPG	Liquefied petroleum gas
MENA	Middle East and North Africa
Mtoe	Million ton oil equivalent
MW	Megawatt
NCNSRC	National Center for Nuclear Safety and Radiation Control
NPEEC	Net primary energy exporting countries
NPEIC	Net primary energy importing countries
NEPIO	Nuclear Energy Programme Implementing Organization
NPP	Nuclear Power Plant
NPPA	Nuclear Power Plants Authority

ABBREVIATIONS *(continued)*

NEEAP	National energy efficiency action plan
OAPEC	Organization for Arab Petroleum Exporting Countries
OECD	Organization for Economic Co-operation and Development
PV	Photovoltaic
R&D	Research and Development
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
RE	Renewable Energy
ROSATOM	Russian State Atomic Energy Corporation
RR	Research Reactor
SAARA	Saudi Arabia Atomic Regulatory Authority
SWHs	Solar water heating system
TCF	Trillion cubic feet
toe	Ton oil equivalent
TWh	Terawatt hour
VAT	Value-Added Tax
UAE	United Arab Emirates

INTRODUCTION

The Arab region has witnessed some major political, social and economic turmoil during the last three decades. During this period, major shifts have also taken place with respect to the energy situation in all Arab countries. Some countries became net importers after relying for some time on energy export revenues to fund their economic development efforts, and most major energy exporting countries in the region have started taking a perilous energy consumption path that will lead them, if no serious adjustments are made, towards becoming net energy importers within the next two decades. For the net energy exporting countries in the region, higher energy consumption will translate into lower rents and, if the economy is not well diversified, this will lead to higher budget deficits, and eventual disruptions of socio-economic development. The region's total primary energy production that is used to cover the region's own energy needs climbed from about 31 percent in 2003 to about 40 percent in 2013. For the GCC countries, this ratio increased from about 25 percent in 2003 to about 33 percent in 2013.

In 2013, total crude oil and natural gas liquids production in the Arab region reached about 26.6 million barrel per day. Crude oil production alone was about 23.2 million b/d representing around 30.5 percent of the total global production. In the same year, the production of natural gas was about 597.8 billion cubic meters (bcm) representing around 16 percent of total global production. For the same year, the estimated region's shares of proven world reserves were 55.8 percent for oil and 27.3 percent for natural gas[1]. Indeed, the energy sector plays a crucial role in all energy exporting countries in the Arab region, since these exports still represent about a third of their GDP, are the source of over 80 percent of their public revenues, and cover close to 100 percent of their public expenditures in 2013[2]. With the drop in oil price, the Arab region's total gross oil export revenue has been estimated at US$ 695 billion for 2014, a 12.0 percent decline from 2013. It was also forecasted to decline by a 45.4 percent to reach $379.5 billion in 2015. These prospects would likely invite the group of net energy exporting Arab countries to reconsider their economic growth strategies and thoroughly review their domestic energy consumption policies, in order to be able to alleviate the burden of energy subsidies on their new economic perspectives, and preserve for better days their primary energy reserves.

On the other hand, the non-energy producing countries in the region have been partially relying on their neighboring energy exporting countries to keep the cost of their energy bill within a manageable size. However, the last few years' oil prices climbs (particularly from 2005 to 2013), before their considerable drops in 2014-2015, have put some major strains on these countries' economies. The group of net energy importing Arab countries would also have to speed the pace of energy policy reforms in order to reduce the burden of its energy bill, as well as review their national energy pricing mechanisms.

Both net energy exporting countries and net energy importing countries in the region share a high vulnerability to the fluctuations of the global hydrocarbon markets, as both groups have their economy strongly tied to the global energy markets, and can inversely benefit or loose from its volatility. Both groups also witnessed a rapid growth of their domestic energy needs over the last three decades. In fact, while the population of Arab countries increased by about 118 percent; and their GDP, at constant 2005 USD, by 114 percent, between 1980 and 2012, the primary energy supply increased by about 415 percent over the same period, electrical consumption by over 845 percent and peak electrical demand by over 740 percent. The region's total primary energy production that is used to cover the region's own energy needs climbed from about 31 percent in 2003 to about 40 percent in 2013 (for the GCC countries, this ratio increased from about 25 percent in 2003 to about 33 percent in 2013). It is clear that an important transformation of the energy situation is taking place in the Arab region: The region is steadily moving from a leading net energy exporting hub to potentially becoming energy dependent. Moreover, this transformation has been taking place, in most cases, in total absence of sustainable modes of domestic energy production and consumption.

[1] Organization of Arab Petroleum Exporting Countries, 2014 (Estimates based on the figures posted on the OAPEC data base indicates a value of 34 million barrel per day for 2013).

[2] Estimations based on figures published in the Arab Monetary Fund, Joint Arab Economic Report 2014 – (statistical annexes).

In fact, during the last three decades, national objectives associated with the domestic management of energy resources, in terms of supply and demand, have not been in most Arab countries part of a comprehensive national energy management strategy, including both the supply and demand sides. The supply side was the focus of energy strategies in the Arab region and energy, in its different forms, was only considered as an input to satisfy the economic and social development requirements. Public energy suppliers, including utilities, were acting as commodity providers, ever trying to satisfy the growing energy needs. Furthermore, prevailing low energy prices in Arab countries, maintained artificially by high, direct or indirect, conventional energy subsidies, gave biased energy pricing signals that favored the development of energy-intensive industrialization options, as well as non-energy conscious energy consumption patterns and behaviors. This was especially true in the net energy exporting countries, but also, until recently, in the net energy importing countries as well. It is only during the last decade that some national objectives (indicative targets) started to shape the outlines of comprehensive national energy strategies, including energy mix, energy efficiency and renewable energy development with varying emphasis throughout the Arab countries.

The resulting situation of these past energy strategies and policies was a remarkable improvement in energy access across most countries in the Arab region. In Saudi Arabia, the fraction of the population connected to the electrical grid jumped from about 41 percent in 1980[3] to 99.5 percent in 2012[4]. Morocco[5] and Tunisia[6] went, respectively, from national electrification rates of 45 percent and 56 percent in 1980 to national electrification rates of 99 percent and 99.5 percent in 2012. However, some disparities between rural and urban areas persist in many Arab countries, even among the highest performing ones. And, in many Arab countries, being connected to the grid is no longer a guaranty of getting undisrupted electrical supply.

Nevertheless, past energy strategies and policies did not initiate an effective planning for the deployment of the region's significant renewable energy (RE) potential (mainly solar, but also wind and to a lesser extent hydropower and geothermal). Indeed, most of the Arab countries started, only recently, to actually consider renewable energy deployment among the possibilities to help meet part of the rising demand, and to diversify their energy mix.

But the most adverse impact of past energy strategies and policies, is the serious deterioration of energy productivity in the region. In fact, only Tunisia managed to decouple its Primary Energy Supply growth from its economic growth, thus improving its energy productivity. For the Arab countries as a group, the energy productivity, whether based on GDP at constant USD2005 or constant USD2005ppp, kept decreasing since 1980. Overall, these indicators respectively fell from 6,049 USD2005/toe in 1980, to 2,509 USD2005/toe in 2012 and from 20,000 USD2005ppp/toe (1980) to 7,442 USD2005ppp/toe (2012). Similar drops were recorded for the group of net energy exporting countries, but a much less drastic fall close to a relative stagnation for the net energy importing countries.

These figures indicate that there is a, largely untapped, vast potential of energy resources that can be released through energy efficiency programmes and measures in the Arab region. It is estimated that the total annual Primary Energy Supply for the region for 2030 can be reduced to 75 percent of its projected value in a *conservative* 'low policy intensity' scenario, and down to as much as 50 percent of its projected value if *more aggressive* 'technical potential' scenarios are pursued[7]. Harvesting these energy efficiency benefits, will considerably reduce the need for additional electrical capacity, at a lower cost for the nation than the cost of increasing conventional power generation plants. It will, most importantly, free up considerable amounts of energy that can be used to enhance exports in net energy exporting countries and substantially reduce the need for energy imports in net importing countries. Indeed, only *EE* has the potential of drastically reversing the frantic energy consumption trends, currently prevailing in the region, with the least

[3] ESCWA estimate based on reported 1980 total population connected to the electrical grid in Metz, 1993 and total population for Saudi Arabia for the same year from UN-Stat.
[4] Arab Union of Electricity, 2013.
[5] Islamic Development Bank, 2013.
[6] African Development Bank, 1991, for 1980 figures and Arab Union of Electricity, 2013 for 2012 figures.
[7] Hormann and others, 2012.

costs to Arab countries, without reducing energy services or slowing down their economic development efforts.

Most Arab countries are starting to include sustainable energy solutions in the development of their current domestic energy strategies, and their associated policies and respective instruments. Demand side management options, based on the implementation of energy efficiency, are also advocated as an important pillar of these strategies. However, in most cases, the announced targets and implementation instruments do not reflect the importance of the existing potentials, and the pace required to reverse the situation towards more sustainable energy systems in the region.

Nevertheless, some encouraging experiences are taking place in the region in several countries, and lessons learned from these experiences can be a very valuable incentive for the other countries to follow suit. Regional cooperation in that sense, and the role that regional organizations and institutions can play to support this transition, would be essential in reaching these accessible, yet so seemingly remote, goals.

This document attempts to provide an analysis of the past domestic policy trends that shaped the evolution of the domestic energy situation in the Arab region, as well as the present policies and institutions that are in place and their ability to reverse the unsustainable domestic energy situation in the Arab region. An assessment of the ability of current and foreseen energy policy trends to meet the present and future economic and social challenges, in the Arab region, with respect to sustainable development and energy security, is sketched. Moreover, some recommendations are made on how to enhance the efficiency and effectiveness of good policy practices, including possible regional cooperation to promote the development of new sustainable energy systems in the Arab region.

The document presents an analysis of the long term policy trends that have shaped the domestic energy situation in the Arab region, while attempting comparisons between the different Arab countries that are not largely skewed by major recent geopolitical or economic shocks. In some parts of the analysis, the following periods were not included: periods that are strongly affected by the "Arab Spring" (post 2012), as well as the present periods affected by the recent drastic drops in oil prices (2014 -2015). The events that took place during the "Arab Spring" period were rather disruptive events and not trend setting ones, since most affected countries experienced disruptions in their economic activities. The drop in oil prices is fairly recent and whatever trends that would be related to it have not taken shape yet.

Chapter I covers the national energy production and consumption trends that are prevailing in the Arab countries, as well as the electricity production and consumption trends that are developing in the region. The chapter also includes an overview of the developing trends regarding energy efficiency/energy productivity and renewable energy respectively, in addition to a brief overview of developing trends associated with other energy sources.

Chapter II identifies and discusses the various driving factors shaping national energy policies to provide an implementation framework for a country's strategy concerning the supply and use of energy resources within its economy, in order to attain its broad national macroeconomic, social and environmental development goals. But also, while considering the availability and security of the supply of the different energy resources to meet each nation's energy needs.

Chapter III introduces the process of developing national domestic energy strategies, as well as the various energy policy instruments that can be developed to implement national strategies. Then, it covers the past energy strategies and policies and their impacts on energy sustainability in the Arab region, in terms of energy access, renewable energy deployment and energy productivity, including a section dedicated to the impact of conventional energy subsidies. The last part of the chapter presents an overview of recent energy strategies and policies' trends and the associated institutional framework, including recent energy pricing reforms, energy efficiency and renewable energy policies and instruments.

Chapter IV provides an outline of the major findings that were identified throughout this document regarding energy policy trends in the Arab region. It also proposes some suggestions on the way forward regarding the domestic energy policies that should be enhanced and promoted to support the reinforcement of a sustainable energy pathway. Finally, it presents the different issues that need further assessment and /or future development, and the key issues that will need a regional outlook in addressing energy policies and regional energy cooperation.

CHAPTER I
ENERGY SITUATION IN THE ARAB REGION

A. PRIMARY ENERGY PRODUCTION AND CONSUMPTION TRENDS

In 2013, total crude oil and natural gas liquids production in the Arab regions reached about 26.6 million barrel per day. Crude oil production alone was about 23.2 million b/d representing around 30.5 percent of the total global production. In the same year, the production of natural gas was about 537.8 billion cubic meters representing around 16 percent of total global production. For the same year, the estimated region's shares of proven world reserves were 55.8 percent for oil and 27.3 percent for natural gas[8]. However, these conventional energy resources are unequally distributed amongst Arab countries and, in most cases, their domestic energy consumption is not carried out in a sustainable manner.

1. *The vulnerable nature of the energy situation in the Arab region*

(a) *Vulnerability due to volatility of international oil prices*

Both Arab Net Primary Energy Exporting Countries (NPEEC) and Arab Net Primary Energy Importing Countries (NPEIC) are highly vulnerable to the fluctuations of the global oil & gas markets[9]. Indeed, both group of countries, as defined in Table 1-1, have their economy strongly tied to the global oil & gas markets, and can inversely benefit or loose from its volatility. High oil and gas prices generate greater revenues for the NPEEC group of Arab countries, and low prices can hurt these countries' economic development. Inversely, high oil and gas prices can put additional stress on already strained public budgets of the NPEIC group, especially those countries applying significant conventional energy subsidies, and lower prices can bring some relief to this group of countries.

TABLE 1-1: ARAB PRIMARY ENERGY IMPORTING AND EXPORTING COUNTRIES

Net Primary Energy Exporting Countries (NPEEC)	Net Primary Energy Importing Countries (NPEIC)
Algeria	Comoros
Bahrain	Djibouti
Iraq	Egypt
Kuwait	Jordan
Libya	Lebanon
Oman	Mauritania
Qatar	Morocco
Saudi Arabia	Palestine
United Arab Emirates	Somalia
Yemen	Sudan
	Syrian Arab Republic
	Tunisia

Source: Compiled by ESCWA.

As an illustration of this high vulnerability to the fluctuations of the global hydrocarbon markets, Table 1-2 shows for 2013, the weight of oil revenues; USD 724.4 billion[10], with respect to different economic indicators.

[8] OAPEC, 2014 (Estimates based on the figures posted on the OAPEC data base indicates a value of 34 million barrel per day for 2013)

[9] Over 95% of the primary energy supply in the Arab region is from hydrocarbon sources (oil and gas)

[10] Arab Monetary Fund, 2014, p. 398 (Table 6/2 in statistical annexes).

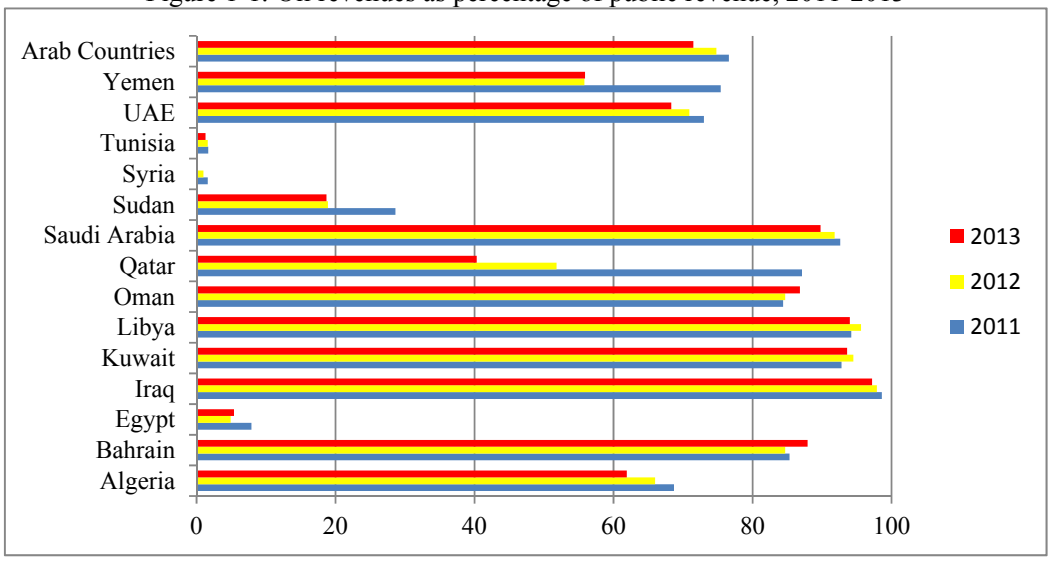
TABLE 1-2: WEIGHT OF OIL REVENUES IN THE ARAB REGION WITH RESPECT TO DIFFERENT ECONOMIC INDICATORS, 2013

Arab Oil revenues as a percent of:	Of Net Primary Energy Exporting Countries (NPEEC)	Of All Arab Countries (NPEEC & NPEIC)
GDP[a/]	33.5%	26.5%
Public Revenues[b/]	81.6%	71.5%
Public Spending[c/]	98.6%	79.2%
Public Investments Expenditures[d/]	124.1%	102%

Source: Arab Monetary Fund, Joint Arab Economic Report 2014 – Table 6/2 p. 398 (statistical annexes).
a/ ESCWA calculations based on values tabulated in Table 2/2 p. 334 (statistical annexes), ibid
b/ ESCWA calculated based on values tabulated in Table 6/1 p. 397 (statistical annexes), ibid
c/ ESCWA calculated based on values tabulated in Table 6/6 p. 402 (statistical annexes), ibid
d/ ESCWA calculated based on values tabulated in Table 2/5 p. 337 (statistical annexes), ibid

These trends are further illustrated for 2011, 2012 and 2013 for the weight of oil revenues in public revenues of Arab oil exporting countries (Figure 1-1).

Figure 1-1: Oil revenues as percentage of public revenue, 2011-2013



Source: Arab Monetary Fund, 2014.

The Arab region's total gross oil export revenue has been evaluated at USD 695 billion for 2014, a 12.0 percent decline from 2013. It is also forecasted to decline by a 45.4 per cent to reach $379.5 billion in 2015[11]. These prospects would likely invite the NPEEC group of Arab countries to reconsider their economic growth strategies and thoroughly review their domestic energy consumption policies, in order to be able to alleviate the burden of energy subsidies on their new economic perspectives, and preserve for better days their primary energy reserves.

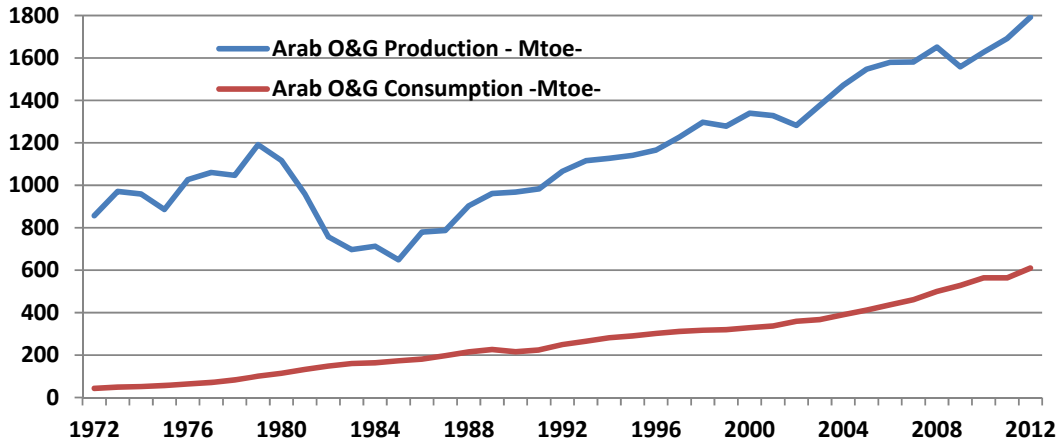
(b) *Vulnerability due to the important increase of domestic energy consumption*

Figure 1-2 shows the evolution of oil and gas production and consumption in the Arab region between 1972 and 2012. In 2013, total oil and gas production in the Arab region amounted to about 1,695 Millions of toe and Primary Energy Supply, excluding biomass, was around 685 Millions of toe. In the same year, the average Primary Energy Supply per capita in Arab countries, excluding biomass, was around 1,940 kgoe and

[11] ESCWA, 2014a and ESCWA, 2015c

varied between around 140 and 330 kgoe per capita in Sudan and Yemen, respectively, to an average of over 8,000 kgoe per capita in the GCC countries, with Qatar exceeding 18,000 kgoe per capita. It is estimated that the average Primary Energy Supply per capita, excluding biomass, increased by about 2 percent per year between 2000 and 2013, at nearly the same rate of the total population growth in the region.[12]

Figure 1-2: Evolution of oil and gas production and consumption in the Arab region



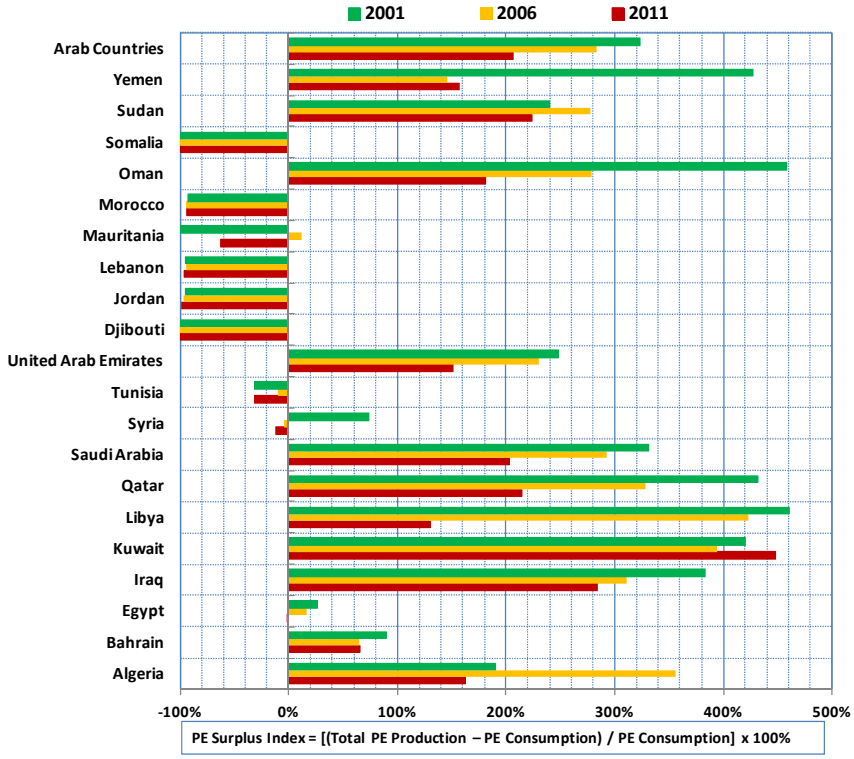
Source: ESCWA/SDPD based on IEA, 2014b.

These energy consumption trends, which are expected to continue in the absence of deep corrective measures, will lead to a critical situation where an increasing share of total energy production is consumed domestically in an unsustainable manner. Figure 1-3 shows the evolution of the energy surplus index between 2001 and 2011. This index is defined as the ratio of the amount of energy produced that is available after domestic energy consumption, divided by the domestic energy consumption. It gives an idea about the dependency level of the country's energy supply. If the sign of this index is positive, it provides a measure of the amount of energy produced that is available for export, or strategic reserves, as a multiple of national energy consumption. If the sign of this index is negative, then it indicates the percent of energy that is imported. For the entire Arab region, this index evolved from 323 percent in 2001, to 207 percent in 2011, indicating that for that decade, the ratio of exported energy to the amount that was domestically consumed dropped from over three folds to about two folds. For that decade; 2001 to 2011, this index dropped for Iraq from 384 percent to 284 percent, for Qatar; from 432 percent to 215 percent, for the Kingdom of Saudi Arabia; from 331 percent to 203 percent, for the United Arab Emirates; from 248 percent to 151 percent and for Oman; from 459 percent to 181 percent.

Moreover, according to minimum and maximum growth scenarios prepared by the Organization of Arab Petroleum Exporting Countries (OAPEC) for the year 2035 horizon, the Primary Energy Supply is expected to increase by 56 percent to 106 percent with respect to 2013 figures.

[12] ESCWA estimates based on data retrieved from OAPEC Database (OAPEC, 2015) and population figures reported in the UN Stats database (UNSD, 2015).

Figure 1-3: Primary Energy Surplus Index in Arab countries for 2001, 2006 and 2011



Source: ESCWA/SDPD calculations based on the OAPEC data base, 2015.

If these energy production and consumption trends are maintained, they will most likely result in the following:

(i) For Arab countries with economies relying on revenues from fossil fuel exports, a substantial reduction in hydrocarbon products destined for export will result in a substantial reduction in potential revenues. This is a major risk to their on-going development as incomes of these countries are greatly dependent on oil and gas revenues. It could be a significant risk to global energy markets where increased energy prices will in turn slow growth in other developing regions. According to some projections, hardly any oil will be left for export in Saudi Arabia by 2038, if current energy production/consumption trends and energy mix are maintained[13].

(ii) For Arab countries that presently have some energy exporting capacities, current growth rates in energy consumption, puts them on an inevitable path towards joining the net importers of energy.

(iii) For Arab countries that are already net importers of energy, current growth rates in energy consumption will increase their vulnerability to international energy price fluctuations, eventually leading to a much weakened energy security situation for these countries.

[13] Lahn & Stevens, 2011, p. 2.

2. *The main characteristics of domestic Primary Energy Supply*

The total primary energy mix in Arab countries is essentially composed of oil products; 52.1 percent, natural gas; 43.3 percent, coal; 1 percent, hydropower; 0.5 percent, biomass; 2 percent, and other renewable sources; 0.2 percent. As such, the region heavily depends on hydrocarbon resources; 95.4 percent, to power its social and economic development.

The share of the different economic sectors of the total final energy consumption in the Arab countries was as follows in 2013[14]: 33.5 percent for the industrial sector, 39.4 percent for the transport sector, 22.3 percent for the residential and tertiary sectors and 2.2 percent for the agricultural sector. The corresponding share of primary energy is as follows[15]: 29.3 percent for the industrial sector, 26.4 percent for the transport sector, 42.1 percent for the residential and tertiary sectors and 2.3 percent for the agricultural sector. The highest share of primary energy goes to the residential and tertiary sectors because of their predominant reliance on electricity, which is essentially produced from oil and gas in the region.

It is important to note that in addition to the demographic, economic and social driving factors leading to this growing energy demand, the maintenance in most Arab countries of low conventional energy and electricity prices, through direct or indirect energy subsidies and administered pricing amplifies the present trends in energy consumption. Indeed, because of these low energy prices, energy inefficiencies has practically no significant financial cost to most energy users, and remain a common trend in a large part of the energy production, distribution and end use practices. In fact, there is a lack of strong and adequate urgent energy efficiency policies and actions to reverse these energy consumption trends.

B. ELECTRICITY PRODUCTION AND CONSUMPTION TRENDS

Electricity consumption has sharply increased in the Arab region during the last forty years. As can be seen in Figure 1-4, this growth rate was much higher than that of the Primary Energy Supply starting from around 1990. In the Arab region, about 94 percent of electricity generation had largely relied on oil and gas, and in 2013 over 42 percent of primary energy supply devoted to energy use[16], was consumed to produce electricity[17]. The use of other sources, especially hydroelectricity and other renewable sources was quite limited and represented only 5.7 percent, mostly hydroelectricity.

1. *The main characteristics of domestic electrical energy consumption*

(a) A rapid growth rate and large disparities between Arab countries

In 2013, the total generated electrical energy in the Arab region was around 970,000 GWh. In the same year, the average electrical energy consumption per capita in Arab countries was around 2,300 kWh and varied between around 300 kWh per capita in Sudan and Yemen to an average of about 10,000 kWh per capita in the GCC countries, with Kuwait and Qatar exceeding 15,000 kWh per capita[18]. It is estimated that the average electrical energy consumption per capita increased by about 4 percent per year between 2000 and 2013, while the total population in the region increased by about 2 percent during the same period[19].

[14] Calculated based on figures reported in the International Energy Agency Data base (IEA, 2014b)

[15] The corresponding primary energy supply to each sector is estimated by Summing up the total of the final energy consumption, other than electricity, for each sector and adding it to the estimated Primary Energy Supply associated with the final electrical energy consumption of the sector

[16] Total primary energy supply with non-energy use, e.g. feedstock, deduced

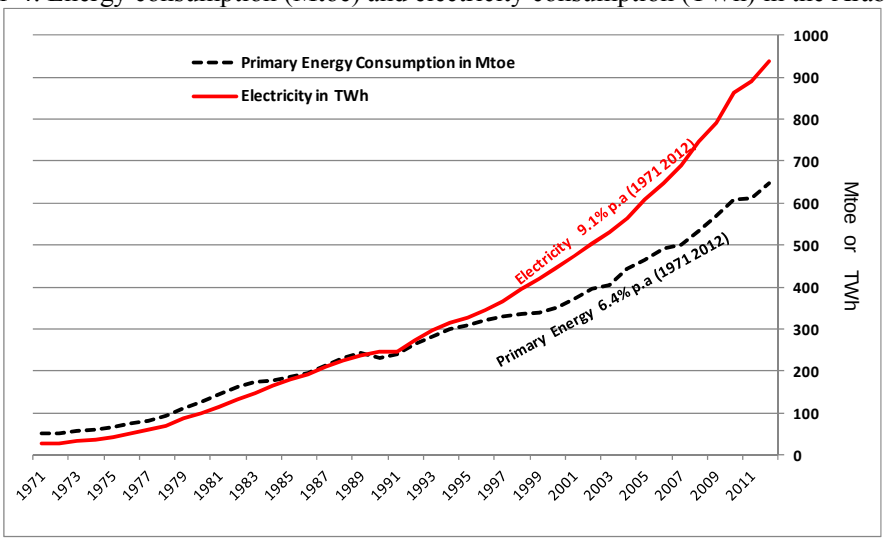
[17] ESCWA estimates based on figures reported in the International Energy Agency Data base(IEA, 2014b)

[18] AUE Bulletin, 2013.

[19] ESCWA estimates based on annual electrical energy consumptions reported in the OAPEC database (OAPEC, 2015) and annual population figures reported in the UN Stats data base (UNSD, 2015)

The installed power capacity in the Arab region was in 2013 around 234 GW, including 1 percent of the installed capacity powered by coal (Morocco) and 5 percent from renewable energy, mostly hydropower (Egypt, Iraq, Morocco and Sudan,)[20]. It is also important to note that during the last two decades electric power generation in the Arab countries has been shifting from oil to natural gas, which became the main source for generating electricity in the Arab region. Hence improving the energy efficiency, and lowering the emissions of air pollutants and GHG, associated with power production. In 2013, 63.1 percent of primary energy used to generate electricity was natural gas, against only 35.6 percent for oil products[21].

Figure 1-4: Energy consumption (Mtoe) and electricity consumption (TWh) in the Arab region



Sources: AUE, 2013 and IEA, 2014b.

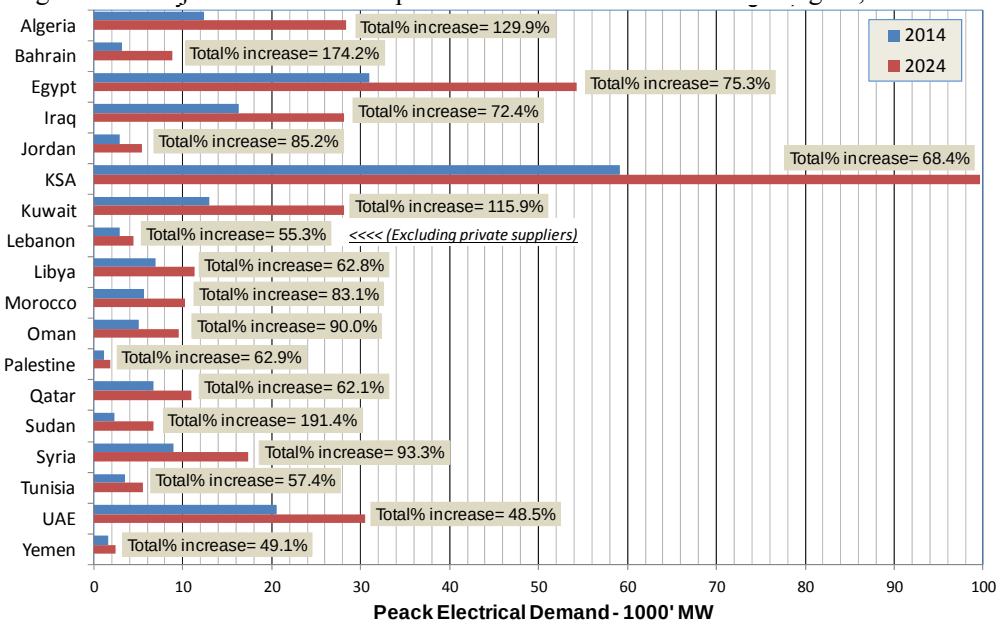
(b) The residential and services sectors applying a particular stress on the power sector

According to the Arab Union of Electricity Statistical Bulletin, the residential and services sectors in 2013 accounted for nearly 60 percent of the total annual electrical consumption in the Arab region; of which about 73 percent were consumed by the residential sector alone. The industrial sector only accounted for about 20 percent of the total annual electrical consumption and so did the remaining other economic sectors. Furthermore, a remarkable increase in peak electrical demands took place in recent years, pushing the region to adopt forecasts calling for a sharp increase in power plants' capacities, in order to meet these increasing loads. In fact, Arab countries have witnessed an increase in the peak electric demand accounting for about 8 percent per annum between 2009 and 2013. Moreover, power plants electricity generation capacity is expected to increase by 79 percent in 2024, when compared to 2014 figures. As it can be seen in Figure 1-5, an overall increase of 191 percent is expected in Sudan, 174 percent in Bahrain, 130 percent in Algeria, and 116 percent in Kuwait.

Energy consumption patterns in the Arab countries indicate that the residential and services sectors represent the most important part of the total electrical energy consumption, of which, more than two thirds are accounted for by the residential sector alone.

[20] AUE, 2013.
[21] ibid

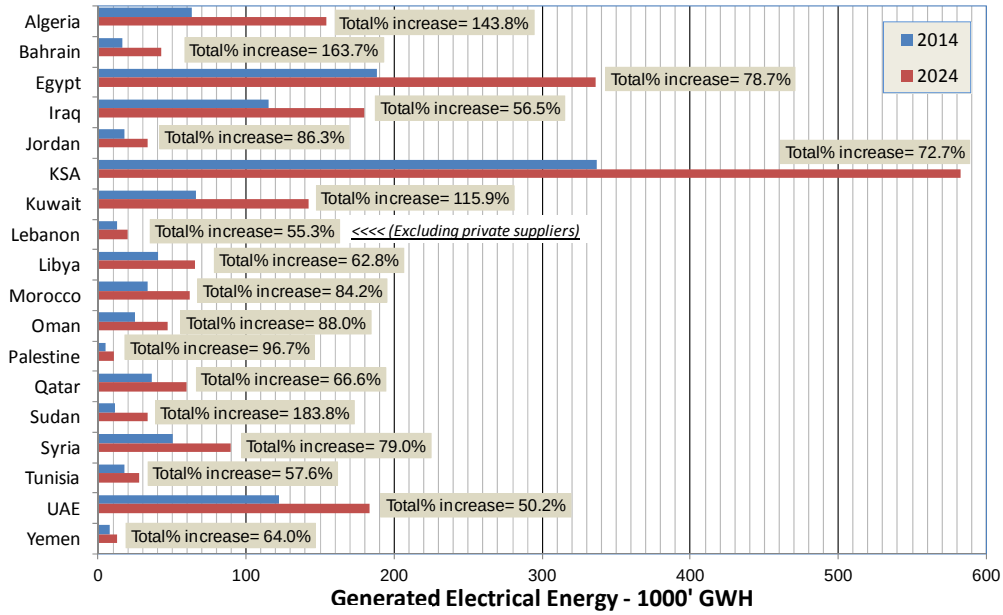
Figure 1-5: Projected evolution of peak electrical demand in the Arab region, 2014-2024



Source: Based on Arab Union of Electricity Statistical Bulletin 2013.

Electrical energy generation is also expected to increase by 79 percent in 2024, when compared to 2014 figures, corresponding to an average annual increase rate of 6 percent over that period of time. As it can be seen in Figure 1-6, an overall increase of 184 percent is expected in Sudan, 164 percent in Bahrain, 144 percent in Algeria and 116 percent in Kuwait.

Figure 1-6: Projected evolution of generated electricity in the Arab region, 2014-2024



Source: Based on Arab Union of Electricity Statistical Bulletin 2013.

Furthermore, peak electrical demands in 2013 were reported in the hot season, with the exception of Jordan, Syria, and Iraq. Most of the peak electrical demands were recorded between 1 p.m. and 9 p.m., which indicates that the building sector, and in particular the high electricity needs associated with air conditioning, bears the main responsibility for these peaks in demands.

2. *The demand-side challenges facing the electrical sector and the need for appropriate demand-side management solutions*

The increases in electrical consumption and demand peaks are largely due to the growing rate of urbanization in the region, and the rising standards of living associated with the people's aspirations for greater comfort. This is further encouraged by the low prices of some household equipment; often with very poor energy performance ratings, which make them affordable to an increasingly high number of potential consumers. Indeed, the large subsidies of consumer energy prices, prevailing in most countries of the Arab region, provide no incentive to end users to choose more energy efficient solutions or equipment.

In the coming years, Arab countries that do not have the required resources to cope with these increasing electricity requirements will find it very difficult to meet the projected electricity demands. And, some Arab countries are already experiencing the first episodes of such a situation.

Facing this energy situation requires that Arab countries consider long-term strategies, and associated policies, to decouple economic growth and social welfare improvement, from energy resource utilization. This will require identification of the energy intensive economic sectors and branches, focusing on their energy efficiency/productivity and designing appropriate energy efficiency programs to be implemented at a pace that is capable of reversing the reported trends. It will involve considering an eventual economic restructuring and diversification to move to less energy resource intensive economies. The energy strategies should consider a realistic and economically viable deployment of renewable energy and clean energy technologies in order to play an ever greater role in the energy mix, therefore improving the sustainability of the energy sector and reducing the region's long term vulnerability to global energy market fluctuations.

C. DEVELOPING TRENDS REGARDING ENERGY EFFICIENCY AND ENERGY PRODUCTIVITY

There is a large potential supply of energy that could be harvested by reducing considerably the important energy inefficiencies that are prevailing in the region. Indeed, the efficiencies associated with the production, distribution and end use of energy compare very poorly with international benchmarks. This situation is due to technological gaps and behavioral deficiencies, aggravated by a lack of adequate policies and economic incentives for promoting more sustainable energy consumption patterns. In fact, in 2012, Arab countries used about twice the amount of energy that the world used to produce the same amount of Gross Domestic Product (0.40 toe / 1000 USD2005 for the Arab Countries Vs 0.24 toe / 1000 USD2005 for the world), and about three times that of the OECD countries (0.13 toe / 1000 USD2005)[22]. "*The Middle East, despite having comparatively little industry, which globally is the largest consumer of energy of any end use sector, is the least energy efficient emerging region*"[23].

1. *Energy efficiency as the most appropriate response to the demand-side challenges in the Arab region*

According to some estimates, there is a large potential to reduce the Primary Energy Supply in the region, through energy efficiency[24], that can amount to more than 25 percent in 2030, even in a *conservative* 'low policy intensity' scenario, which corresponds to about 50 percent of total current consumption in the region. If a *more aggressive* 'technical potential' scenario is pursued, the region could potentially reduce projected Primary Energy Supply by more than 50 percent in 2030[25]. Harvesting these energy efficiency benefits, will free up important amounts of energy that can be used to enhance exports in net energy exporting countries, or to secure the energy future for coming generations, and reduce energy imports in net importing countries.

[22] IEA, 2014b.

[23] Springborg, 2014.

[24] The region relies almost exclusively on fossil fuels for all of its energy needs (over 97% of its primary energy). Any energy efficiency measures, whether at the end use level, the energy transformation, transport/transmission, or distribution levels will result in a reduction in the primary energy requirements.

[25] Hormann and others, 2012.

It can also be used to supply additional end users / provide additional services where there is a lack of access to energy services, and in many instances, delay the need for additional power plants and energy infrastructure. Based on national accounts, energy efficiency is the most cost effective source of energy for all Arab countries. Furthermore, energy efficiency is associated with many positive impacts at many levels: Social, economic, and environmental[26].

2. *The need for strong political commitments for a full access to energy efficiency potentials*

In order to be able to fully tap into this virtual energy source, a strong political commitment should be reached to make energy efficiency one of the main pillars of each country's energy strategy. Furthermore, associated adequate policies and standards need to be developed and/or existing ones reinforced, in a coherent systemic approach. Also, appropriate institutional structures, human and financial resources need to be mobilized in line with the declared goals.

Already, many Arab countries are showing a growing interest in energy efficiency and are recognizing the important role it can play in their energy system, including energy exporting countries[27]. Case studies conducted by ESCWA on energy efficiency policies in the building sector in Kuwait[28], the transport sector in Egypt[29] and the industrial sector in Tunisia[30], showed the important existing potential in terms of energy efficiency in these three countries/sectors and the already accomplished results.

Efforts to improve energy efficiency have also found strong support at the regional level. In addition to ESCWA's and other regional UN bodies' involvement to promote energy efficiency in the Arab region, the Arab Ministerial Council for Electricity approved during the twenty sixth meeting of its executive bureau on 23/11/2010; resolution number 195, an "Arab Guideline for Improving Electricity Efficiency and Rationalize its Consumption at the End User". The guideline calls upon Arab countries to commit to national energy efficiency action plans (NEEAP) that should be prepared and evaluated every three years. More than ten Arab countries already produced a first NEEAP, and many are joining in this endeavor, which is being followed up by the Energy Department of the League of Arab States. Other initiatives are taking place at a sub-regional level, mainly in the GCC, to harmonize appliances and building energy performance standards.

However, the major parts of these efforts are mainly focusing, in most Arab countries, on programmes and policies that can only have a substantial impact in the long term. They are not effectively addressing, with an adequate pace, inefficiencies that are already in place. Therefore missing EE opportunities that can produce immediate impacts that can slowdown, or reverse, the growth rates recorded in the energy service needs in the different sectors, without negatively interfering with their economic and social developments. Moreover, the levels of human and financial resources allocated to implement these programmes and policies, are far from being adequate.

D. DEVELOPING TRENDS RELATED TO RENEWABLE ENERGY SOURCES

Renewable energy (RE) sources include wind energy for standalone mechanical use, such as pumping and milling, or centralized and decentralized wind power production, decentralized and centralized solar photovoltaic systems, and solar thermal for power generation and process heat. RE also includes hydropower and geothermal energy where such resources are available.

[26] Ryan and Campbell, 2012.
[27] Lahn, 2013.
[28] Krarti, 2014.
[29] Korkor, 2014.
[30] Missaoui, 2014.

1. *A largely untapped RE potential in the Arab region*

In the Arab region, there is a significant potential for developing renewable energy (RE) applications, especially those associated with solar and wind utilizations. However, this potential remains largely untapped despite the ongoing programmes and efforts. Indeed, RE can play a major role in improving the energy mix, and therefore the energy security, of Arab countries that are heavily dependent on hydrocarbons for their energy supply, as was indicated previously. This is especially true for the NPEIC group of countries, but also so for the NPEEC group of countries which will be able to displace, through RE, part of their domestic hydrocarbon energy consumption to make it available for export, or strategic reserves.

RE can also offer reliable and sustainable solutions for access to modern energy services in many countries in the region, thus contributing to poverty alleviation in many of its rural and remote areas. Furthermore, the recent trends in the market of RE technologies, including PV panels and wind turbines, that resulted in significant systems' cost reductions worldwide, have made many of the RE technologies economically competitive grid parity with fossil generation sources, even for the NPEEC group of Arab countries, especially when considering the economic repercussions on national accounts. Indeed, for Arab countries that are subsidizing, directly or indirectly, conventional energy at the end users level, many RE technologies, with the right dose of public financial support, can be found competitive if the resulting reductions in the subsidy bills of national budgets over several years are taken into account.

Many Arab countries have expressed interest in introducing RE in their energy mix, and have engaged in many programmes and projects to implement RE solutions in their energy supply schemes. However, these efforts are still very limited in most Arab countries, and the contribution of RE remains marginal. In fact, the share of RE in the installed power generation capacity, including large-scale hydro, was about 5 percent, based on the Arab Union of Electricity and International Energy Agency data for 2014, with hydropower standing at 4.6 percent of the installed capacity for electricity generation in the Arab region. By the end of 2014, wind installed capacity reached 1654 MW, mainly in Morocco, Egypt and Tunisia with 787, 610 and 245 MW respectively. At the same time, the solar, PV and CSP, power generation installed capacity totaled 277 MW in the region. Table 1-3 summarizes the installed RE power generation capacity in most Arab countries.

Several Arab countries have very highly developed dissemination programs for solar water heating systems (SWHs), such as PROSOL in Tunisia and PROMASOL in Morocco, and the installed capacity of SWHs reached in 2012 around 4.8 million square meters [m^2] throughout the region, mostly in the NPEIC group of Arab countries, with Palestine, Tunisia Jordan, Egypt, Syria and Morocco having the highest market penetration records, and some local manufacturing capabilities. Nonetheless, there is still a substantial potential for SWHs deployment in the Arab region, even in these pioneering countries[31].

On the other hand, many other applications of renewable energy sources remain largely untapped in the region. These include standalone direct uses of renewable energy, such as space and process heating, food drying and water pumping. These applications also include small scale off grid PV systems intended for specific services, such as space cooling, refrigeration, lighting and telecommunication. These standalone renewable energy systems, if widely installed through suitable dissemination schemes, can viably address the issue of providing energy services to many parts of the Arab region's countries, especially their rural and remote areas, at a competitive economic cost.

[31] AFED, 2013.

TABLE 1-3: INSTALLED RENEWABLE ENERGY POWER GENERATION CAPACITY IN THE ARAB COUNTRIES, BY END OF 2014

Countries/ Electrical Power capacity [MW]	PV	CSP	Wind	Biomass & Waste	Hydro	Total
Algeria	7.1	25	10	0	228	**270**
Bahrain	5.0	0	0.5	0	0	6
Djibouti	1.4	0	0	0	0	1
Egypt	15.0	20	610	0	2 800	3 445
Iraq	3.5	0	0	0	1 864	1 868
Jordan (*)	31.6	0	1.4	4	10	17
Kuwait	1.8	0	0	0	0	2
Lebanon	1.0	0	0.5	0	282	284
Libya	4.8	0	0	0	0	5
Mauritania	15.0				48	63
Morocco (*)	15.0	20	787	0	1 745	2567
Oman	0.7	0	0	0	0	1
Palestine	1.0	0	0	0	0	1
Qatar	1.2	0	0	40	0	41
Saudi Arabia	7.0	0	0	0	0	7
Sudan	2	0	0	55	1 590	1 648
Syria	0.8	0	0	0	1 151	1 152
Tunisia	4.0	0	245	0	66	315
UAE	22.5	10 0	0	3	0	126
Yemen	1.5	0	0	0	0	2
Total	**112**	**16**	**1 654**	**102**	**9 784**	**11 817**

(*) By 2015, total PV installed capacity in Jordan was 30 MW and total CSP installed capacity in Morocco was 180 MW

Sources: ESCWA, 2015a.

For the special case of Palestine, where energy supply and services are frequently disturbed by the Israeli restrictions and existing volatile security situation, decentralized RE solutions can be one of the most effective ways to insure energy security and access to energy services for the country. Indeed, Palestine has initiated an ambitious solar initiative to reach a share of 10 percent of RE in its energy mix by 2020, starting with the installation of 5 MW of grid connected rooftop PV systems[32]. Palestine has also the highest rate of Solar Water Heaters deployment in the Arab region with over 57 percent of households using solar water heaters in 2015[33]. In addition, solar thermal energy covered 40 percent of hospitals' water heating needs and 25 percent of hotels' needs in 2010[34]

2. *A judicious deployment of centralized and decentralized RE technologies needs to be developed*

A full up-scaling of the development of RE sources for centralized power generation in the Arab region will require some major overhaul of the existing electrical transmission, and distribution systems at the national levels in order to accommodate the large quantities of intermittent injections of electrical energy produced by

[32] Palestinian Energy and Natural Resources Authority, 2012.
[33] Palestinian Central Bureau of Statistics, 2015.
[34] Economic Feature, 2010.

solar and wind sources. In fact, only smart grids, which are the exception throughout the Arab region, are capable of handling the associated substantial relative variation of such energy input into the grid. This full development will also require setting up strong interconnecting networks between the neighboring countries in the region and dependable power exchange agreements allowing the exchange of surplus energy productions across national boundaries, so it can be used where it is needed.

Up-scaling the development of other RE applications can also be of major benefit to many countries in the region, offering very valuable alternatives for providing energy services to a variety of end users. These applications include decentralized grid connected small-to-medium scale RE power generating systems; e.g. through a net metering scheme, the development of direct uses of renewable energy through dedicated decentralized systems, such as water pumping and low and medium temperature thermal processes. Such applications also include the development of small scale off grid RE systems for power supply to individual end users, or groups of them, especially in rural or remote areas. It can also be dedicated to specific energy services, such as telecommunication, exterior lighting, and mobile refrigeration units for itinerant health facilities.

3. *Ambitious RE targets announced throughout the Arab region*

It is clear that the Arab countries' RE market hasn't reached its full potential, but there are promising signs of development through pipeline projects and increasing political commitments, and if the current efforts are continued, investments and progress should follow and lead to some important deployments of RE[35].

Investment in RE in the Arab countries totaled USD 1.9 billion in 2012, an increase of 56 percent over 2011 and a 6-fold increase compared to 2004. Currently, there is about USD 125 billion of committed investment in renewable energy projects in the region, including, USD 109 billion of investment in Saudi Arabia that is committed to the development of solar energy, USD 9 billion investment in solar power projects and USD 3.5 billion in wind power projects in Morocco, USD 4 billion worth of renewable energy projects in Kuwait, USD 2.1 billion of planned government investment in RE in Jordan, and USD 1 billion of planned government investment in Egypt[36].

Interest in RE has also been developing at the regional level, and an Arab strategic framework was drawn providing a regional global vision for the development of RE in the Arab region[37]. The document outlining the strategic framework was adopted by the League of Arab States, LAS, during its 3rd Arab Economic and Social Development Summit in January 2013 in Riyadh, Kingdom of Saudi Arabia.

An Arab Renewable Energy Framework (AREF) was later on adopted by the Executive Board of the Arab Ministerial Council of Electricity in its 30th meeting on 16 September 20140. The framework invites each Arab state to present to LAS a National Renewable Energy Action Plan (NREAP) indicating their targets in terms of RE contribution to their energy consumption by 2030, and the way to reach it, to confirm the pledges made in the context of the Arab Strategic framework document.

The sum of the declared RE targets will result into an estimated additional 75 GW, including hydropower, of RE power generation installed capacities in the region by 2030, if all Arab countries accomplished their pledges. This is about 30 percent of the 2013 total electrical installed capacity. Furthermore, the present published countries' targets indicate that the RE that are currently programmed to be operational by 2030, can result in an increase of the RE contribution by a total installed capacity of over 117 GW of RE sources, excluding hydropower, by that date. These announced targets indicate a RE share of electricity generation in each Arab country ranging from 5 to 42 percent, by 2030[38].

[35] AFED, 2013.
[36] IRENA and LAS, 2014
[37] Ibid and LAS, 2013a
[38] Ibid and REN21 and others, 2013.

Indeed, nineteen Arab states have announced renewable energy targets. Most of these targets represent fractions of electricity generation or installed capacity. Morocco's clean power target of 42 percent installed capacity by 2020 stands out as the most ambitious target in the Arab region. According to its 'Solar Plan' Tunisia is planning to reach a substantial RE target of 30 percent of its electricity generation by 2030. Algeria, Egypt, Qatar and Saudi Arabia have also announced ambitious targets in excess of 20 percent of electricity generated for different horizons.[39]

Based on the renewable energy projects' pipelines in the region, most Arab states are presently procuring significant utility-scale renewable power projects. Table 1.4 gives an overview of Future targets stated by Arab countries.

TABLE 1-4: FUTURE RE TARGETS BY TECHNOLOGY

Countries / Electrical Power capacity [MW]	PV	CSP	Wind	Biomass & Waste	Geothermal	Total	Target Year
Algeria	13 575	2 000	5 010	1 000	15	**21 600**	2 030
Bahrain		50	10	25		**85**	
Egypt	2 900	1 100	7 200	19		**11 219**	2 022
Iraq	240	80	80			**400**	2 016
Jordan	304	1 350	1 200	30		**2 884**	2 020
Kuwait	3 500	1 100	3 100			**7 700**	2 030
Lebanon	0	0	100	25		**125**	2 020
Libya	844	375	1 000			**2 219**	2 025
Mauritania	45		30			**75**	
Morocco	1 550	450	2 020	2		**4 022**	2 020
Oman	177	200	50			**427**	
Palestine	45	20	44	21		**130**	2 020
Qatar	200	440		40		**680**	2 020
Saudi Arabia	16 000	25 000	9 000	3 000	1 000	**54 000**	2040 (initially 2032)
Sudan	250	50	320	230	1 000	**1 850**	
Syria	1 100	50	1 500	260		**2 910**	2 025
Tunisia	1 518	460	1 755	300		**4 033**	2 030
UAE	500	401	30	900		**1 831**	2 030
Yemen	4	100	400	6	200	**710**	2 025
Total	**42 752**	**33 226**	**32 849**	**5 858**	**2 215**	**116 900**	

Source: Estimations of ESCWA/SDPD based on official national RE targets of the countries collected by ESCWA and REN21, 2013

Another largely untapped RE application in the Arab region is solar domestic water heating, and here as well, substantial targets are also announced, either in terms of installed capacity of collector areas[40].

As indicated in Table 1-4, almost all Arab states have committed to one or more technology-specific targets. These targets reveal a regional focus on solar rather than wind technologies. The combined CSP and PV targets are more than double the wind targets. Among solar technologies, PV targets are almost 37 percent

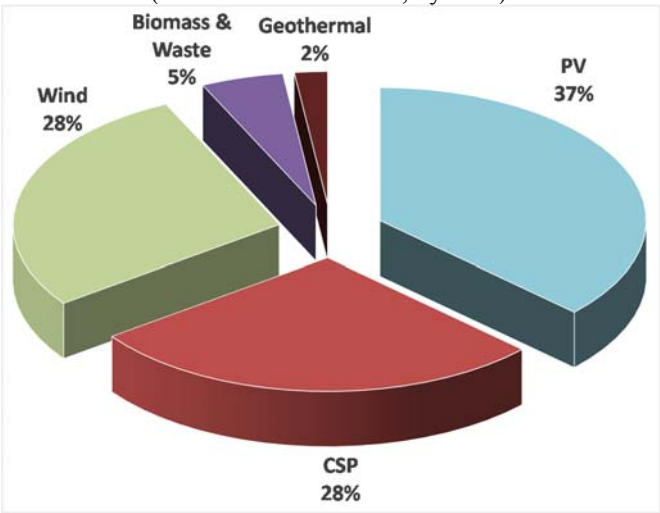
[39] The percent of installed capacity doesn't mean the percent of generated energy
[40] and LAS, 2013

higher than CSP targets. Targets for other renewable energy technologies such as geothermal and waste-to-energy are substantially lower than solar or wind[41] (Figure 1-7).

Other alternative potential, or under development, energy sources and supply in the Arab region include nuclear energy, coal, unconventional hydrocarbon sources and biomass & bio-fuels.

According to the findings presented in an ESCWA Working Paper[42], nuclear programmes development in Arab countries exhibit a range of positions that extends from apparent disinterest in nuclear energy up to on-going construction of a first nuclear power plant (NPP). The majority of Arab countries are still in the pre-project stage, either in the preparation to make a knowledgeable commitment for establishing a nuclear programme, or simply working on reassessing the appropriateness and viability of the nuclear option for their long-term energy plan and evaluating various obligations and commitments associated with the commencement of nuclear power programmes.

Figure 1-7: Share of technologies in future Arab RE installed capacity
(Total of 116 900 MW, by2040)



Source: Estimations of ESCWA/SDPD based on official national RE targets of the countries

E. Developing trends associated with other energy sources

1. *Nuclear energy*

In the same context, the integrated regional assessment of the basic nuclear infrastructure in the Arab region depicts the presence of adequate facilities for radiation application, nuclear R&D and training. These facilities include research reactors, accelerators, research reactors fuel fabrication, and other nuclear-related laboratories, including hot cell laboratories which are necessary to R&D of nuclear fuel cycles. Such basic nuclear infrastructure and the accumulated experience in its implementation and utilization over the last decades present valuable support to the nuclear infrastructure development in the Arab region.

For the Arab countries, considering the nuclear energy option will allow them to diversify their energy mix, away from their dependence on hydrocarbon products, and therefore reduce their vulnerability to the

[41] IRENA and LAS, 2014.
[42] ESCWA, 2015e.

volatility of their international markets, increase the lifespan of the region's oil and gas reserves, and release more hydrocarbon products for export.

The UAE is currently the only Arab country at an advanced stage of project implementation reaching the end of phase 3 of IAEA's milestone approach and expecting to commission its first NPP by 2017. Jordan, Egypt and KSA have already made a decision to introduce nuclear energy. Jordan finalized its bid evaluation and signed a project development agreement expecting to start the construction of its first NPP in 2016. Egypt is in the preparation stage to start an international bidding process for its first nuclear energy plant and recently has signed a project development agreement with Rosatom. KSA projects in its new electric expansion plan 18 GW of nuclear capacities by 2032. Algeria is also close to making a commitment to nuclear power and has reached the end of phase 1 of IAEA's milestone approach. Bahrain, Iraq, Lebanon, Libya and Yemen currently don't include any nuclear option in their energy supply strategies. Kuwait, Oman and Qatar have revoked their national plans in the aftermath of the Fukushima accident in favor of a regional nuclear plan among GCC countries.

The five countries that have already initiated a nuclear power program, namely UAE, Jordan, Egypt, KSA and Algeria, show different development stages of their nuclear infrastructure, in terms of national implementing authority, nuclear regulatory body, HRD and other related aspects as can be noted in Annex 1.

It is clear that the nuclear option appears to offer many advantages to many Arab countries, especially those with important desalination requirements. However, many challenges face the development of NPP in the region, including geopolitical, governance, economic, and financial barriers, as well as the lack of qualified human resources. Furthermore, any serious consideration of the nuclear option should carefully weigh its various advantages against the heavy capital investment costs associated with setting up and later on dismantling the nuclear facilities, the capacity of ensuring long-term nuclear fuel supply, the technical and environmental complexities associated with the management of the nuclear waste and the local capacity of managing eventual nuclear accidents.

2. *Coal*

At this stage only Morocco is using coal as part of its energy mix. However, global renewed interest in coal, and especially its 'clean' technology version, has led many other Arab countries to consider coal as part of their future energy mix. These include Egypt who recently signed an agreement with an Abu Dhabi-based investment group to construct Egypt's first coal-fired power plant in the Suez region[43]. Egypt has also signed seven cooperation framework agreements with different private operators in the field of coal powered electricity in China[44] and according to some projections' estimates; the contribution of coal in the energy mix for generating electricity in Egypt would reach 25-30 percent by 2030[45]. Dubai is in the process of contracting the construction of coal-fired power generation facilities to be part of its new electrical energy production capacity; the Hassyan Clean Coal Power Plant Project to be completed in three phases of 1,200 megawatts each with Phase 1 expected to be operational by 2020.[46.] Saudi Arabia, Oman, Bahrain[47], and Tunisia[48] are also considering coal as an option for their energy mix.

[43] *ESI Africa*, 2015.
[44] Declarations of Egypt's Minister of Electricity and Renewable energy, 2015.
[45] *Mada Masr*, 2015.
[46] *PennEnergy*, 2015.
[47] *Economist Intelligence Unit*, 2011
[48] Institut Wuppertal du Climat, de l'Environnement et de l'Energie, 2012.

3. *Unconventional hydrocarbon energy sources*[49]

Unconventional oil and gases include all hydrocarbon resources that are difficult to extract, because of their location on the ground or their nature that makes them difficult to produce. The liquids category includes heavy and extra-heavy oils, shale oils and tar shales and tar sands. The natural gases category includes shale gas, tight gas from compact reservoirs, coal-bed methane gas, and in the long term methane hydrates.

Arab countries account for more than 7,000 trillion cubic feet (TCF)[50] of unconventional hydrocarbon resources. Some Arab countries such as Jordan and Morocco are actively preparing for the exploitation of oil shale[51] . Others, such as Oman, KSA and may be Algeria will be the first countries to exploit unconventional shale gas[52]. Hydraulic fracturing, known as hydro-'fracking' is used for both shale oil and shale gas and raises public concerns about ground water pollution and extended land use, as well as possibly inducing seismic activities. Moreover, in-situ technologies for processing oil shale can be harmful to groundwater while other oil shale processing technologies require large amounts of water[53]. Indeed, hydrofracking is a water-intensive activity, where a mixture composed of 80 percent water, sand and chemicals, is used in to facilitate the fracturing and increase the permeability of the shale[54]. Furthermore, it takes 2.6 to 4 barrels of water to produce one barrel of oil from oil shale; and 2.3 to 5.8 barrels of water for one barrel of oil from oil sands. A shale gas well can use 2 to 4 million gallons of water to drill and fracture, and one report indicates that shale gas production requires up to four times the amount of water usually consumed by conventional natural gas[55].

4. *Biomass / Bio-fuels*[56]

Biomass resources in the region include wood from forests, residual material from agricultural and forestry processes, and organic industrial, human and animal wastes. Different technologies can be used to transform biomass resources into clean forms of energy, including bio-fuels. These technologies can also allow a significant reduction in the quantities of waste that require final disposal (waste-to-energy), therefore positively contributing to the overall waste management schemes that can be retained. Known values of annually generated solid waste in the Arab region ranges from 1.44 Million tons (Lebanon) to 5 Million tons (Algeria)[57]. Many Arab countries, including Egypt, Morocco and Tunisia, have already started using biomass in the energy mix of some industrial facilities, and many are using methane generated in landfills to produce electricity (e.g. KSA, Jordan, Tunisia and UAE)[58].

Furthermore, gaseous or liquid bio-fuels can be produced from selected crops, wild plants or algae, plants, crop residues, agro-industrial wastes and urban wastes. Liquid bio-fuels are used mainly in the transport sector with bio-ethanol and bio diesels amongst the most widely used bio fuels worldwide. Sugar canes and corn are also widely used as a feedstock to produce bio-ethanol. However, these two sources of feedstock are not sustainable in the Arab region, since it would take away important arable land and fresh water resources, from other higher priority goals. Wild plants, such as Jatropha[59], are being considered for feedstock to bio-fuels to avoid such situations. Another track for bio-fuel being investigated in some of the gulf countries (KSA, UAE, etc.) involves desert algae[60].

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[49] This section, prepared by the author of this document, is also included in ESCWA's publication (ESCWA, 2015b)
[50] Corresponding to over 198,000 bcm
[51] World Energy Council, 2013.
[52] Majid, 2014.
[53] World Energy Council, 2013.
[54] Lindström and others, 2014.
[55] University of Michigan, 2014.
[56] This section, prepared by the author of this document, is also included in ESCWA's publication (ESCWA, 2015b)
[57] World Energy Council, 2013.
[58] ESCWA, 2013.
[59] *JATROpha in MEDiterraneo*
[60] Khan, 2015.

Various and complex environmental impacts can be associated with Bio-energy production. These impacts can be positive (waste management) or negative (arable land and fresh water use) depending on the type of biomass used as feedstock, local conditions, the efficiency and intensity of the biomass use, and associated inputs used in the bio-energy production.

F. REGIONAL COOPERATION ON PRIMARY ENERGY SUPPLY AND ELECTRICAL INTERCONNECTIONS

As discussed previously, the Arab region is a major production and transit zone of oil and natural gas. Oil is mainly exported by means of tankers, complemented by some transnational oil pipelines. Natural gas is mainly exported by means of tankers through LNG terminals in the Gulf region (Qatar), and mainly through natural gas pipelines in North African countries (Algeria). However, a very limited number of these pipelines were developed to consolidate a regional cooperation on primary energy supply from NPEE to NPEI countries in the Arab region.

On the other hand, electrical grids transnational interconnections in the region have been the focus of Arab countries over the last two decades, and more than 35 electrical inter-connections are already in operation in 16 Arab countries.

1. *Regional networks for oil and gas transit*

The region includes four transnational oil pipelines and seven transnational natural gas pipelines to transit, respectively, oil and natural gas from the exporting Arab countries to European, Asian and American markets. In addition, the Arab region has fifteen LNG plants representing the third of LNG plants available worldwide. Algeria has 5 LNG plants, Egypt 2 plants, Libya 1 plant, Oman 1 plant, Qatar 4 plants, UAE 1 plant and Yemen 1 plant[61].

Only two oil pipelines are operational, which are the SUMED (Suez–Mediterranean Pipeline), conveying oil from the Gulf to the Mediterranean region and the Iraq–Turkey Oil Pipeline transiting oil from Iraq to the Mediterranean region while the other two pipelines, namely the Trans-Arabian Crude Oil Pipeline (Tapline) and the Iraq–Syria pipeline are no longer in service.

All seven gas pipelines are operational: The Enrico Mattei Pipeline; Algeria–Italy (via Tunisia), The Pedro Duran Farell Pipeline; Algeria–Spain (via Morocco), Medgaz; Algeria–Spain (direct submarine pipeline), Greenstream Pipeline; Libya–Italy (direct submarine), Arab Gas Pipeline; Egypt–Jordan–Lebanon (for few months in 2009-10) –Syria, Egypt–Israel Pipeline; Arish–Ashkelon(submarine), and the Dolphin System connecting Qatar to GCC as UAE (Abu Dhabi) and Oman[62].

As can be noticed, none of the oil pipelines was essentially intended for regional inter-Arab trade. Only two of the gas pipelines were mainly intended for regional inter-Arab trade, namely the Arab Gas and the Dolphin System pipelines. However, it should be noted that some of the Arab NPEI countries benefited from some forms of preferential pricing arrangements when importing oil or natural gas from the Arab NPEE countries. In addition, countries such as Tunisia and Morocco benefited from the passage of the Algerian natural gas pipelines by getting some amounts of natural gas as crossing rights, with transit fees ranging between 6 and 7 percent of the transit volume. The bilateral agreements also included the possibility of getting additional natural gas supply at some preferential prices.

Nonetheless, there is very little natural gas trade movements between the Arab natural gas exporting and importing countries. Indeed, in 2010, out of the around 200 bcm, exported by Arab countries; 70.5 bcm through pipelines and 129.5 bcm through LNG tankers, only 26.8 bcm (13.4 percent) were destined to Arab countries; 23.84 bcm of pipeline gas (33.8 percent) and 2.94 bcm of LNG (2.27 percent)[63].

[61] World Bank and PPIAF, 2013.
[62] ibid
[63] ibid

But the need for natural gas is rapidly growing across the Arab region, at a rate of about 6.2 percent[64], especially for electric power generation, as discussed in Section B, which is very propitious to establishing a strong regional trade market between natural gas exporting and importing countries. Indeed existing infrastructures can be enhanced and used to export natural gas; through onshore/offshore pipelines or through LNG terminals and tankers, from Arab gas exporting countries to Arab gas importing countries. Another alternative would be to consider generating electricity in gas rich countries and exporting it to the gas importing countries.

2. *Electrical interconnections in the region*[65]

The Arab region is currently divided into three blocks of electrical grids that are not yet interconnected: *The first block*; Maghreb interconnection (Morocco, Algeria, Tunisia and Libya). *The second block*; EIJLLPST interconnection including eight countries (seven Arab countries: Egypt, Iraq, Jordan, Lebanon, Libya, Palestine and Syria, in addition to Turkey). Sudan asked to join this group through a connection project with Egypt. *The third block* is the GCCIA or GCC Interconnection Authority (comprising the six GCC countries; Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE).

Furthermore, the situation in the Arab region, in terms of transnational electric interconnections, will continue to evolve in view of the many interconnection projects in progress; Egypt-Saudi Arabia; Egypt-Sudan, Saudi Arabia-Yemen, Jordan-Saudi Arabia and Jordan-Palestine. These projected interconnections will expand the existing blocks and connect them to one another, and then eventually connect them directly, via underwater cables, to transcontinental destinations (Europe, Africa and Asia).

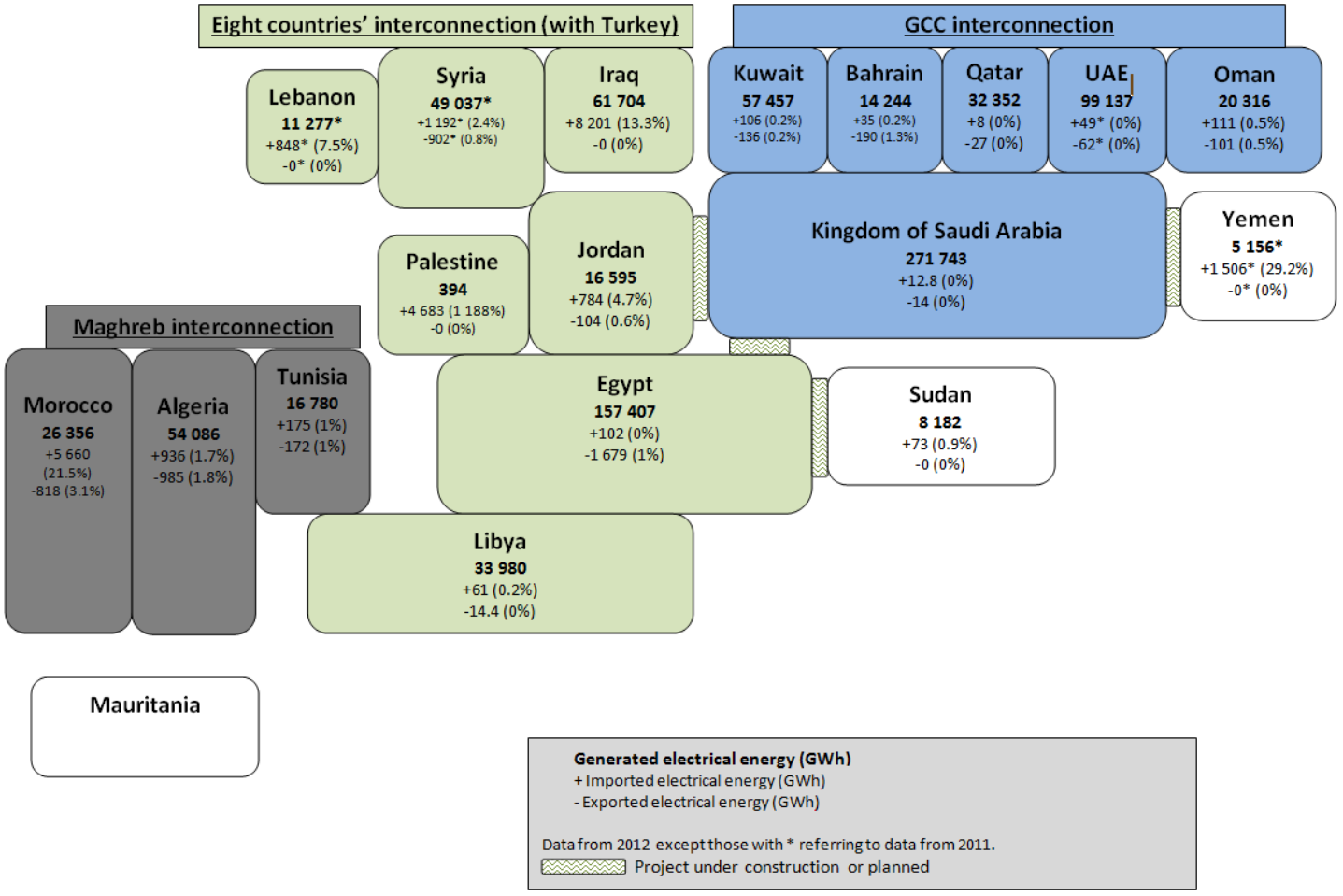
In addition, reinforcement of existing interconnections are planned to allow a better regional market integration by strengthening the North African backbone (Morocco to Libya) and integrating the Mashreq with the Maghreb through Egypt, which in turn will be interconnected with the GCC block (through Saudi Arabia). These interconnections will open a corridor for a large regional electrical exchange market.

Figure 1-8 shows the existing and projected electrical grids transnational interconnections. Transnational interconnections allow involved countries to share their capacity reserves and therefore improve their supply reliability; reduce the need for investment in new generation capacity, and favors the development of electric power generation from RE and other clean energy sources, particularly in the context of interregional programs for their development and full up-scaling.

It is worth noting that the vital importance of developing the regional cooperation in terms of electrical grids' interconnections has led the League of Arab States (LAS) to carry out a three-part study on the feasibility of interconnecting the electrical systems of the Arab countries: *Part I*: Study of Interconnections of Electrical Systems in the Arab World, *Part II*: Study of Electricity-Gas Trade among the Arab Countries; and *Part III*: Study of Institutional and Regulatory Frameworks[66].

[64] ibid
[65] World Bank, 2013 and Hafner and others, 2012.
[66] AMCE/LAS, 2015

Figure 1-8: Existing and planned electrical grids interconnections in the Arab Region



Source: Compiled by ESCWA based on AUE statistics and LAS reports.

CHAPTER II
ENERGY POLICY SHAPING DRIVERS, COMPONENTS AND INSTITUTIONAL FRAMEWORKS

National energy policies are designed to provide an implementation framework for a country's strategy concerning the supply and use of energy resources within its economy to attain its broad national macroeconomic, social and environmental development goals. Furthermore, these policies should also consider the availability and security of the supply of the different energy resources to meet each nation's energy needs.

Ideally, energy strategies and subsequent policies should aim at producing and maintaining an energy system that is sustainable. The sustainability of the energy system can be built around the following principles:

- ✓ Ensuring energy security through a balanced and versatile energy supply mix,
- ✓ Attaining environmental sustainability through integrating in the energy mix clean and renewable energy resources,
- ✓ Improving energy productivity through optimizing the allocation of energy resources and designing and enforcing appropriate energy efficiency policies and actively encouraging the implementation of energy efficiency actions,
- ✓ Ensuring an equitable access to energy services
- ✓ Guaranteeing economic competitiveness, and social equity.

Furthermore, there are two main policy drivers for higher domestic energy performance: energy prices and energy policies[67]. Both are set by government policies, and both must motivate a wider range of consumers, energy providers, and energy technology suppliers and services suppliers to adopt more productive ways of achieving society's social and economic outputs from available energy resources.

A. ENERGY POLICY SHAPING DRIVERS

1. *Energy needs in the region*

Energy needs represent the main shaping factor of national energy policies. These needs vary significantly amongst the different states in the Arab region, but can be linked to the following main universal determining issues:

- Population and demographic characteristics: Population growth and other demographic factors, such as the employment rate and growth and increases in household incomes, translate into new energy use patterns that will affect energy needs. In fact, an increase in household income will result in rising the standards of living and aspirations for greater comfort that is usually obtained through energy consuming equipments including private motorized vehicles and household appliances. Larger household incomes can also induce the construction of larger and more energy intensive homes. The growing rate of urbanization in the Arab region would also be a multiplying factor for these energy consumption triggers.

- The economic structure: The composition of the economic sectors outputs, or structure (e.g., the mix or type of mining, industrial or commercial activities). In the Arab region, different economical structures prevail in different countries. Many countries have an economy based on resource extraction (primary economic activities), relying essentially on oil and natural gas exploration and exports. These countries include the GCC, Algeria, Libya and Iraq. Most other Arab countries have mixed economic structures that are based on a combination of secondary activities (manufacturing industries) that can include energy intensive branches, and tertiary activities (services). Furthermore, different economic sectors would rely on one or several energy sources. The economic structure of each country will determine the

[67] For a full discussion of the price–policy dynamic see IEA Energy Efficiency Market Report 2013.

level of its energy requirements, and the evolution of this structure can have an important impact on the evolution of these energy requirements.

- The level of the economic operators' activities: The energy needs for a country are substantially affected by the economic operators' output. These needs are the highest when the output level is near, or at, its maximum level (economic growth) and are lowest when the output level is near, or at, its minimum (economic slowdown or recession).

- Climatic and geographical conditions: Many energy services, especially in the building sector, are highly dependent on climatic conditions. Some Arab countries have very hot weather conditions which translate into substantial energy requirements associated with space cooling (residential, commercial, public sectors and some industrial branches), and products and process refrigeration for food storage in some industrial branches. In fact, some industrial facilities such as pharmaceutical, electronics, food processing and textile require water heating, and/or either space cooling or refrigeration or both for their industrial processes. Such climatic conditions can also affect energy consumption in the transport sector (air conditioning of vehicles), and some electricity generation equipment. Other Arab countries have relatively cold, to very cold, regions that will require energy for space heating (residential, commercial, public sectors and some industrial branches). Finally, some Arab countries have a mix of both climatic conditions across their territories, and are facing both climatic impacts in their energy requirements.

- Another challenge in the region is natural water scarcity which resulted in directing a significant portion of the energy resources in the region to desalination to overcome this situation. In fact, an important share of the energy consumption in the GCC countries, and some other countries in the region such as Algeria, is spend on desalination to respond to these growing needs, with the GCC countries producing more than half of the world desalinated water[68]. According to some projections, power generation and desalination in Arab countries can mobilize most of their oil production in the near future, if water demand keeps increasing at the present rates. One of these projections claims that Kuwait could be utilizing all of its oil production internally before the year 2040, with around 70 percent dedicated to producing electricity and desalination[69].

- Technological aspects: Energy needs are also determined by the technological state of energy production, transport and distribution facilities, other industrial facilities, transportation system and vehicles, and all other energy services equipments (HVAC equipments, office equipments, lighting systems and household appliances). The prevailing, and projected evolution, of these technological characteristics determine the type of energy sources used and the level of energy efficiency that is associated. In general, well designed solutions using suitable energy sources and newer technologies are more energy efficient. Therefore, requiring lower energy needs to produce the same economic output or provide the same energy service.

Energy strategies and subsequent energy policies and their implementing instruments can provide an effective mean to influence the technological choices discussed above and provide corrective measures to deal with existing inefficient energy uses, or reliance on inappropriate energy sources. Policies aiming at improving and reinforcing the levels of energy efficiencies, if designed and implemented effectively, can result in drastically reducing the energy needs of the country and therefore its energy bill.

Furthermore energy strategies and subsequent energy policies and their implementing instruments are developed to serve national development goals, including economic development objectives, energy supply and demand patterns, capital investment requirements, social services and technological development. Table 2-1 shows the evolution of some of the driving parameters over the last three decades.

[68] Saif, 2012.
[69] Darwish and others, 2009, pp. 58–87.

TABLE 2-1: GROWTH OF POPULATION, GDP, AND PRIMARY ENERGY SUPPLY DURING THE LAST THREE DECADES

Decades		1980-90	1990-2000	2000-2010
All Arab Countries	Population (%)	2.9	2.3	2.3
	GDP at 2005 USD (%)	-1.2	3.1	5.1
	GDP at PPP as 2005 USD (%)	-1.8	2.8	4.9
	Primary Energy (%)	6.2	4.2	5.6
Arab NPEE Countries	Population (%)	3.6	2.6	2.8
	GDP at 2005 USD (%)	-2.1	2.7	5.1
	GDP at PPP as 2005 USD (%)	-3.2	2.2	4.9
	Primary Energy (%)	6.5	4.7	6.0
Arab NPEI Countries	Population (%)	2.5	2.1	1.9
	GDP at 2005 USD (%)	3.4	4.3	5.1
	GDP at PPP as 2005 USD (%)	4.0	4.3	5.0
	Primary Energy (%)	5.8	3.2	4.5

Source: Calculated based on IEA, 2014b for Primary energy and GDP / UNSD. 2015a for population

2. *Energy security issues*

As can be deduced from the previous sections, a nation's social and economic development is intimately tied to ensuring a secure and dependable flow of energy supplies. Furthermore, the cost of these supplies should be economically and socially acceptable. Therefore, a country's energy strategy and subsequent policies, would have to imperatively address these issues, by promoting the development of a set of conditions maximizing its energy security or minimizing the vulnerability of its economy to energy supply and pricing fluctuations.

This concept was well summarized by the following statements: The UNDP defines energy security as "the continuous availability of energy in varied forms, in sufficient quantities and at affordable prices"[70]. Similarly, the IEA defines energy security as "the uninterrupted availability of energy sources at an affordable price"[71].

(a) Primary energy supply sources and energy mix

For all countries in the region, energy security strategies should translate into a set of long term measures to reduce the reliance on any one source of energy, especially imported sources, and to multiply and diversify the energy sources and suppliers to obtain a dependable energy mix. Energy security strategies should also aim at:

- ✓ Reducing the energy requirements of the country through a strong and sustained emphasis on energy efficiency;
- ✓ Optimizing the allocations of energy resources;
- ✓ Developing locally available sources of energy, including renewable sources.

For net energy exporting countries in the region that already enjoy a wealth of indigenous sources of energy, the issue of energy security would be considered from an additional perspective involving the capacity to secure a sustainable and profitable energy market for their products. Attracting foreign investments for exploration and production and seeking the stability of international energy markets, are key issues affecting the "energy demand" security for these net energy exporting countries. Furthermore, and in terms of national energy policies, the energy security of these countries would require setting up the same *three goals*

[70] UNDP, 2000.
[71] IEA, 2014a.

discussed previously, in order to reinforce their capacity to continue receiving revenues from exporting conventional sources of energy for longer periods of time[72]. Energy security strategies would also be greatly reinforced by regional, or international, cooperation agreement(s) on energy trades[73].

(b) Development of electricity generation capacity

Arab countries have witnessed a rapid increase in their electricity demands during the last decades, and continue to do so. Moreover, current projections estimate that power plants electricity generation capacity is expected to increase by 78 percent in 2024, when compared to 2014 figures and the needs for generated electrical energy are also expected to increase by a comparable proportion[74]. It is therefore essential that Arab countries be able to mobilize the necessary financial resources to meet these increasing demands from non-renewable and renewable sources, or implement serious measures to reduce these energy inflations without crippling their socio economic developments.

3. *Energy access issues*

Access to modern energy services is essentially associated with the level of electrification rate of the country, as well as the access to other modern forms, renewable and non-renewable, of energy sources. In addition to its crucial role in meeting basic human needs, such as cooking, refrigeration, lighting and hygiene (domestic hot water and ventilation) as well as providing thermal comfort (heating and/or cooling) in private and public spaces, access to energy services is essential to support health, education, water and other infrastructure facilities, and to power economic activities.

According to the International Energy Agency (IEA) database for 2014[75], most of the Arab countries that are the focus of this report[76] have a national electrification rate of about 98 percent or above, except for Mauritania, Sudan and Yemen where the national electrification rate is respectively 21 percent, 35 percent and 42 percent in addition to Syria with a national electrification rate of 93 percent[77]. Furthermore, access to modern energy services also depends on the quality of this access and the affordability of these energy services to the majority of the population. Yet, to this date, many countries in the region are not able to provide adequate energy services for a significant portion of their population. In the case of electricity, this is mainly due to certain gaps in the electrical generation capacity, leading to planned or unplanned interruption of the services, such as the case of Lebanon, Yemen, Iraq and more recently Egypt, but also Palestine due to its particular status.

As a result, many areas in the Arab region are still suffering from energy poverty while connected to the grid, particularly in rural areas. Some estimates indicate that about 54 million people in the Arab region (excluding South Sudan) have no access to the electrical grid, and about 48 million people are relying on biomass for cooking[78] and many more have poor access to modern energy services[79]. This lack of energy services aggravates the cycle of extreme poverty for the concerned social groups, especially in the rural areas, and some peri-urban locations, resulting in poor social and economic conditions, which have an adverse impact on basic issues such as food security, water supply, health care, social services, education,

[72] Luft and Korin, 2009.
[73] ESCWA, 2015b.
[74] Arab Union of Electricity, 2013.
[75] IEA, 2015.
[76] This report covers the Arab region, with a main focus on the ESCWA eighteen Member countries in addition to Algeria
[77] Figures for Yemen and Syria reflect the situation prior to the major conflicts in both countries
[78] IEA, 2015.
[79] Conflict induced displacement crisis such as the ones currently affecting Lebanon, Syria, Iraq, Sudan, Yemen and Gaza, also induce very harsh conditions forcing the displaced people to live in severely energy constrained situations. These particular issues are beyond the scope of this paper. For further discussions of related energy situations , the reader can refer to the following reports: https://www.chathamhouse.org/publication/heat-light-and-power-refugees-saving-lives-reducing-costs and https://www.icrc.org/eng/assets/files/publications/icrc-002-4249.pdf

communication and overall development. Furthermore, most of this population lives in the rural areas of the Arab region, particularly in Sudan and Yemen.

Addressing this energy access gaps is essential and will benefit all households' members, and in particular women and children who suffer the most from the limited access to energy services, particularly the significant health, safety, and environmental problems usually associated with the use of inefficient solid fuels in households. The collection and transport of this type of fuel is also time-consuming and often coupled with some gender roles and inequalities issues.

(a) Development of the electrical grid

Arab countries with the lowest electrification rates have very limited electrical grid coverage, with large portions of the population still not connected to the grid. Other Arab countries need to proceed with a deep overhaul of their transportation and distribution grids in order to be able to accommodate higher levels of energy delivery and adapt, through smart grids, to the fluctuation of electricity produced from renewable energy sources.

(b) Development of natural gas distribution networks

Very few Arab countries, such as Algeria and Tunisia, have developed extended public networks of natural gas distribution grids allowing end users' access, such as households, commercial and institutional buildings and industries, to this very versatile form of energy. Saudi Arabia is also in the process of developing such networks.

Indeed, many energy services can be insured through this form of energy, such as cooking, water heating, industrial thermal processes and even transportation when using CNG, as was developed in Egypt[80]. The use of natural gas for such applications is generally associated with higher energy productivity for the national accounts at lower environmental costs than other nonrenewable sources.

(c) Access to modern energy services in rural areas

Many Arab countries invested important efforts in improving the electrification coverage for their populations. Morocco, a leading country in that respect, implemented a National Rural Electrification Program (*Programme d'Electrification Rurale Global: PERG*) allowing the country to evolve from an overall national electrification rate of 45 percent, and 18 percent in its rural areas, in 1995[81] to a national electrification rate of 99 percent, and close to 98 percent in its rural areas, in 2012[82]. However, according to the IEA database, lower electrification rates are present in the rural areas, compared to urban areas, of almost half of the Arab countries, even those with national electrification rates around 98 percent or above. In some of these countries, the real connection rate in rural areas is still low because of the high connection fees compared to the rural households' financial capacities. Energy policies should address the issues related to providing modern energy services to rural areas, which are essential to the development and welfare of the population of these areas. Energy services from available local renewable resources can be a very viable solution in many cases, especially through decentralized direct uses of renewable energy, such as water pumping, space & process heating, food drying, as well as small scale off grid PV systems dedicated to specific services, such as lighting, telecommunication, etc. These direct uses of renewable energy sources, if widely implemented through appropriate dissemination programmes, can be a valuable mean for providing energy services to rural and remote areas, at a reasonable economic cost. In Morocco, the PERG has installed almost 50000 PV off grid systems for rural electrification of remote areas.

[80] Korkor, 2014.
[81] Mitsubishi UJF Research & Consulting Co., Ltd, 2007.
[82] Islamic Development Bank, 2013.

4. *Sustainability issues*

"...Development is not possible without energy, and sustainable development is not possible without sustainable energy…"[83]. Indeed sustainable development requires that economic and social development, for present and future generations, be maximized without having long term negative impacts on the environment. Only sustainable energy solutions can provide a sustainable approach to power economic and social development while meeting such requirements.

Two of the main pillars of sustainable energy solutions are ***Energy Efficiency*** and ***Renewable Energy*** sources. Energy efficient systems and equipments require much less energy to provide the same services, allowing the reduction of energy needs at the energy production and end use levels. This will in turn help renewable energy solutions to reach a higher share in the energy mix, whether in their direct applications (solar water heating, PV and Wind pumping, etc), or in their use to generate electricity in decentralized or centralized systems.

Moreover, sustainable energy solutions, whether through EE or RE, can provide additional means to supply more, present and future, end users with energy services, hence contributing to improving access to modern energy services. Finally, EE and RE have a positive impact on the environment by reducing the amount of conventional energy sources and their associated nuisances to the environment, whether pollutants, greenhouse gases or strains on fossil water resources.

In fact, sustainable energy solutions are so important to sustainable development, that, in 2012, the UN General Assembly declared 2014-2024 as the United Nations Decade of Sustainable Energy for All (SE4All)[84]. The initiative aims to catalyze actions around three clear objectives to be achieved by 2030:

(i) Ensuring universal access to modern energy services;
(ii) Doubling the global rate of improvement in energy efficiency (with respect to 2010);
(ii) Doubling the share of renewable energy in the global energy mix (with respect to 2010).

These goals are fully compatible with the development goals of all Arab countries, as was clearly indicated by a high level panel during the Arab Launch of the United Nations Decade of SE4All, organized by ESCWA in Amman (Jordan) on 23 March 2015. Participants in this panel called for the acceleration of the adoption of policies leading to energy resources diversification and energy sustainability to support economic and social development goals in the region[85].

5. *End user energy pricing and energy poverty issues*

Energy policies should also consider revising consumer energy pricing schemes. In fact, throughout the Arab region, many countries maintain significantly low energy prices through various artificial and un-discriminate schemes of energy price subsidies for all energy consumers. This situation generally induces a lack of interest in sustainable energy solutions at the end user level, and can even promote a careless attitude towards the use of energy that can result in widely increasing energy consumption beyond the levels required to usually meet the actual energy needs.

[83] United Nations General Assembly, 2012.
[84] United Nations, 2013.
[85] During this event, the Jordanian Minister of Energy and Mines Resources declared that "Energy is the main and vital driving force for all the other sectors. It is critically essential to progressively implement policies and reforms to enhance the sustainability of the energy sector'' and the UN ESCWA Deputy Executive Secretary declared that. "Our future is dependent on our ability to formulate a balanced energy equation built around an integrated system, of efficient use of resources, technology development, and conservation, in which matches environmental needs and secure supplies and energy services to all Arab population, and this requires efforts to achieve rapid transition toward just and sustainable energy systems".

Furthermore, these energy subsidies have become a very heavy burden on most Arab states' economies and an obstacle to socio-economic development, and even to the development of the energy sector itself[86] and other priority sectors such as health and education.

This economically nonviable situation cannot be maintained indefinitely and energy subsidies will eventually be substantially reduced, or eliminated, due to eventual future international energy prices hikes. As a result, access to modern energy services can significantly be impaired because of high energy bills. Indeed, energy costs will eventually represent a disproportionate and unsustainable share of end users' disposable income, if no energy efficiency measures are adopted to drastically reduce the energy consumption associated with the different energy services.

6. *International and regional cooperation issues*

Many aspects of energy policies are often largely influenced by geopolitical conditions which determine to a large extent the availability and price of conventional and non-conventional energy sources. On the other hand, international cooperation, and especially regional cooperation agreements, can help in developing the national energy sector and alleviate the contingencies associated with the changing geopolitics. International and regional cooperation agreements are designed to support national energy policies and promote their national energy security.

Regional agreements, bilateral or multilateral, often address the issue of interconnectivity between national electrical grids, or natural gas networks, in order to allow transnational energy exchange. Also, some countries can benefit from the passage of a gas pipeline, through its territory, from a neighboring producing country to an importing country. International and regional cooperation can also promote the development of energy efficiency markets, the deployment of renewable energy and other energy sources that can be considered for the region.

B. ENERGY POLICY COMPONENTS

The different driving factors, competing to shape the energy strategy, and subsequent adopted energy policies, need to be dealt with in a coherent and systematic approach that take into account the long term implications and, especially those that are most relevant for the Arab region; e.g. the Water-Energy nexus and the Water-Food-Energy nexus.

1. *Energy policy issues*

The main energy policy issues that need to be addressed when developing a national energy strategy can be grouped into five main themes:

- ✓ The contribution that accessible efficient energy use can make to overall social welfare
- ✓ The impacts that energy can have on the competitiveness of the different economic operators and sectors
- ✓ The role of the energy sector in the macroeconomic equilibrium
- ✓ The ongoing security implications of energy demand and supply policies
- ✓ The impacts that energy consumption and its prospects, can have on the environment, both at the local and global levels

Energy policy also needs to be adaptive (regularly reviewed in view of contextual factors such as global market prices, public needs and technological advances) and it needs to interact with other areas of the economy – be incorporated into planning across sectors – e.g. industrial policy, transport policy, housing etc. as well as power and water.

[86]Fattouh and El-Katiri, 2012.

Furthermore, any national energy strategy should be capable of addressing urgent requirements, while taking into account, and integrating, future developments in the short, mid and long term time frames. Ideally, the end result would allow the national energy situation to be moving towards an optimum sustainable state, where the social and economic development goals are reached with the least amount of non-renewable and non-indigenous energy resources that can economically be acceptable if all associated externalities, such as environmental impacts and the depletion of national resources, are taken into account[87] [88]. The energy strategy should also result in the least damage possible to the environment, both at the local and global levels.

The energy strategy for a nation should be developed to address the issues discussed above, and should be translated into practical policy instruments and measures capable of shaping a new energy direction that meets the objectives of the strategy. Furthermore, these strategies and instruments need to show how they contribute to overarching goals to develop durable social welfare and economic productivity improvements, while addressing the various present needs of social and economic sectors, and provide effective guidelines to different stakeholders and economic operators. Policies must highlight benefits and motivate all decision makers to willingly participate in making the necessary and immediate adjustments, and contributing in shaping the new and more productive energy future.

For success to be guaranteed, this policy development work should result from a consultative and participative process involving all the concerned public and private stakeholders and economic operators. Only by doing this can the various parties begin to understand why change is necessary, how they might all benefit from an improved policy paradigm, and the roles and opportunities that they can expect to participate in.

Some of the key components of successful energy strategies include the following elements[89]:

- ✓ Long-term, high-level focus
- ✓ Clear purpose, goals and objectives
- ✓ Clear boundaries (targeted sectors/sub-sectors and time span)
- ✓ Understanding of context and internal and external factors affecting success
- ✓ Organizational structure and resources necessary to achieve goals and objectives"

Furthermore, and in order to provide a clear vision for the implementation of national energy strategies, national action plans are usually developed to set clear and specific targets for the short, mid and long term time frames. Specific national action plans can cover the future energy mix, energy access, energy efficiency and conventional and renewable energy deployments. The national action plans are used as roadmaps for the realization and implementation of the national energy strategies.

2. *Energy policy instruments*

There are various energy policy instruments that are used to implement national strategies. These can be summarized as follows in a hierarchical order:

- ✓ Statutory or framework laws; are the texts that convert the strategy into general operating legal frameworks indicating the objectives to be achieved at the national level, the context for the detailed policy texts and the targeted economic sectors, key accountabilities and expectations of associated stakeholders. They are usually the least evolving texts over time because of their strategic and generic nature. Therefore, they should be prepared based on a holistic and prospective approach. These texts should essentially address the issues related to the energy mix; the energy supply, transport and

[87] For a discussion of the externality costs refer to "Getting the Prices Right: From Principle to Practice", Ian Parry et al, IMF 2014

[88] For a specific discussion about this issue related to natural gas in the Gulf countries, refer to "Finding the 'Right' Price for Exhaustible Resources-The Case of Gas in the Gulf", Glada Lahn and Paul Stevens, Chatham House 2014

[89] IEA and OECD, 2009.

distribution infrastructures; the access to energy services and their associated costs to the nation and end users; and the energy sustainability goals in terms of energy efficiency and renewable energy deployments. These statutes need to be open to future changes in technologies and practices, encompassing all options, whether demand or supply side, conventional or new, and ensure an open and competitive domain for these options to contribute. Moreover, social and associated macroeconomic indicators should be defined and evaluated periodically in order to monitor the reinforcement of these framework-laws and their effective implementations.

- ✓ Policies, programmes, regulations and standards; are the texts that translate the statute or framework laws into operational policies and measures and set their applications and delivery modalities for each sector and sub-sector. The success of their implementation requires a consultative and participative approach involving diverse public and private stakeholders. The consultation enables the identification and effective design of appropriate implementation mechanisms capable of ensuring effective transition to the targeted objectives. Because these policies operate in dynamic markets they need to respond to how existing structures and actors adapt to the overarching statutory or frame-work laws, changing markets and policies. Regular evaluation - review cycles ensure policies adapt to change. Social and microeconomic indicators should also be defined and evaluated periodically in order to monitor the implementation of these policies and measures and evaluate their effectiveness and any needs for their adjustment.

- ✓ Market development strategies, marketing programmes and mechanisms are required to ensure the development of competitive supply lines of sustainable energy technologies and services and effective demand by consumers. Without the demand and supply of these new products and services there can be no change, regardless of statutory intent or policy mandate. Policies can include special implementation schemes and financing mechanisms to initiate/promote market development.

- ✓ Public backstopping, including financial, technical and institutional support instruments to various targeted products and actors. Financial support can include direct subsidies through financial contributions and/or fiscal privileges for targeted products and services. Subsidies used for the implementation of sustainable energy solutions are best provided to early adopters, or to explore market response to new technologies through pilot programmes, and should always include a phase out strategy. If well designed, they can make a better use of energy price subsidy funds by displacing them to end user efficiency, hence reducing future needs for end-users energy subsidies. However, grants and subsides are not sustainable instruments, and can create market distortions, as is the case with feed in tariffs for renewable supply, which can discourage demand side measures. In the long run, objectives can be better developed with performance based regulations.

- ✓ Instruments for related institutional and human resources development, including capacity building, technology transfer, and the development of relevant industrial capabilities and skills, as well as required R&D work.

The successful implementation of these instruments requires adequate authority in addition to clarity of roles and responsibilities among the various stakeholders. Well defined coordination and enforcement mechanisms are also essential. Monitoring the implementation of the policies is crucial in noting the progress made and identifying any requiring adjustments. Availability of key reliable data information, and transparent access to it, are essential to properly conduct the monitoring and evaluation tasks.

C. INSTITUTIONAL FRAMEWORKS FOR ENERGY POLICIES

Domestic energy strategies and policies require an adequate institutional framework to carry out all the necessary studies and assessments to develop all the different elements to be retained. The institutional framework should be organized around solidly backed structures with a clear mandate to design, formulate, implement, and evaluate energy policies and programs. It should also have a strong in-house economic,

marketing, evaluation and technical capacities to supervise necessary sectoral studies, design interventions, prepare legislative texts to implement the retained policies, and evaluate outcomes. It is of course, necessary to integrate this institutional framework with the overall governance system and political structure that is in place in the country.

Energy efficiency and renewable energy institutional frameworks may be mandated to perform additional tasks, such as the actual logistical implementation of related national projects and programmes. In which case, they need to comprise additional sub-structures, e.g. dedicated project management units, with all the necessary staffing and expertise.

CHAPTER III
DOMESTIC ENERGY POLICIES' TRENDS IN THE ARAB REGION

National energy policies in the Arab region, and associated institutional frameworks, are the main instruments that governments have, to implement a national energy supply and demand-side management or energy productivity strategies. These instruments enable countries to secure/access and apply energy resources in an efficient manner. Such a responsible management of energy resources is necessary to achieve sustainable social and economic development goals, while preserving the environment at the national and global levels.

The current high levels of energy intensity, in the region, points to a failure to match low end-user energy costs with policies that ensure high efficiency of use, or high productivity. However, there are signs indicating that the region is starting to respond to this productivity gap.

However, the region faces many challenges, and there are many policy options for improved outcomes as indicated in an IEA document on energy efficiency recommendations for the region[90]. Some of these challenges, which were identified by a panel of energy experts from the Arab region and also discussed in the previous two chapters, include the following:

- ✓ A rapid growth in energy demand for the different economic sectors;
- ✓ Issues related to the international energy price fluctuations that can cause eventual energy supply and economic disruptions for some of the NPEI group of Arab countries, and important loss of revenues for the NPEE group of countries when these prices drop drastically;
- ✓ Severe climatic conditions that put additional stress on energy requirements, especially for potable water supply and energy services associated with refrigeration and space cooling;
- ✓ A limited capacity for enforcing regulatory policies;
- ✓ Issues related to Institutional governance, capacity and coordination;
- ✓ Low costs to end users of conventional domestic energy resources make demand side and renewable alternatives much less economic than in other countries. Most of these low end-users' energy prices are the result of implicit or explicit energy subsidies, which are becoming severe burdens to public budgets;
- ✓ A limited role of the private sector with a public sector that is gradually lacking adequate resources to invest in energy related infrastructures.

A. PAST ENERGY STRATEGIES AND POLICIES AND THEIR IMPACTS ON ENERGY SUSTAINABILITY IN THE ARAB REGION

During the last three decades, national objectives associated with the domestic management of energy resources, in terms of supply and demand, have not been part of a comprehensive national energy management or development strategy in most Arab countries. Energy supply, in its different forms, was considered as an input to economic and social development requirements, and energy suppliers, including utilities, were acting as commodity providers, to satisfy the growing energy needs. Furthermore, energy pricing signals resulting from prevailing low energy prices in Arab countries favored the development of energy-intensive industrialization options, as well as non-energy conscious energy consumption patterns and behavior. This was especially true in the NPEE countries, but also until recently in the NPEI countries as well. It is only during the last decade that some national objectives (indicative targets) started to shape the outlines of comprehensive national energy strategies, including energy mix, energy efficiency and renewable energy development with varying emphasis throughout the Arab countries.

The past three decades can therefore be characterized as follows, in terms of resulting domestic energy situation:

90 IEA, 2014c.

1. A focus on the energy supply side

Until recently, ensuring an adequate supply of energy to power the social and economic development plans, was the main focus of energy policies in the Arab region, which is a usual tendency in developing countries. During the last three decades; 1980-1990, 1990-2000 and 2000-2010, energy was almost exclusively considered from the supply side for the two first decades, and for most countries in the region, the possibility to "sustainably" manage the demand side, has only been on the agenda of energy policies during the second half of the last decade. The main objectives were to provide a sufficient supply of energy, in its different forms, to meet the growing energy demands over the years. In some cases, utility companies in the Arab region used some "unsustainable" demand side management by pushing for additional electrical consumption during the off peak hours of the day, in order to optimize their electrical load curves. One such measure was used from the late seventies to 2005 by the Tunisian Electrical utility, STEG[91] through establishing a very attractive residential electricity tariff for electric hot water heaters to encourage residential end users to switch from natural gas or LPG water heaters in Tunisia to off peak electric power. This initiative, taken by the national utility company, was promoting, at that time, the least efficient available technology for heating hot water from a country's primary energy resources management stand point[92], and continued to be implemented even during the time, when Tunisia started to review its energy policies and to consider energy efficiency and renewable energy as part of its future energy strategy. This is a case where a wider perspective might have considered solar and high efficiency gas end-use applications in a more strategic way for different types of consumers.

An examination of the evolution, over the last three decades (1980-2012), of the domestic energy situation based on some key energy and economic indicators confirms the focus on the energy supply side. These indicators include population, GDP, primary energy supply, electrical consumption and peak electrical demand, as well as some indicative ratios using these indicators. Table 3-1 summarizes the evolution of these key indicators over the last three decades and shows that while the population of Arab countries increased by about 118 percent; and their GDP by 114 percent, between 1980 and 2012, the primary energy supply increased by about 415 percent over the same period, electrical consumption by over 845 percent and peak electrical demand by over 740 percent. Furthermore, Table 3-1 shows that similar trends can be observed for the Arab countries as a group, the GCC countries, the NPEE and the NPEI groups of countries, over the three decades. Although part of these expansion rates can be correlated to the important increase in energy access and the gap closure in national electrification, according to an eminent energy economics expert in the region, these energy growth rates, "*were beyond such factors as economic and population growth*"[93], and way above the projections made by specialized international institutions. Indeed, the recorded values for the Middle East part of the Arab region exceeded, for 2010, the projections made by the IEA in its 1998 edition of the World Energy Outlook[94], using the Business As Usual (BAU) scenario, by more than 60 percent[95]. The same IEA report noted that power generation capacity in Saudi Arabia grew at an annual rate of 14.5 percent from 1975 to 1996.

It is worth considering the above evolutions in light of the fact that most Arab countries have harsh climate conditions, and scarce fresh water resources, that the NPEE group of countries has a unique and singular competitive advantage in oil and/or natural gas. For this group of countries, with a singular dependence on their endowments of oil and gas, there is a strong tendency to make these resources available at cost to their domestic consumers. Indeed these strategies of centrally allocated low cost access to these energy resources have enabled significant social and economic development in the region, at a pace few other societies have

[91] Khemiri, Sarrra, 2008.

[92] Over 95% of electricity in Tunisia is produced from natural gas & oil products, with an overall efficiency, for that period of time, less than 35%. Taking into account transmission & distribution losses and the efficiency of the water heater, the overall efficiency with respect to primary energy resources is less than 30%, while the least performing gas or fuel hot water heater would have an overall efficiency of about 45% during that same period of time, and better performing gas water heaters could reach an efficiency of 70%

[93] El-Katiri and Fattouh, 2015.

[94] IEA, 1998.

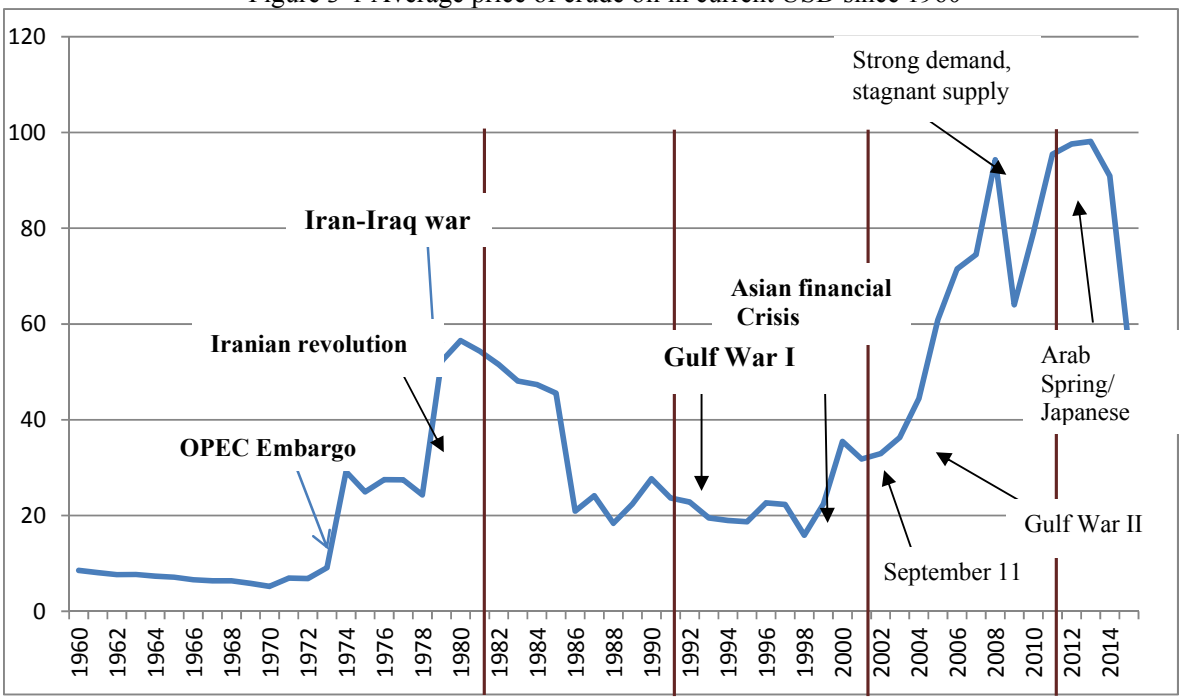
[95] ESCWA estimate based on IEA, 1998 and IEA Energy data base

been able to achieve. In fact, access to energy services, especially air conditioning for thermal comfort and productivity, as well as desalination were the main drivers of the sharp increase in electrical consumption and demand in these countries.

As can be noted in Table 3-1, the 1980-1990 decade registered the highest expansion rates in terms of primary energy supply, electrical energy demand and consumption. This expansion took place in the NPEE as well as in the NPEI group of countries, despite a decline in the GDP of the former, associated with the decline in oil prices by about 55 percent (Figure 3-1), that was recorded in the same period. These high expansion rates are largely explained by high population growth, higher electrification rates and an increasing dependence on electrical energy services for households, schools, hospitals, as well as other services. It is worth noting that the total growth rates of electrical energy demand and consumption were about twice those of the primary energy supply, indicating that the share of power generation of the total primary energy supply increased drastically during that period. In fact, electrical consumptions and peak electrical demands increased at rates that are 3.5 to 4.0 times that of the population growth rate in the NPEE and NPEI groups of countries (the GCC, with a population growth about twice that of the Arab region had slightly lower ratios). During the 1990-2000 decade the electrical demand and consumption expansion rates were lower than in the previous decade but continued to grow at higher rates than the population and GDP growth rates for both the NPEE and NPEI countries. However, the growth rate of the primary energy supply was lower than that of the GDP for the NPEI group of countries. These same trends persisted during the 2000-2010 decade, but with significantly higher rates than the 1990-2000 decade.

Table 3-1 and Figure 3-1 also show the strong correlation between the international oil prices and GDP for the NPEE group of countries.

Figure 3-1 Average price of crude oil in current USD since 1960[96]



Source: ESCWA based on IMF International Financial Statistics

[96] Graph initially published in "Survey of Economic and Social Developments in the Arab Region, 2014-2015", E/ESCWA/EDID/2015/2 – Delimitation of decades added in this paper

TABLE 3-1: EVOLUTION OF POPULATION, PRIMARY ENERGY SUPPLY, ELECTRICAL CONSUMPTION AND PEAK ELECTRICAL DEMAND IN THE ARAB REGION DURING THE LAST THREE DECADES

	Total growth over the period 1980-1990						Ratio of total energy growth / Total population growth (1980-1990)			Ratio of total energy growth / Total GDP_USD2005 growth (1980-1990)		
	Population	GDP_USD2005	GDP-PPP_USD2005	Peak electrical demand	Electrical consumption	Primary energy supply	Peak electrical demand	Electrical consumption	Primary energy supply	Peak Electrical Demand	Electrical Consumption	Primary energy Supply
All Arab Countries	33%	-11%	-17%	137%	150%	83%	4,2	4,5	2,5	E□ GDP □	E□ GDP □	E□ GDP □
GCC Group	64%	-1%	-1%	128%	202%	85%	2,0	3,2	1,3	E□ GDP □	E□ GDP □	E□ GDP □
NPEE Group	42%	-19%	-28%	149%	169%	87%	3,5	4,0	2,1	E□ GDP □	E□ GDP □	E□ GDP □
NPEI Group	31%	40%	49%	111%	114%	75%	3,6	3,7	2,4	2,8	2,9	1,9

	Total growth over the period 1990-2000						Ratio of total energy growth / Total population growth (1990-2000)			Ratio of total energy growth / Total GDP_USD2005 growth (1990-2000)		
	Population	GDP_USD2005	GDP-PPP_USD2005	Peak electrical demand	Electrical consumption	Primary energy supply	Peak electrical demand	Electrical consumption	Primary energy supply	Peak electrical demand	Electrical consumption	Primary energy supply
All Arab Countries	25%	35%	32%	60%	79%	51%	2,4	3,2	2,0	**1,7**	**2,2**	**1,4**
GCC Group	25%	44%	43%	78%	87%	71%	3,1	3,5	2,8	**1,8**	**2,0**	**1,6**
NPEE Group	29%	31%	24%	55%	75%	58%	1,9	2,6	2,0	**1,8**	**2,4**	**1,9**
NPEI Group	26%	52%	53%	72%	90%	37%	2,8	3,5	1,4	1,4	1,7	0,7

	Total growth over the period 2000-2010						Ratio of Total energy growth / Total population growth (2000-2010)			Ratio of total energy growth / Total GDP_USD2005 growth (2000-2010)		
	Population	GDP_USD2005	GDP-PPP_USD2005	Peak electrical demand	Electrical consumption	Primary energy supply	Peak electrical demand	Electrical consumption	Primary energy supply	Peak electrical demand	Electrical consumption	Primary energy supply
All Arab Countries	26%	64%	62%	94%	92%	72%	3,6	3,5	2,8	**1,5**	**1,4**	**1,1**
GCC Group	56%	71%	70%	108%	99%	93%	1,9	1,8	1,7	**1,5**	**1,4**	**1,3**
NPEE Group	32%	65%	61%	94%	91%	79%	2,9	2,8	2,5	**1,5**	**1,4**	**1,2**
NPEI Group	23%	64%	63%	94%	92%	55%	4,1	4,0	2,4	1,5	1,4	0,9

	Total growth over the period 1980-2012						Ratio of total energy growth / Total population growth (1980-2012)			Ratio of total energy growth / Total GDP_USD2005 growth (1980-2012)		
	Population	GDP_USD2005	GDP-PPP_USD2005	Peak electrical demand	Electrical consumption	Primary energy supply	Peak electrical demand	Electrical consumption	Primary energy supply	Peak electrical demand	Electrical consumption	Primary energy supply
All Arab Countries	118%	114%	92%	741%	846%	415%	6,3	7,2	3,5	**6,5**	**7,4**	**3,6**
GCC Group	240%	175%	171%	845%	1150%	576%	3,5	4,8	2,4	**4,8**	**6,6**	**3,3**
NPEE Group	156%	93%	60%	755%	917%	481%	4,8	5,9	3,1	**8,2**	**9,9**	**5,2**
NPEI Group	112%	250%	275%	710%	710%	277%	6,3	6,3	2,5	2,8	2,8	1,1

Source: ESCWA Calculations based on IEA data base

2. A remarkable performance in terms of securing energy access to the population, albeit some mixed results in some countries and some shortness to meet climbing energy demands during recent years

The region witnessed a remarkable rate of development over the past three decades. Social and economic infrastructures that took many decades to built in developed countries, has been developed within these last three decades in many Arab countries. Some of these infrastructures and their embodied energy, however, have unfortunately been dissipated in unrest and warfare.

During these decades, the focus on the energy supply side played a major role in improving considerably energy access in the vast majority of the countries within the region. In Saudi Arabia, the fraction of the

population connected to the electrical grid jumped from about 41 percent in 1980[97] to 99.5 percent in 2012[98]. Morocco[99] and Tunisia[100] went, respectively, from national electrification rates of 45 percent and 56 percent in 1980 to national electrification rates of 99 percent and 99.5 percent in 2012.

This notable performance in terms of securing energy access to the population was also reported by the SE4All Global Tracking Framework[101], for both electricity access and non-solid fuels[102] (Table 3-2). Indeed, based on a complex multi-tier index (ranging from 0 to 5) for rating electricity access, the main two sub-regions of Arab countries, namely Northern Africa and Western Asia[103], scored respectively, 4.2/4.7 and 4.0/4.4 for 2000/2010. The two regions ranked amongst the top three developing countries' regions in the world (out of eight regions), along with Latin America and the Caribbean region. Furthermore, these three regions are considered to be the only three developing countries' regions in the world to reach universal access to electricity by 2030. According to the same report, Egypt, Iraq, Morocco and Saudi Arabia were among the top twenty developing countries in the world with the greatest annual progress in access to electricity between 1990 and 2010. However, five countries in the Arab region; namely Djibouti, Mauritania, Somalia, Sudan (not part of the Northern Africa and Western Asia regions) and Yemen, are still lagging behind in terms of securing electricity access to their population (Table 3-3). In fact, Mauritania was ranked amongst the top 20 countries in the world with lowest access to electricity and Sudan was ranked amongst the top 20 countries in the world with the largest electricity access deficit.

As for access to non-solid fuels[104], which is part of one of the three goals of the SE4All decade, and according to the Global Tracking Framework report, Northern Africa and Western Asia have the highest access rates of all regions in the world, including developed countries. Northern Africa practically reached universal access to non-solid fuel by 2012, and the fraction of the population without access to modern cooking solutions in the Middle East will be less than 3 percent by 2030. Furthermore, Algeria, Egypt and Iraq are among the top twenty countries with highest annual incremental growth in access to non-solid fuel during the years 1990 to 2010. Still, Somalia is among the top 20 countries with the lowest access rates to non-solid fuel, and Sudan is among the top 20 countries with the largest access deficits.

In spite of this remarkable performance of the Arab region in terms of access to energy services (most of the countries with low performance are struggling with persisting geopolitical crisis), some disparities between rural and urban areas still persist in many Arab countries, even among the highest performing ones. In some Arab countries despite the progress in access, being connected to the grid is no longer a guarantee of getting undisrupted electrical supply, and some countries, such as Lebanon and, in circumstances of high electrical demands, Egypt, are rationing the hours of electrical supply to the grid connected end users. Also, in many countries, including Lebanon and Tunisia, some public energy services such as street lighting at night are simply discontinued in many locations. This is mainly due to lack of available electrical capacity, with more than eight Arab countries reporting in 2013 and 2014 maximum peak electric loads that represent 80 percent

[97] ESCWA estimate based on reported 1980 total population connected to the electrical grid in Metz, 1993 and total population for Saudi Arabia for the same year from UN-Stat

[98] Arab Union of Electricity, 2013

[99] Islamic Development Bank, 2013

[100] African Development Bank 1991, for 1980 figures and Arab Union of Electricity, 2013 for 2012 figures

[101] IEA and the World Bank, 2014

[102] Within the GTF methodology, Electricity access is defined as availability of an electricity connection at home or the use of, electricity as the primary source for lighting. Access to modern cooking solutions is defined as relying primarily on non-solid fuels for cooking (The methodology does not take into account whether the connection provides an adequate and reliable service, which it may often fail to do). For rating energy access, the GTF uses, household survey evidence to determine "the percentage of the population with an electricity connection and the percentage of the population who primarily use non-solid fuels for cooking"

[103] The Global Tracking Framework regional figures are based on the following countries affectation: North Africa includes Algeria, Egypt, Libya, Morocco & Tunisia. And Western Asia includes Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, United Arab Emirates & Yemen, but also includes Cyprus, Israel and Turkey

[104] The use of inefficient solid fuels in households is associated with significant health, safety, and environmental problems. The collection and transport of this type of fuel is time-consuming and often coupled with some gender roles and inequalities issues.

or more of their total installed capacities[105] and some Arab countries already experienced their first electrical blackouts.

This situation is best described by the following[106]: "*Irregular services with recurring power outages have characterized electricity provision throughout wide parts of the MENA, typically in response to decade-long underinvestment in electricity generation and in transmission and distribution networks. In many parts of the Levant and the Gulf countries, this situation is further exacerbated by a culture of non-payment of utility bills by some parts of the population. Recurring blackouts, seen in recent years across many parts of the Levant, Iraq, Egypt, and perhaps most paradoxically several Gulf Cooperation Council (GCC) members (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates – UAE), are just one of the most visible consequences of lagging new investment and insufficient capacity across many parts of the MENA. These blackouts proportionally affect middle-income households and small businesses significantly more than any other energy user group. Long waiting times for new electricity connections for private households and businesses are often the consequence, resulting in annual losses in foregone business activity and backup costs for the economies concerned*". There is still, despite apparently high levels of electricity intensity and availability, a need for more power supply in many Arab nations. For the special case of Palestine, energy supply and services are frequently obstructed by the Israeli embargo, military attacks, and the prevailing unstable security situation. Improving access to energy services, especially in Gaza, requires abnormal levels of distributed energy resources, resilient to attack, and persistence with the most frugal usage.

TABLE 3-2: EVOLUTION OF ENERGY ACCESS IN THE ARAB REGION FROM 1990 TO 2010, COMPARED TO OTHER GROUPS OF COUNTRIES

ENERGY ACCESS	Access to Electricity (% of population)					Access to Non-Solid Fuel (% of population)				
	Total			Rural	Urban	Total			Rural	Urban
Region	**1990**	**2000**	**2010**	**2010**	**2010**	**1990**	**2000**	**2010**	**2010**	**2010**
Northern Africa	85	92	99	99	100	88	96	100	99	100
Western Asia	89	89	91	78	97	83	90	95	86	99
WORLD	76	79	83	70	95	47	54	59	35	84
Upper middle income (World)	93	96	98	96	99	53	64	71	36	85

Source: IEA and the World Bank, 2014

[105] These countries include: Bahrain, Tunisia, Saudi Arabia, Syria, Kuwait, Lebanon, Egypt and Yemen. Based on figures reported in the 2013 & 2014 Arab Union of Electricity Bulletin

[106] El-Katiri and Fattouh, 2015

TABLE 3-3: EVOLUTION OF ENERGY ACCESS IN THE ARAB COUNTRIES FROM 1990 TO 2010

ENERGY ACCESS	Access to Electricity (% of population)					Access to Non-Solid Fuel (% of population)				
	Total			Rural	Urban	Total			Rural	Urban
Country	**1990**	**2000**	**2010**	**2010**	**2010**	**1990**	**2000**	**2010**	**2010**	**2010**
Algeria	94	98	99	98	100	86	> 95	> 95	> 95	> 95
Bahrain	87	91	94	90	95	> 95	> 95	> 95	> 95	> 95
Djibouti	**43**	**46**	**50**	**10**	**61**	**84**	**87**	**87**	**21**	**90**
Egypt	96	98	100	99	100	93	> 95	> 95	> 95	> 95
Iraq	92	94	98	94	100	89	> 95	> 95	91	> 95
Jordan	95	100	99	99	100	88	> 95	> 95	> 95	> 95
Kuwait	87	91	94	90	94	> 95	> 95	> 95	> 95	> 95
Lebanon	93	95	100	99	100	92	> 95	> 95	> 95	> 95
Libya	97	100	100	99	100	89	> 95	> 95	> 95	> 95
Mauritania	**12**	**15**	**18**	**2**	**42**	**20**	**32**	**42**	**21**	**66**
Morocco	49	71	99	97	100	81	91	> 95	87	> 95
Oman	87	91	94	90	96	> 95	> 95	> 95	> 95	> 95
Palestine[a/]	87	91	94	90	96					
Qatar	87	91	94	90	94	92	> 95	> 95	> 95	> 95
Saudi Arabia	87	91	94	90	95	> 95	> 95	> 95	> 95	> 95
Somalia	**22**	**26**	**29**	**14**	**54**	**< 5**	**< 5**	**< 5**	**< 5**	**5**
Sudan	**23**	**25**	**29**	**15**	**57**	**< 5**	**7**	**21**	**13**	**24**
Syria	85	87	93	78	100	84	> 95	> 95	> 95	> 95
Tunisia	93	95	100	99	100	82	94	> 95	> 95	> 95
U. Arab Emirates	87	91	94	90	95	86	> 95	> 95	> 95	> 95
Yemen	**38**	**41**	**45**	**31**	**75**	**52**	**61**	**67**	**49**	**> 95**

Source: IEA and the World Bank, 2014

a/Palestine is referred to in the report as West Bank & Gaza

3. A performance below existing potential in terms of renewable energy deployment

The region has a significant RE potential (mainly solar, but also wind and to a lesser extent hydropower and geothermal) that can be taped into to provide sustainable energy resources to supplement the existing energy supply. Most of the Arab countries have only recently started to pursue renewable energy deployment as part of their mix of supply options to help meet rising demand, and diversify their energy mix. It is interesting to note that the focus on the energy supply side is also strongly present in the renewable energy action plans and targets, and that no scenarios were developed to integrate the share of renewable energy in the energy mix associated with a proactive energy demand side management, integrating energy efficiency and rational energy sources substitution.

As can be noted in the Global Tracking Framework report, the share of total final energy consumption derived from all renewable energy sources (bio-energy, aero-thermal, geothermal, hydro, ocean, solar, wind), the indicator retained for measuring progress in terms of RE deployment has regressed in the Arab region during the period 1990-2010. This renewable energy contribution is mainly composed of traditional biomass and hydropower, with very small contributions from solar and wind. The share of RE regressed because of the large increase in energy consumption, which was mainly satisfied by conventional energy sources, and on the other hand the improvements that were recorded in terms of access to modern energy sources, which

resulted in shrinking the contribution of traditional biomass. Table 3-4 presents the findings of the Global Tracking Framework on a regional level, and Table 3-5 presents those findings on a country by country level.

TABLE 3-4: EVOLUTION OF RENEWABLE ENERGY DEPLOYMENT IN THE ARAB REGION FROM 1990 TO 2010, COMPARED TO OTHER GROUPS OF COUNTRIES

Renewable Energy	Share (%) of RE in TFEC[a/]			Share (%) in TFEC[a/] for 2010								RE share (%) in 2010 of:		Total final energy consumption (PJ) in 2010
Region	**1990**	**2000**	**2010**	**Traditional biomass**	**Modern biomass**	**Hydro**	**Liquid biofuels**	**Wind**	**Solar**	**Geothermal**	**Other**	**Electricity capacity**	**Electricity generation**	
Northern Africa	6,5	6,2	5	2,5	1	1,4	—	0,2	—	—	—	9,6	7,2	3 974
Western Asia	8,2	5,8	4,3	0	1,6	1,5	0	0,1	0,6	0,5	0	11,4	7,4	11 697
World	16,6	17,4	18	9,6	3,7	3,1	0,8	0,3	0,2	0,2	0,3	23,9	19,4	329 834
Upper middle income (World)	18,8	19,6	16,7	8,4	2,6	4,1	0,6	0,1	0,3	0,2	0,2	27	22,1	120 299

Source: IEA and the World Bank, 2014
a/TFEC: Total Final Energy Consumption

TABLE 3-5: EVOLUTION OF RENEWABLE ENERGY DEPLOYMENT IN THE IN THE ARAB COUNTRIES FROM 1990 TO 2010

Renewable Energy	Share (%) of RE in TFEC[a/]			Share (%) in TFEC[a/] for 2010								RE share (%) in 2010 of:		Total final energy consumption (PJ) in 2010
Countries	1990	2000	2010	Traditional biomass	Modern biomass	Hydro	Liquid biofuels	Wind	Solar	Geothermal	Other	Electricity capacity	Electricity generation	
Algeria	0,2	0,6	0,3	0,3	0	0	—	—	—	—	—	2,5	0,4	1 044
Bahrain	E —	A —	—	—	—	—	—	—	—	—	—	0	. —	221
Djibouti	—	—	—	—	—	—	—	—	—	—	—	—	—	5
Egypt	8,6	8,2	6,1	1,8	1,9	2,2	—	0,3	—	—	—	12,4	9,9	1 792
Iraq	1,6	0,3	1,6	—	0,1	1,5	—	—	—	—	—	24,9	9,5	855
Jordan	2,8	2,1	3	0,1	0	0,1	—	0	2,8	—	0	0,6	0,5	188
Kuwait	E 02	A.—	—	—	—	—	—	—	—	—	—	—	—	513
Lebanon	11,5	5	5	2,6	0,2	1,8	—	—	0,4	—	—	12,1	5,3	161
Libya	3,1	2,1	2,1	2,1	0	—	—	—	—	—	—	—	—	347
Mauritania	40,9	42,6	35,1	35,1	—	—	—	—	—	—	—	36,9	—	33
Morocco	8,5	6,7	7,2	3,4	0,6	2,7	—	0,5	—	—	—	23,7	18,5	500
Oman	E —	A —	—	—	—	—	—	—	—	—	—	—	—	265
Palestine[b/]	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Qatar	E —	A —	—	—	—	—	—	—	—	—	—	—	—	397
Saudi Arabia	0	0	0	0	0	—	—	—	—	—	—	—	—	3 005
Somalia	100	96,3	94,8	67	27,8	—	—	—	—	—	—	—	—	89
Sudan	73,3	81,6	66,6	43,3	20,8	2,5	—	—	—	—	—	69,3	49	437
Tunisia	14,5	14,2	14,6	13,9	0,4	0,1	—	0,1	—	—	—	3,2	1,2	291
United Arab Emirates	—	0,1	0,1	—	0,1	—	—	—	—	—	—	0	—	1 799
Yemen	2,1	1,2	1	—	1	—	—	—	—	—	—	—	—	211

Source: IEA and the World, 2014

a/ TFEC: Total Final Energy Consumption

b/ Palestine is referred to in the report as West Bank & Gaza

Nevertheless, in some areas, Arab nations are leading the development of RE technologies. Saudi Arabia, already a global leader in water desalination is currently building one of the first fully integrated solar power and water supply plants. It should also be noted that, in many zones with large solar energy potentials, the environmental conditions remain very difficult for renewable energy sources. Air borne dust and sand, and fouling of solar collector surfaces limit significantly the available solar insolation in the region and mandate special cleaning technologies that needs to be developed to replace costly on-going cleaning of solar

collectors. Year around high ambient temperatures in many such countries also require adapted solar technologies whose performance does not deteriorate at high ambient temperatures.

4. A very poor performance in terms of energy productivity and significant, largely untapped, potential of energy resources that can be released through energy efficiency

Energy efficiency offers the largest scale economic means for tackling the different issues of unsustainable energy production and use in the region. Achieving this substantial potential will require a full range of price and policy measures: energy price reforms, improvement / replacement of existing power plants, a significant effort on demand side and end-use productivity, and addressing energy availability constraints. The outcomes cover a range of results including, improved micro and macroeconomic productivity, more competitive products, more effective transportation, and better health from more comfortable living spaces, and improved environmental impacts.

The SE4All Global Tracking Framework report shows that despite the very important potential of energy efficiency in the Arab region, the region is the only one in the world where energy-GDP intensity has deteriorated. In fact, Western Asia, which is essentially composed of the Arab countries located in the Gulf and the Middle East, is the only region in the world to show a substantial deterioration in energy – GDP intensity, particularly in the past decade. Northern Africa is among the two slowest-performing regions based on the rate of energy intensity improvement. Table 3-6 presents the findings of the Global Tracking Framework on a regional level, and Table 3-7 presents those findings on a country by country level.

The Global Tracking Framework approach uses the compound annual growth rate (CAGR) of energy intensity as an indicator for evaluating the progress in energy efficiency at the national level. "*Energy intensity is measured as the ratio of total primary energy supply to the value-added of the economy measured in terms of purchasing power parity to ensure a fairer comparison of energy intensity across developed and developing countries*"[107].

Aggregate energy intensity has generally been used as a proxy for energy efficiency, although energy intensity is not a good proxy for energy efficiency, because this indicator does not discern between changes in aggregate changes in energy intensity (a proxy for efficiency of energy use, or by shifts in the components that produce aggregate GDP (the denominator of the indicator which reflects the structural mix and size of economic activities. Economic structure doesn't shift quickly from energy intensive to non-energy intensive type of activities. Only when structural mix and fuel mix changes are accounted for, can energy efficiency be said to be identified. Other factors may also affect energy intensity, such as demographic variations, weather deviations from normal records, switches in fuel-use, and acceleration or slowdown in the overall level of economic activities.

Aggregate energy intensity has generally been used as a proxy for energy efficiency, although energy intensity is not a good proxy for energy efficiency, because this indicator does not discern between efficiency changes in the use of energy and changes in the components that produce aggregate GDP (the denominator of the indicator) which reflects the structural mix and size of economic activities, as well as the fluctuation in oil revenues for the NPEE countries. Only when structural mix and fuel mix changes are accounted for, can energy efficiency be identified. Other factors may also affect energy intensity, such as demographic variations, weather deviations from normal records, switches in fuel-use, and acceleration or slowdown in the overall level of economic activities.

In order to take into account such considerations, the Global Tracking Framework proposed an approach where the reported energy intensities are completed by "*a decomposition exercise of changes in final energy consumption that distinguishes between activity, structure, and underlying efficiency effects*" and to "*give a more nuanced picture of energy efficiency trends, the headline indicators are complemented with indicators*

[107] IEA and the World Bank, 2014

of the energy intensity of three end-use sectors; agriculture, industry, and 'other sectors'[108] *and two energy supply sectors; electricity and gas, along with the specific energy consumption of selected energy-intensive products*".

Other aspects that need to be taken into consideration when using energy intensity figures as an indicator for energy performance, as pointed out in a recent study conducted by RCREEE in thirteen Arab countries on energy efficiency indicators[109], are the following facts related to the energy situation in Arab countries:

- National official statistics do not reflect the informal energy market, which can result in showing lower energy intensities than the actual figures. Indeed, biomass, which represents a substantial portion of rural household energy consumption, particularly in Egypt, Iraq, Yemen and Morocco, is very often not included or inaccurately estimated, in national energy balances.

- Informal trade and cross-border smuggling of petroleum products in the region, is not reflected in national official statistics, and will make energy intensities look lower or higher than the actual figures (especially for the road transportation figures), depending on the course that the smuggling takes. In fact, significant illegal trade of petroleum products took place or is still taking place from Syria to Lebanon and Jordan, Iraq to Jordan, Saudi Arabia to Jordan, UAE and Yemen, Algeria to Morocco and Tunisia, Libya to Tunisia, and Egypt to Palestine.

- Suppressed energy demand that is, or has been, prevailing in many Arab countries, which is in part due to the lack of adequate energy access as in Yemen, Sudan and Palestine, but also due to the low levels of energy services in households in many Arab countries. This is especially true with electrical appliances and air conditioning equipment, as in Yemen, Sudan and Palestine and even Egypt and Morocco, and to a lesser extent other Arab countries. Many countries are still building up their stocks of appliances, as an example, 78 percent of the existing stock of 1.6 million room air conditioning units in Tunisia was installed during the last five years (2009 - 2014)[110].

TABLE 3-6: EVOLUTION OF ENERGY INTENSITY IN THE ARAB REGION FROM 1990 TO 2010, COMPARED TO OTHER GROUPS OF COUNTRIES

Energy Efficiency	**Rate of primary energy intensity improvement, CAGR (%)**[a/]			**Level of primary energy intensity, (MJ/$2005 PPP)**		**Rate of final energy intensity improvement, CAGR (%)**[a/]	**Final to primary energy ratio**		**Cumulative energy savings (PJ)**
Region	**1990–2000**	**2000–2010**	**1990–2010**	**1990**	**2010**	**1990–2010**	**1990**	**2010**	**1990–2010**
Northern Africa	–0.18	0,07	–0.06	6,4	6,4	0,2	64	67,4	–2,093
Western Asia	0,55	1	0,77	7,1	8,3	0,42	67,1	62,6	–10,469
WORLD	–1.61	–0.99	–1.30	10	7,7	–1.53	71,7	68	2 275 646
Upper middle income (World)	–2.59	–1.13	–1.86	14,1	9,7	–2.47	72,5	64,1	1 462 534

Source: IEA and the World Bank, 2014
a/CAGR: Compound Annual Growth Rate

[108] Other energy sectors include residential, services and transportation
[109] RCREEE, 2015c
[110] El Hanchi, 2015

TABLE 3-7: EVOLUTION OF ENERGY INTENSITY IN ARAB COUNTRIES FROM 1990 TO 2010

Energy Efficiency	Rate of primary energy intensity improvement, CAGR (%)[a/]			Level of primary energy intensity, (MJ/$2005 PPP)		Rate of final energy intensity improvement, CAGR (%)[a/]	Final to primary energy ratio		Cumulative energy savings (PJ)
Region	**1990–2000**	**2000–2010**	**1990–2010**	**1990**	**2010**	**1990–2010**	**1990**	**2010**	**1990–2010**
Algeria	**0,3**	**0,34**	**0,32**	5,9	6,3	1,1	57,4	67	**–909**
Bahrain	–2.38	–0.64	–1.51	20,6	15,2	–1.51	54,5	54,6	1 535
Djibouti	2,81	–0.26	1,26	5,2	6,7	4,03	—	—	**–42**
Egypt	–1.89	1,16	–0.38	7,4	6,8	–0.61	70,8	67,6	1 860
Iraq	–10.76	4,8	–3.29	30,2	15,5	–4.81	75,7	55,2	23 829
Jordan	–1.04	–2.16	–1.60	13,1	9,5	–2.13	71,1	64	714
Kuwait	**5,46**	**0,57**	**2,99**	6,2	11,2	2,56	43,4	39,9	**–5,800**
Lebanon	2,78	–2.26	0,23	4,8	5,1	0,46	58,2	61	**–598**
Libya	3,1	–2.82	0,09	7,7	7,9	0,92	48,5	57,1	**–2,712**
Mauritania	–7.19	–0.35	–3.83	20,3	9,3	–1.77	—	—	839
Morocco	1,56	–0.04	0,76	4,3	5	1,01	71,9	75,6	**–1,076**
Oman	**2,01**	**4,53**	**3,26**	6,4	12,3	2,53	44,5	38,6	**–2,035**
Palestine[b/]	—	—	—	—	—	—	—	—	—
Qatar	3,79	–0.99	1,37	7,9	10,3	1,25	54,1	52,8	**–3,106**
Saudi Arabia	**2,63**	**1,9**	**2,27**	8	12,6	2,45	60,1	62,2	**–27,204**
Sudan	–3.28	–4.12	–3.70	16,3	7,7	–3.00	57,1	66,1	5 749
Somalia	—	—	—	—	—	—	—	—	—
Tunisia	–0.70	–1.57	–1.14	5,6	4,5	–1.11	73,6	74,1	744
United Arab Emirates	**0,53**	**1,89**	**1,21**	6,4	8,2	0,77	79,3	72,7	**–3,685**
Yemen	0,84	–0.05	0,39	4,9	5,3	0,41	72,1	72,2	**–470**

Source: IEA and the World Bank, 2014

a/ CAGR: Compound Annual Growth Rate

b/ Palestine is referred to in the report as West Bank & Gaza

On a country by country level, and according to the Global Tracking Framework, four Arab countries; Algeria, Egypt, Saudi Arabia and United Arab Emirates are among the 40 largest energy consuming countries in the world. But none of the Arab countries are among the 20 countries that experienced the most rapid improvement in energy intensity over the 20 years between 1990 and 2010, even though many of these countries started from relatively high levels of energy intensity in 1990. On the contrary, as can be seen in Table 3-7, most Arab countries recorded negative energy intensity trends reflecting the deterioration in the energy intensity of these countries.

As a result of this, many Arab countries, with a combination of relatively high energy demand and relatively high energy intensity, have the highest opportunities in terms of improving their domestic energy performances. According to the Global Tracking Framework, Saudi Arabia is among the 20 largest energy consuming countries in the world that have the most important opportunities.

It can also be noted that figures in Table 3-7 also reveal that many Arab countries are showing some improvements in the trends of energy intensity during the latest of the two decades, which may indicate that these countries are realizing this deteriorated situation and starting to take some corrective measures.

Another approach for assessing aggregate energy performance is to look at the evolution of both energy consumption and GDP, and examine the relationship of their growth rates over time. If the economic growth rate is higher than the growth rate of energy consumption, then economic growth is considered to be decoupled from energy consumption and the wider the gap between the two rates, the less energy intensive the economy is becoming. On the other hand, if the economic growth rate is lower than the growth rate of energy consumption, than economic growth is considered to be coupled to energy consumption, and the wider the gap between the two rates, the more energy intensive the economy is becoming. The intersection of the two curves indicates the point of transition from a situation of coupled economic growth and energy consumption to a decoupled one (or vice-versa).

The following graphs show the evolution of the Total Primary Energy Supply (TPES) and GDP. Both, GDPs at constant USD2005 and USD2005 using Purchasing Power Parity (PPP) were examined for the Arab region, the NPEE and NPEI, as well as for selected countries from the two sub-regions. Graphs for the world Total, OECD and Non-OECD groups of countries are also provided for comparison.

GDP at Purchasing Power Parity (PPP) gives a theoretical approximation of the relative effective domestic purchasing power of the average producer or consumer within an economy. Thus the GDP at PPP can provide a better indicator of the total national wealth and effective value of the GDP in terms of living standards, especially in developing countries, since it compensates for the eventual distortions associated with the exchange rates of local currencies in the international markets.

The curves provide the evolution of Total Primary Energy Supply (TPES) from 1980 to 2012, as well as GDP at constant USD2005 and USD2005ppp using Purchasing Power Parity. The curves use the 1980' values as reference values, and plot the ratios of each subsequent year's values to these reference values. The following figures indicate that:

- For the Arab countries as a group, the gap between economic growth, both at constant USD2005 and constant USD2005ppp, keeps getting wider until the year 2012, indicating that more energy is consumed by the region every year than the corresponding produced wealth (i.e. intensity is getting worse, see Figure 3-2). Results shown in Figure 3-3 indicates that this is in total contrast to the trends that can be observed for the entire world, where starting from 1984 lesser primary energy was needed per unit of created wealth (GDP). The OECD group of countries even managed a reduction of its primary energy supply in 2009, while roughly maintaining it at that level ever since and keeping a positive growth for GDP. Furthermore, figures for the non-OECD group of countries show that these countries, as a group, managed to decouple their economic growth from their primary energy supply since 1994, and from that date are using lesser primary energy per unit of produced wealth (GDP).

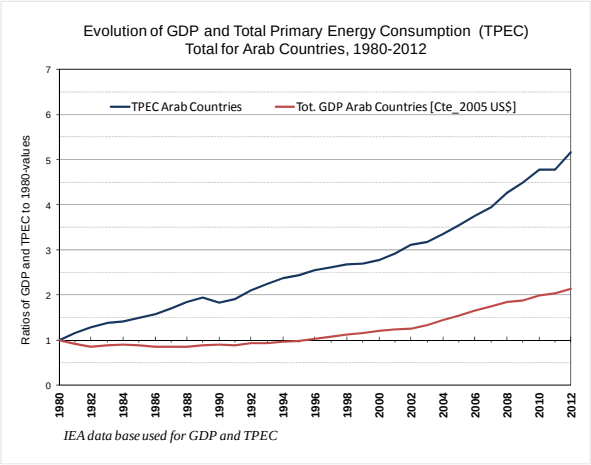
- Similar trends to those observed for the Arab countries as a group, but even more accentuated, are recorded for the group of Net Primary Energy Exporting (NPEE) countries (Figure 3-2). These trends are even more critical for two of the countries belonging to this group, namely Saudi Arabia and the United Arab Emirates, where the total primary energy supply is growing at a much faster rate than GDP. The situation is less critical in a third country belonging to the same group, namely Algeria (Figure 3-4).

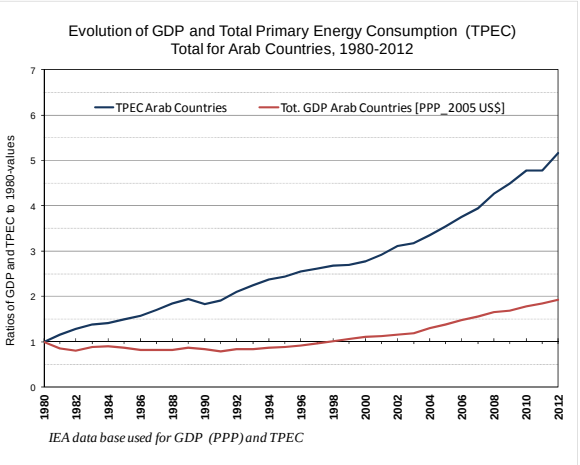
- The trends observed for the group of Net Primary Energy Importing (NPEI) countries are much less critical, although, as for the Arab region as a group, more primary energy has been consumed by the NPEI group of countries every year than the corresponding produced wealth (Figure 3-1). However, since 2010, this group seems to stabilize its primary energy supply to have similar growth rates as its production of wealth as reflected in the GDP. Yet, some countries belonging to this group continue to have trends that are more critical than the entire group, as is the case for both Egypt and Jordan. Only one country managed to decouple its economic growth from its Primary Energy Supply around the year 2000, namely Tunisia, and since that date is using lesser primary energy per unit of produced wealth (GDP).

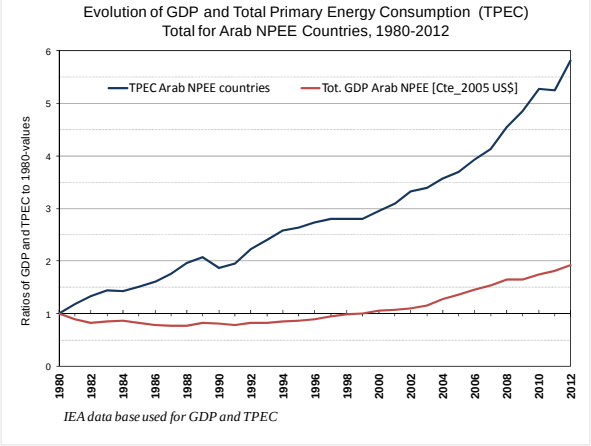
These trends observed in the Arab countries are in perfect alignment with the findings reported in the SE4All Global Tracking Framework report that were discussed previously.

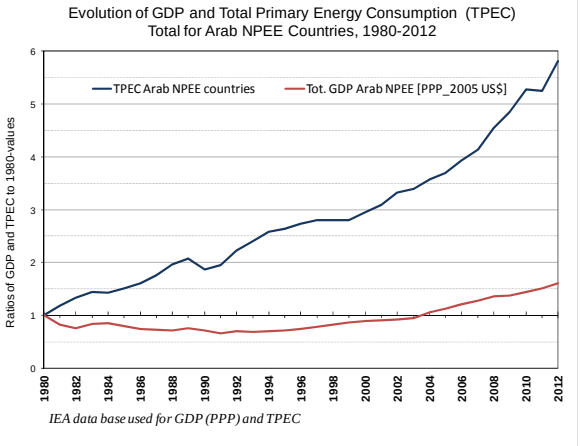
Figure 3-2 Comparison of annual evolution of GDP and Total Primary Energy Supply (TPES)
Arab countries and NPEE & NPEI groups of countries

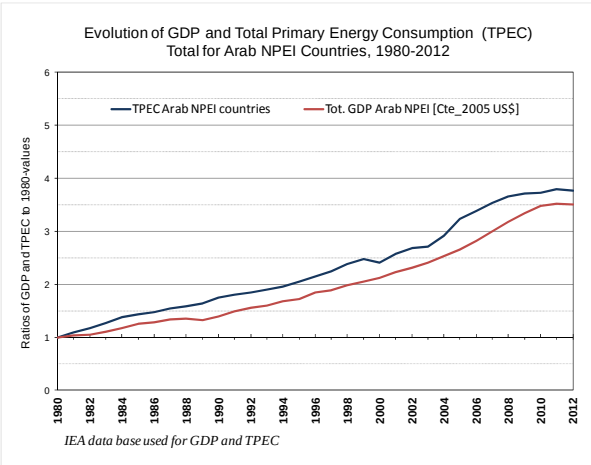
Datasets from IEA data base for 1980-2012
(Both, GDPs as 2005 USD and 2005-USD using PPPs, were examined)











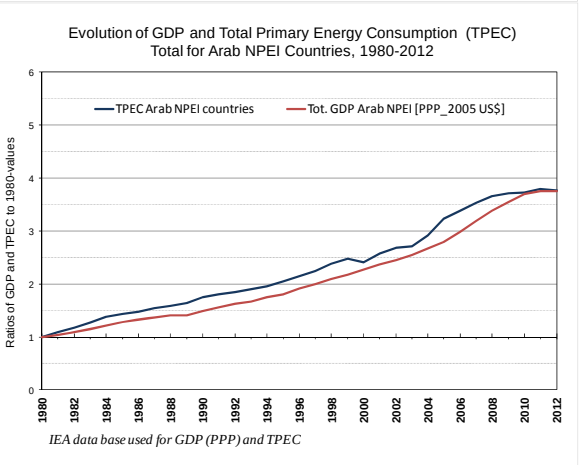
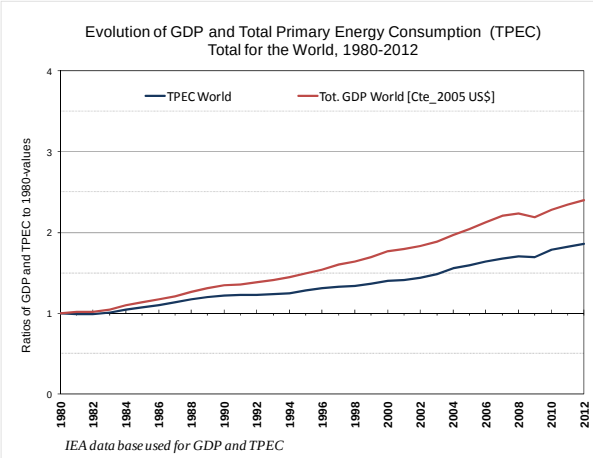
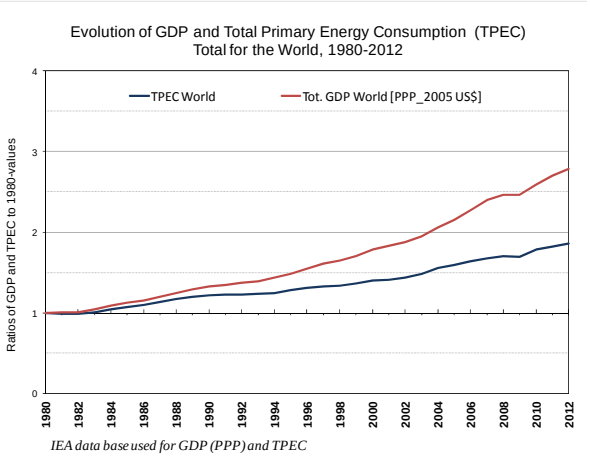
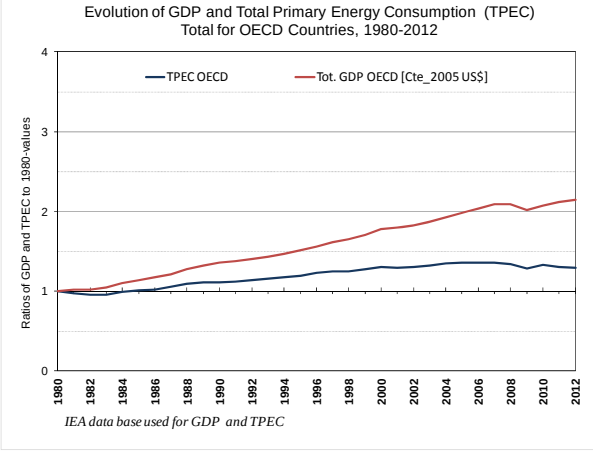


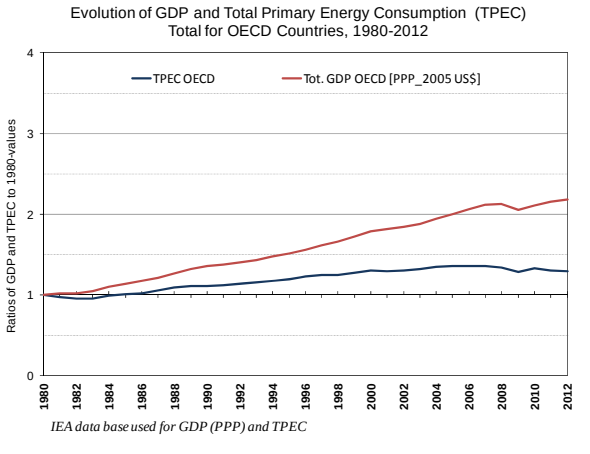
Figure 3-3 Comparison of annual evolution of GDP and Total Primary Energy Supply (TPES)
World, OECD and Non-OECD countries

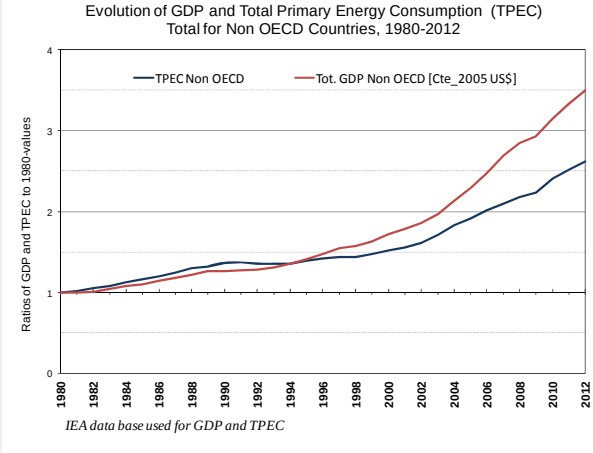
Datasets from IEA data base for 1980-2012
(Both, GDPs as 2005 USD and 2005-USD using PPPs, were examined)











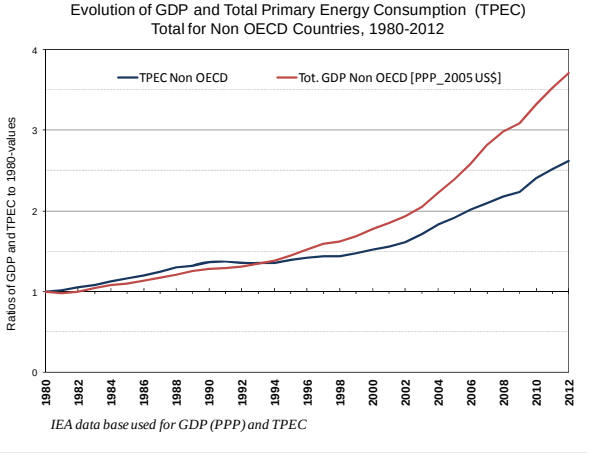
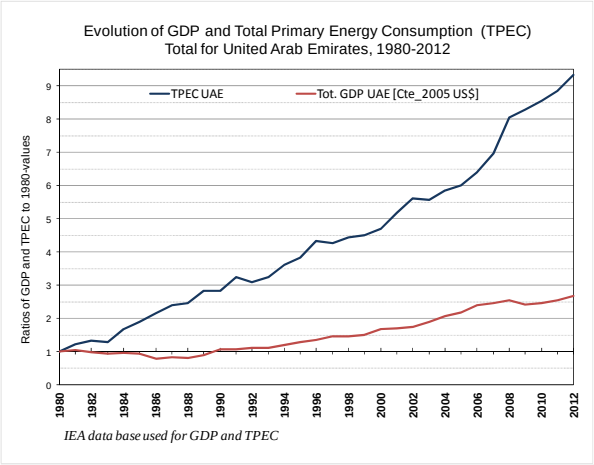
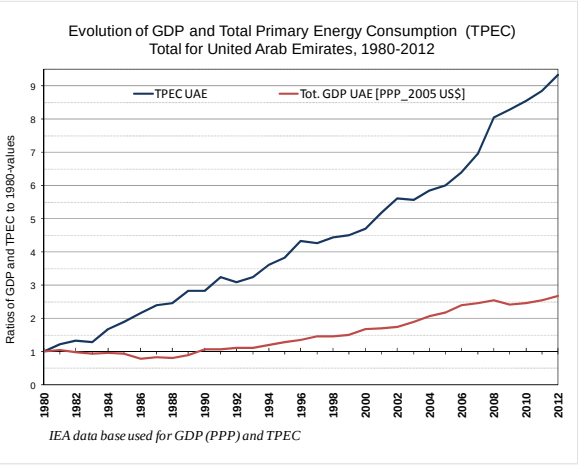
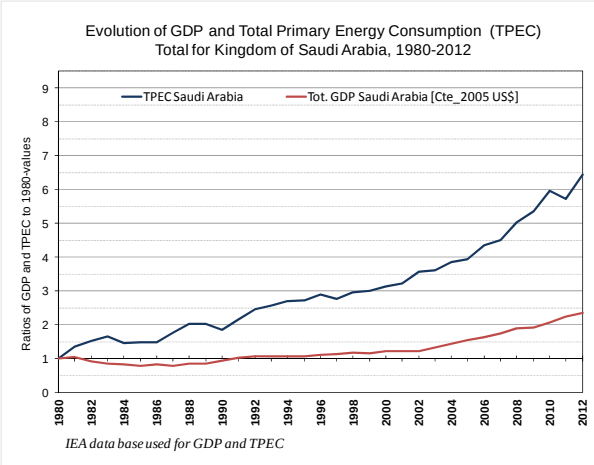


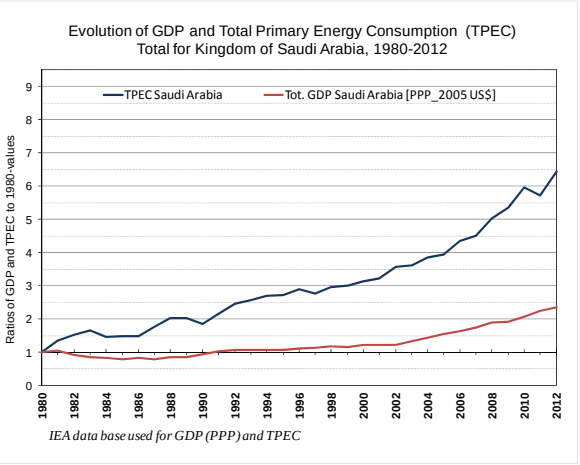
Figure 3-4 Comparison of evolution of GDP and Total Primary Energy Supply (TPES)
Selected Arab NPEE countries (UAE, Saudi Arabia and Algeria)

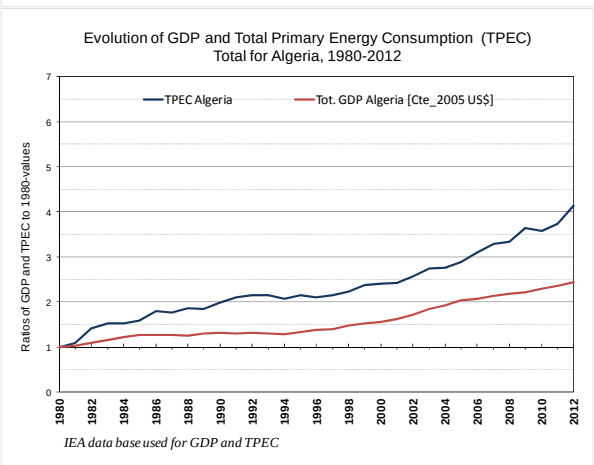
Datasets from IEA data base for 1980-2012
(Both, GDPs as 2005 USD and 2005-USD using PPPs, were examined)











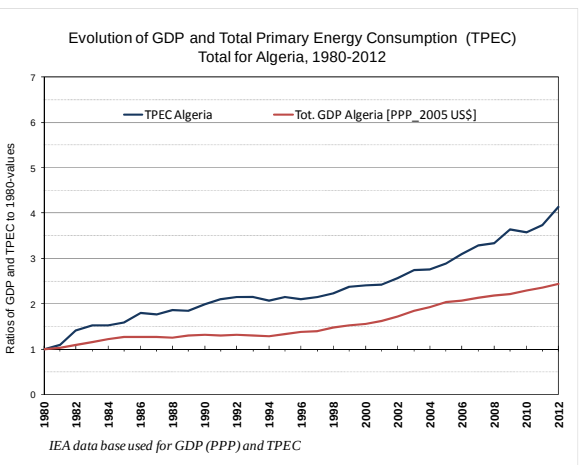
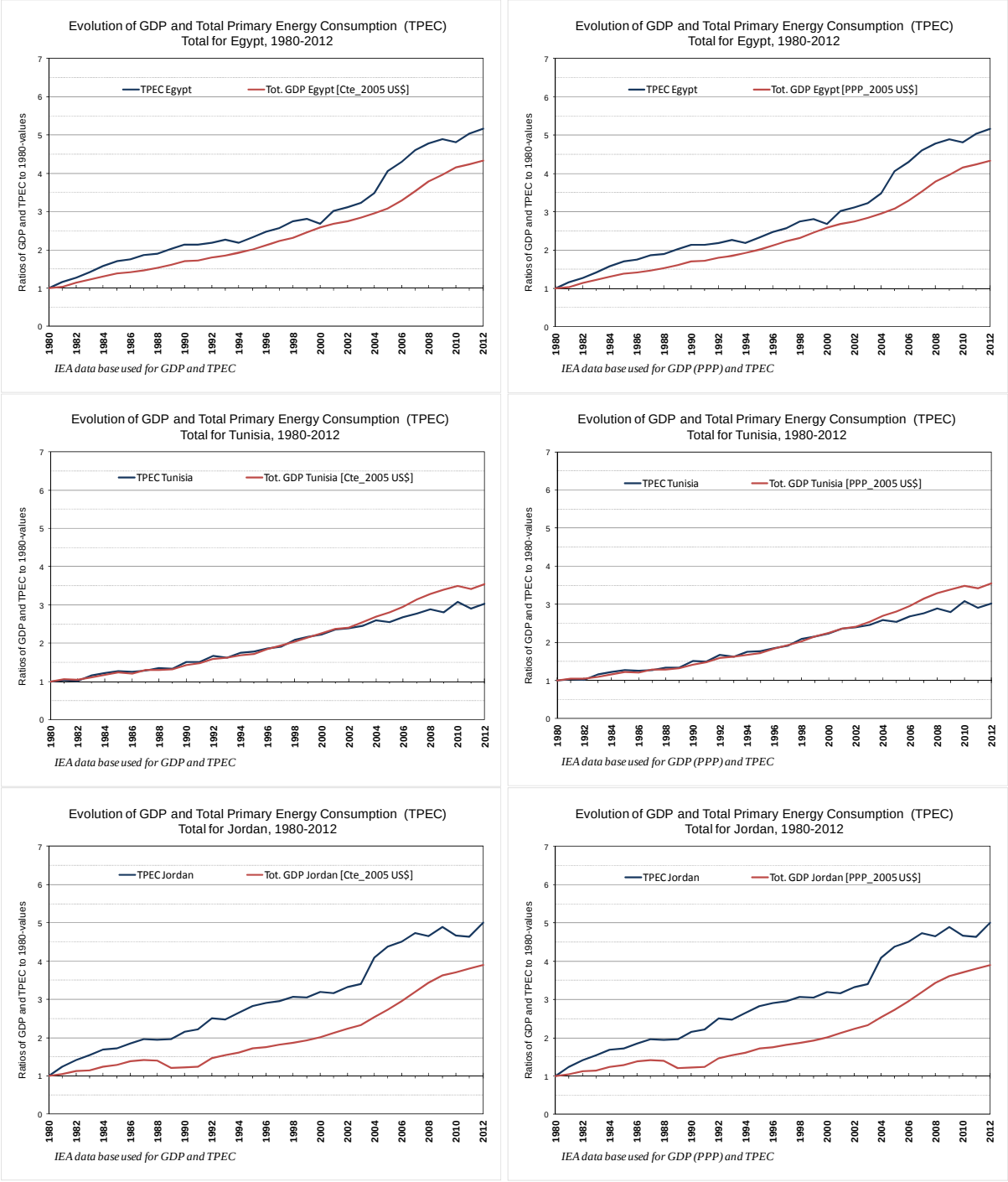


Figure 3-5 Comparison of evolution of GDP and Total Primary Energy Supply (TPES)
Selected Arab NPEI countries (Egypt, Tunisia and Jordan)

Datasets from IEA data base for 1980-2012
(Both, GDPs as 2005 USD and 2005-USD using PPPs, were examined)



Box 1: Energy productivity versus energy intensity

Many energy economists[111] are proposing to use Energy Productivity, rather than Energy Intensity, for assessing improvements in Energy Efficiency and setting up energy policy aims concerning energy demand abatements. Energy productivity is defined as the amount of economic output for a given level of energy supply, it is the mathematical reciprocal of Energy Intensity; i.e. it is defined as [GDP/Energy Supply]. Therefore, both indicators use the same components and have the same energy policy relevant features.

Nevertheless, Patrick Bean[112] and a McKinsey report on Energy Productivity[113], argue that the differences between the two indicators go beyond semantics. These documents claim that energy productivity has a more positive connotation since it focuses on valuing the additional output obtained from improving energy efficiency, rather than the shrinking of energy demand, therefore portraying grander ambitions. In fact, for setting up energy policy aims, energy productivity suggests more tangible goals, that are in line with the principles of behavioral economics. They also argue that energy productivity is more coherent, more intuitive and better mimic energy efficiency essence since, unlike energy intensity, it looks at the amount of economic output resulting from the energy input to an economic sector or the whole economy. In fact, this indicator is the economic equivalent of the technological energy efficiency, which also evaluates the useful output of an equipment or a process with respect to its energy input. Moreover, having the GDP, i.e. the economic output, in the numerator brings a theoretical coherence to this energy efficiency proxy.

Furthermore, the mathematical expression of energy intensity does not allow straightforward comparisons of relative changes across time and countries. Indeed, at low levels of energy intensity, the figures appear to converge towards an asymptotic mean that can, in the long run, infer an illusion of equivalent energy performance between countries. It can also indicate a better performance with respect to the base year in relative, and absolute, terms for countries that initially started from a less energy performing situation than those that initially started from a better situation, when in reality the later produced better societal and economic results. Patrick Bean[114], who refers to this singularity as the "*energy intensity illusion*", cites the case of China and Japan as an example for such a distortion. "*Between 1980 and 2011, China's energy intensity fell 90 percent, from 2.41 to 0.24 toe/thousand dollars (international, PPP), while Japan's fell 71 percent, from 0.35 to 0.11 toe/thousand dollars (international, PPP)*". However, the incremental in energy productivity for Japan for the same period was 6,480 *dollars (international, PPP)/toe* when that of China, was only 3,750 *dollars (international, PPP)/toe.* This shows "*that the gaps in performance between countries are larger than energy intensity values might suggest, leaving more room to create additional value from energy usage to the benefit of society*".

In fact, the mathematical expression of energy productivity does not induce this kind of asymptotic illusion and does not suggest ambiguous conclusions. On the contrary, it provides additional insights and stands as a more directly relevant measure of a country's economy, energy, and environmental performance.

Finally, the energy productivity indicator can provide a first order insight into the weight of the energy bill on the economy, or sector, by comparing its values to that of the cost of energy.

Table 3-8 shows the annual evolution rates (percent) of Energy productivity for the Arab region. Both, Primary Energy Productivity at constant USD2005 and Primary Energy Productivity at constant USD2005 using Purchasing Power Parity (PPP) were considered. Other energy policy drivers and indicators are also

[111] Bean, 2014
[112] ibid
[113] McKinsey Global Institute, 2008
[114] Bean, 2014

provided, including annual evolution rates (percent) of population, GDP at constant 2005 USD, GDP at constant 2005 USD per Capita, GDP at constant USD2005 using Purchasing Power Parity (PPP), GDP at constant 2005 USD PPP per Capita, Total Primary Energy Supply (TPES) and Total Primary Energy Supply (TPES) per Capita. These figures were calculated for the Arab region as a group, and the NPEE and NPEI groups of Arab countries.

The annual evolution was evaluated for each of the three decades of 1980-1990, 1990-2000 and 1990-2010 and the following observations can be made based on the calculated figures:

- For the Arab countries as a group, the energy productivity, whether based on GDP at constant 2005 USD or constant USD2005ppp using PPP, kept decreasing since 1980. Overall, these indicators respectively fell from 6,049 [USD2005]/toe in 1980, to 2,509 [USD2005]/toe in 2012 and from 20,000 [USD2005PPP]/toe (1980) to 7,442[USD2005PPP]/toe (2012). The first decade was the worst decade with a decreasing rate of -7 percent (constant 2005 USD) and -7.6 percent (constant 2005 USD using PPP). The second decade witnessed a net slowdown in the rate of decay of energy productivity to -1.1 percent and -1.4 percent respectively, and the third decade witnessed a stabilization of the energy productivity with a decrease of only -0.5 percent and -0.6 percent respectively. These figures confirm that aggregate energy productivity in the Arab region, as a whole, has been on the decline since 1980, and it only started to significantly slow down this decaying trend during the last decade.

  The population growth rate was 2.9 percent during the first decade, and then it stabilized at 2.3 percent during the following decades. The GDP decreased during the first decade at an annual rate of -1.2 percent (constant 2005 USD) and -1.8 percent (constant 2005 USD using PPP), then increased at a rate of 3.1 percent and 2.8 percent respectively during the second decade, and kept increasing at a rate of 5.1 percent and 4.9 percent respectively during the third decade. Primary Energy Supply increased at an annual rate of 6.2 percent during the first decade, 4.2 percent during the second decade and 5.6 percent during the third decade, a rate that is getting closer to that of the growth rate of the GDP.

- For the group of Net Primary Energy Exporting (NPEE) countries, the energy productivity, whether based on GDP at constant USD2005 or constant USD2005 using PPP, also kept decreasing since 1980. Overall, these indicators respectively fell from 7,735 [USD2005]/toe in 1980 to 2,562 [USD2005]/toe in 2012 and from 25,200 USD2005PPP/toe (1980) to 6,939 USD2005PPP/toe (2012). The first decade was, as well, the worst decade with a decreasing rate of -8 percent (constant 2005 USD) and -9.1 percent (constant USD2005 using PPP). The second decade witnessed a net slowdown in the rate of decay of energy productivity to -1.9 percent and -2.3 percent respectively, and an even slower decay of the energy productivity was recorded during the third decade with a decrease of only -0.8 percent and -1 percent respectively. These figures .confirm that energy productivity in the group of Net Primary Energy Exporting (NPEE) countries has been on the decline since 1980 at rates that are worse than those of the Arab region as a whole, and this decaying trend only started to significantly slow down during the last decade.

  The population growth rate was at 3.6 percent during the first decade, and then it stabilized at 2.6 and 2.8 percent during the second and third decades respectively. The GDP decreased during the first decade at an annual rate of -2.1 percent (constant 2005 USD) and -3.2 percent (constant 2005 USD using PPP), then increased at a rate of 2.7 percent and 2.2 percent respectively during the second decade, and kept increasing at a rate of 5.1 percent and 4.9 percent respectively during the third decade. Primary Energy Supply increased at an annual rate of 6.5 percent during the first decade, 4.7 percent during the second decade and 6.0 percent during the third decade, at rates that were always higher than that of the GDP growth rates.

  It is important to note that for this group of countries, the growth rate of the GDP during the three decades was closely aligned with the trends of the international average price of crude oil (Figure 3-

1). Indeed, their revenues, still in 2013, heavily relied on export of petroleum products; representing about 35 percent of GDP and higher than 82 percent of public revenues (Table 1-2 of Chapter I). This situation induces a certain volatility in their energy productivity that drastically appears when oil revenues are going down, as was observed in the first decade (1980-1990). This was further aggravated by the unceasingly increasing Primary Energy Supply, also reflected in the continuously increasing per capita energy consumption throughout the three decades; 2.8 percent, 2 percent and 3.1 percent respectively.

- For the group of Net Primary Energy Importing (NPEI) countries, the energy productivity, whether based on GDP at constant USD2005 or constant USD2005 using PPP, was decreasing during the first decade (1980-1990), at a rate of -2.2 percent (constant USD2005) and -1.6 percent (constant USD2005 using PPP). This decreasing rate is a much milder rate than the one relative to the NPEE countries. Then energy productivity took a slightly positive trend during the second decade with a growth rate of +1.0 percent and +1.1 percent respectively, then a slower growth rate at +0.5 percent was recorded during the third decade, when using either of the GDPs basis (constant USD2005 or constant USD2005 using PPP). Overall, these indicators respectively fell from 2,520 [USD2005]/toe in 1980 to 2,340 USD2005/toe in 2012 and from 9,115 USD2005PPP/toe (1980) to 9,064 USD2005_PPP/toe (2012). These figures are in total contrast with those relevant to the NPEE group of countries. Even though Primary Energy Supply kept increasing during the three decades at a pace close to that of the NPEE group of countries (5.8 percent during the first decade, 3.2 percent during the second decade and 4.5 percent during the third decade).

  The population growth rate was at 2.5 percent during the first decade, and then it stabilized at 2.1 and 1.9 during the second and third decades respectively. The GDP kept increasing since 1980, at continuously increasing rates, 3.4 percent, 4.3 percent and 5.1 percent (constant 2005 USD) and 4.0 percent, 4.3 percent and 5.0 percent (constant 2005 USD using PPP), respectively, for the 3 consecutive decades. Primary Energy Supply also kept increasing during the three decades at, respectively, an annual rate of 5.8 percent, 3.2 percent, and 4.5 percent. Only the first decade had a primary energy growth rate higher than that of the GDP.

  It should also be noted that this group of countries, whose revenues are not associated with the export of petroleum products, did not have the same volatility in their energy productivity. Furthermore, the growth rate of the per capita energy consumption throughout the three decades; 3.1 percent, 1.1 percent and 2.6 percent respectively, but they were only higher than the GDP/capita during the first decade.

The examination of these different indicators provides a first order insight of the energy situation of the region resulting from the implementation of the different energy policies that were retained in the different Arab countries during the past three decades. It also provides some preliminary indications on where energy policies failed or did not properly address the energy situation in the respective countries.

It is clear that energy policies that were implemented during the last three decades did not contribute to improve the energy productivity in the region. On the contrary, these energy policies, or their absence, contributed to the net decline of energy productivity in the NPEE countries of the region, and at best its stagnation in the NPEI countries. Nevertheless, corrective measures have started to be put in place and seem to be producing some results during the last decade, which are reflected in the significant slowdown of the decline of energy productivity during this decade. But, the productivity gap is so important, and much more efforts are needed to reverse the current trends. These aspects will be further discussed in the next section.

TABLE 3-8: ANNUAL EVOLUTION RATES (PERCENT) OF ENERGY PRODUCTIVITY AND OTHER ENERGY POLICY INDICATORS IN THE ARAB REGION DURING THE LAST THREE DECADES

Decades		1980-90	1990-2000	2000-2010
All Arab Countries	Population	2.9 %	2.3 %	2.3 %
	GDP at 2005 USD	-1.2 %	3.1 %	5.1 %
	GDP / Capita	-4.0 %	0.8 %	2.8 %
	GDP at PPP as 2005 USD	-1.8 %	2.8 %	4.9 %
	GDP_ PPP / Capita	-4.6 %	0.5 %	2.6 %
	Primary Energy	6.2 %	4.2 %	5.6 %
	Primary Energy / Capita	3.2 %	1.9 %	3.2 %
	P. Energy Productivity_Cte.USD (based on USD 2005)	-7.0 %	-1.1 %	-0.5 %
	P. Energy Productivity_PPP (based on PPP)	-7.6 %	-1.4 %	-0.6 %
Arab NPEE Countries	Population	3.6 %	2.6 %	2.8 %
	GDP at 2005 USD	-2.1 %	2.7 %	5.1 %
	GDP / Capita	-5.5 %	0.1 %	2.2 %
	GDP at PPP as 2005 USD	-3.2 %	2.2 %	4.9 %
	GDP_ PPP / Capita	-6.6 %	-0.4 %	2.0 %
	Primary Energy	6.5 %	4.7 %	6.0 %
	Primary Energy / Capita	2.8 %	2.0 %	3.1 %
	P. Energy Productivity_Cte.USD (based on USD 2005)	-8.0 %	-1.9 %	-0.8 %
	P. Energy Productivity_PPP (based on PPP)	-9.1 %	-2.3 %	-1.0 %
Arab NPEI Countries	Population	2.5 %	2.1 %	1.9 %
	GDP at 2005 USD	3.4 %	4.3	5.1
	GDP / Capita	0.8 %	2.2 %	3.1 %
	GDP at PPP as 2005 USD	4.0 %	4.3 %	5.0 %
	GDP_ PPP / Capita	1.5 %	2.2 %	3.1 %
	Primary Energy	5.8 %	3.2 %	4.5 %
	Primary Energy / Capita	3.1 %	1.1 %	2.6 %
	P. Energy Productivity_Cte.USD (based on USD 2005)	-2.2 %	1.0 %	0.5 %
	P. Energy Productivity_PPP (based on PPP)	-1.6 %	1.1 %	0.5 %

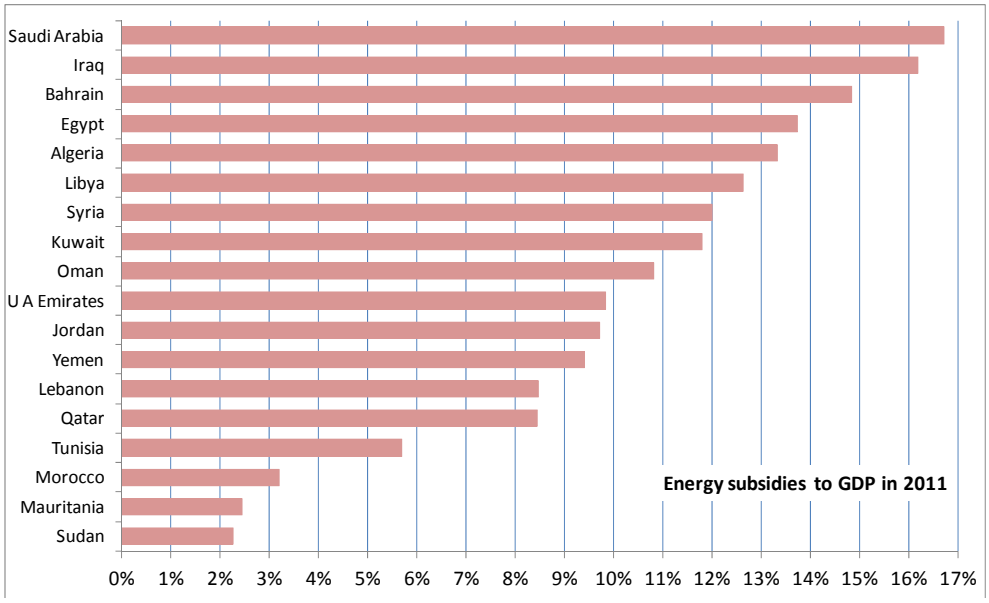
Source: ESCWA calculations based on IEA database for Energy and GDP, and UN stat for population.

5. Energy subsidies, an instrument that became counter-productive, no longer serving its initial goals

Low energy prices have been used in the Arab region as an instrument to promote social and economic development and energy access to the population by providing supply of energy products to a wide range of consumer segments at affordable prices. Low end-use energy prices, due to explicit or implicit energy subsidies, were also used to support the development of domestic industries and other economic activities (agriculture, transportation, etc.). These low energy prices are often presented as an important social benefit provided by the region's governments to insure the affordability of energy services to everyone. For the NPEE countries, low energy prices and /or explicit energy subsidies are also often considered part of an unwritten social contract, "*where governments extracted their countries' hydrocarbon riches in return for citizens' participation in sharing resource rents– through direct state transfers and social welfare benefits..., and the provision of low-cost domestic energy."*[115] However, *"Energy subsidies .... have placed huge pressure on government finances, undermining the fiscal sustainability of many of the region's lower middle-income countries."* [116]

Indeed, energy subsidies became a very pervasive and controversial fiscal policy tool, and have grown to be a very heavy burden for many Arab countries. In fact, as can be seen in Figure 3-6, energy subsidies reached in 2011 (before the recent drastic drops in oil prices) between 8.5 percent and 17 percent of the GDP of at least 14 Arab countries. And, in at least 13 Arab countries, public spending to support energy subsidies, ranging from 9 percent to more than 40 percent of government spending[117], was higher than the combined public spending on health and education.

Figure 3-6 Ratios of energy subsidies to GDP for 2011



Source: Arab Monetary Fund, 2014

Even though NPEE countries can still accommodate the fiscal pressure caused by energy subsidies, these energy pricing policies continue to provide the wrong signals to all consumers and different economic actors by maintaining the unsustainable domestic energy consumption patterns that are in place. This in turn is a threat to these countries' long term fiscal stability that heavily relies on their energy exports. As domestic energy consumption will continue to monopolize an increasing share of their energy production, it will be competing with the part destined to provide the bulk of their revenues. The need to address these issues

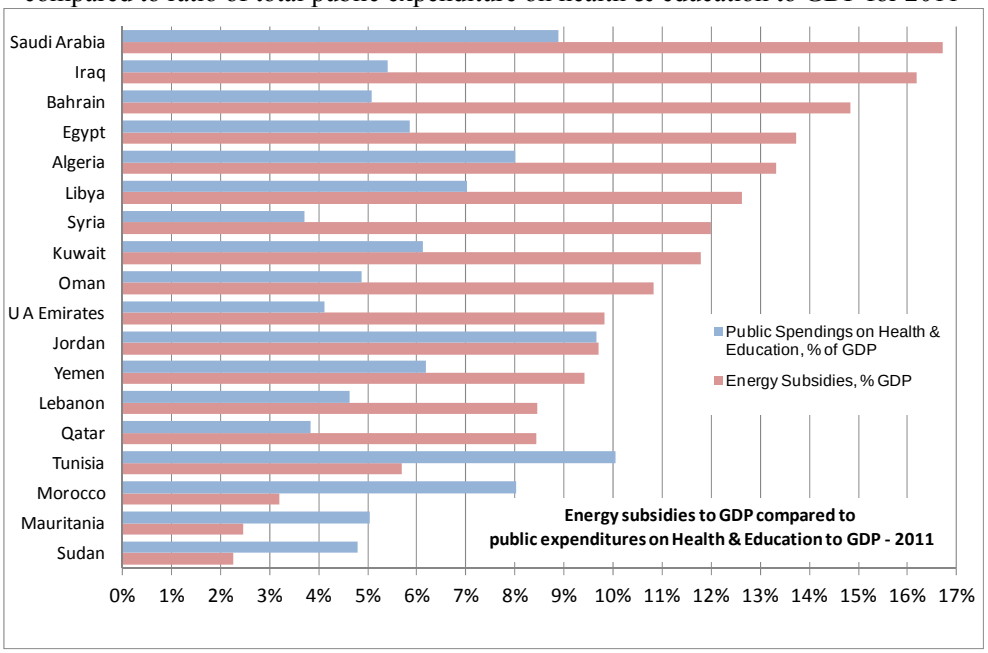
[115] El-Katiri and Fattouh, 2015
[116] ibid
[117] Estimated based on the figures reported in the previous reference and World Bank, 2015.

would become even more urgent if the recent drop in energy prices, which considerably reduced these revenues, will persist.

Furthermore, *"the actual experience of those [energy subsidy] programs showed that it had a limited effectiveness, particularly in terms of protecting vulnerable groups because those programs were mainly universal programs that lacked proper targeting of low-income groups. Moreover, those programs led to* ***economic distortions that had a negative impact on the efficiency levels of economic resources distribution*** *in Arab countries."*[118]

The public budget costs of energy subsidies have also affected the ability of many governments in the Arab region to invest in the energy sector infrastructure and in improving the quality of energy services, including fuel supply and electricity. This situation has particularly lead, in many Arab countries, to a decade long of underinvestment in electricity generation and in transmission and distribution networks, as well as a reduced capacity to "*invest in new infrastructure, or shift to modern, cleaner, and more efficient technologies. The result is often the provision of low quality services to end users, most visibly in the region's electricity sectors*"[119].

Figure 3-7 Ratios of energy subsidies to GDP
compared to ratio of total public expenditure on health & education to GDP for 2011



Source: Arab Monetary Fund, 2014 for energy subsidies and various sources for public expenditures on health & education

Finally, energy subsidies, widely defended as a social and economic development measure ensuring energy access to the neediest segments of the population, are only marginally ensuring this role. In fact, the indiscriminate schemes of energy price subsidies largely benefit the main energy consumers, such as energy intensive industries and medium to high income households. Indeed, "*In a recent study, the IMF found that the poorest quintile in Egypt, Jordan, Mauritania, Morocco, and Yemen receives only about 1–7 per cent of total diesel subsidies, while the richest quintile received subsidies of 42–77 per cent of the total. In Egypt, the poorest 40 per cent of the population receives only 3 per cent of direct gasoline subsidies, 7 per cent of natural gas subsidies, and 10 per cent of diesel subsidies*"[120].

[118] Arab Monetary Fund,2014
[119] El-Katiri and Bassam Fattouh, 2015
[120] El-Katiri and Fattouh, 2015

6. Prevailing energy systems in the Arab region rank amongst the weakest in terms of sustainability

The World Energy Council developed an indexing system[121] to provide a comparative ranking, at the global level, of the sustainability of national energy systems. The scheme highlights how a country is addressing three energy sustainability dimensions, namely energy security, energy equity and energy related environmental sustainability. These three axes are referred to as the "Energy trilemma dimensions", and a ranking index is provided for each of the three dimensions in each country, as well as a balance score reflecting how well each country is managing the trade-offs between the three dimensions.

The proposed World Energy Council indexing system defines the three dimensions as follows:

- ✓ *Energy security*: "The effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of energy providers to meet current and future demand."
- ✓ *Energy equity*: "The accessibility and affordability of energy supply across the population."
- ✓ *Environmental sustainability*: "The achievement of supply and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources."

Table 3-9 provides an extract of the 2014 Energy Trilemma index for the Arab countries, as well as some selected countries from other regions. The index ranks the countries from the best performers to the worst. A low index indicates a good ranking, and thus a good performance. As can be seen in this table, 12 out of the 16 countries, which were indexed, ranked 50th and above in the overall 2014 index. With respect to the three individual energy sustainability dimensions of the Energy Trilemma index:

- ✓ 7 Arab countries scored well in terms of energy equity, mainly due to access to affordable energy services resulting from end-user energy subsidies,
- ✓ 11 countries ranked 50th and above in terms of energy security,
- ✓ And all 16 countries ranked 50th and above in terms of environmental sustainability.

In conclusion, the scores indicate that the sustainability of the energy systems, which are in place in many countries in the Arab region, is among the weakest in the world. Furthermore, even the relatively good scores associated with energy equity are not durable, since they are associated with energy subsidies, which are becoming highly unbearable.

[121] World Energy Council, 2014

TABLE 3-9 - 2014 ENERGY TRILEMMA INDEX RANKING AND BALANCE SCORE FOR THE ARAB COUNTRIES

		Energy Security	Energy Equity	Environmental Sustainability	Overall Index-2014	Balance Score-2014
Net Primary Energy Exporting Countries (NPEEC)	Algeria	80	49	78	79	BCC
	Bahrain	40	13	126	47	ABD
	Iraq	-	-	-	-	-
	Kuwait	79	26	121	76	BCD
	Libya	73	91	108	114	CCD
	Oman	97	12	124	72	ACD
	Qatar	3	6	103	20	AAD
	Saudi Arabia	68	7	125	68	ABD
	United Arab Emirates	47	8	102	35	ABD
	Yemen	87	109	110	126	CDD
Net Primary Energy Importing Countries (NPEIC)	Djibouti	-	-	-	-	-
	Egypt	58	54	89	85	BBC
	Jordan	112	61	114	108	BDD
	Lebanon	127	123	68	123	CDD
	Mauritania	48	115	94	99	BDD
	Morocco	118	72	96	111	CCD
	Somalia	-	-	-	-	-
	Sudan	-	-	-	-	-
	Syria	64	81	117	119	BCD
	Tunisia	36	58	57	45	BBB
Selected Countries from other regions	Switzerland	22	5	1	1	AAA
	Denmark	6	47	9	5	AAB
	France	41	11	10	9	AAB
	Germany	27	42	27	11	BBB
	United States	8	1	83	12	AAC
	Japan	62	20	41	23	ABB
	Malaysia	28	21	84	26	ABC
	Brazil	29	86	19	30	ABC
	China	19	82	127	74	ACD
	South Africa	42	85	129	83	BCD

Source: World Energy Council, 2014

B. REVIEW OF RECENT ENERGY STRATEGIES AND POLICIES IN THE ARAB REGION

1. Recent energy strategies and policies trends

Despite the unsustainable energy situation prevailing in the region, the focus on the supply side continues to occupy the front stages in many Arab countries, even when considering new and renewable energy sources. The following extracts from the *mission statement* of the Bahraini Electricity and Water Authority (EWA)

best illustrates this focus on the supply side: "The Electricity and Water Authority (EWA is responsible ***for providing reliable and quality supply of electricity*** and water for sustainable development of Bahrain, ***the pillars of EWA Strategy*** supporting ***the Vision*** includes delivering a ***responsive*** and ***consistent service*** to customers, ***providing sufficient and sustainable capacity*** supporting the Kingdom of Bahrain's Economic Development". In the same statement, the demand side is only mentioned as the sixth objective, and just as a *public awareness raising* task: To "Promote ***public awareness*** for conservation of electricity and water through best possible methods and tools"[122]. However, In November 2014, the Bahrain Ministry of Electricity and Water and the United Nations Development Programme (UNDP), signed a project agreement to establish the Bahrain Unit for Sustainable Energy. "The unit started to be operational in 2015 and will be responsible for establishing strategies, policies and legislation and for promoting initiatives and investment projects that boost energy efficiency and will also widen the share of the production of energy from renewable sources"[123].

(a) Some initial steps towards more sustainable energy systems

Many Arab countries, especially those belonging to the NPEI group of countries, have recently started to put an important emphasis on shifting to more sustainable energy systems, including a demand side management approach of energy at the national level, in addition to securing a diversified mix of energy supply.

Saudi Arabia is one of the NPEE countries that recently embarked on a comprehensive demand side management programme. In 2010 the Saudi Energy Efficiency Center (SEEC) was established with a clear mandate to develop the national programme for rationalizing energy consumption in the country and improving energy efficiency across all economic sectors. The center is also in charge of developing related policies and following up their implementation with the relevant stakeholders[124]. The following mission statement of the SEEC is revealing of this new commitment; to "*Preserve the national wealth of energy resources, which consequently strengthens development and national economy, and achieves the lowest levels of possible consumption levels in comparison to the general national product and populations*". In 2012, the center, in collaboration with relevant ministries, regulatory authorities and major national companies, launched a comprehensive Saudi Energy Efficiency Program (SEEP)[125].

Another pertinent example of these national approaches based on more sustainable energy systems is the Moroccan energy strategy developed in 2009 around five main axes:

- ✓ To provide a supply of electricity through a mix of different technological options that are reliable and competitive,
- ✓ To increase the share of RE,
- ✓ *To make **EE a national priority***,
- ✓ To mobilize indigenous energy resources and,
- ✓ To promote regional integrations

The strategy was translated to a clear roadmap, including action plans and specific objectives in the short, medium and long term. This roadmap includes ambitious objectives in terms of RE contribution; 54 percent of additional capacity scheduled for 2013-2017; representing about 30 percent of present installed capacity, and 42 percent of the overall additional capacity scheduled for the 2020 horizon. It also includes **specific targets for EE deployments; 12 percent of total national energy consumption by 2020 and 15 percent by 2030**[126].

[122] http://www.mew.gov.bh/default.asp?action=category&id=10
[123] http://archives.gdnonline.com/NewsDetails.aspx?date=04/07/2015&storyid=390856
[124] Energy and Arab Cooperation, 2014b
[125] http://www.seec.gov.sa/?lang=en
[126] Energy and Arab Cooperation, 2014a

The Tunisian case is another illustration of this new focus on more sustainable energy systems, including an important proactive demand side management outlook. As previously discussed, Tunisia is the only Arab country that managed to decouple its economic growth from its energy consumption growth around the year 2000, and its economy was in 2014 using 20 percent less energy than in 2000 to produce the same amount of wealth[127]. This was partially achieved by structural changes in the country's economy that emphasized the role of the services sector and less energy intensive industries in the productive systems, but it was also largely achieved through a two decades-long efforts of rationalizing energy use in the different economic sectors.

Furthermore, in 2013 Tunisia had engaged a national debate on its energy policy, involving all stakeholders; public and private sectors, civil society, experts, representatives from the regions, etc. The debate concluded that Tunisia must fully engage in an energy transition based on a revision of the modes of production, processing and power consumption to strengthen its security of energy supply, maintain the competitiveness of its economy and protect the environment. The strategy of the energy transition is not only based on technical and economic aspects, or even behavior, but more profoundly involves the design of country's energy systems. This energy transition is based on a decentralized energy economy that involves social and political changes to replace the old centralized and pyramidal energy economy. The energy transition also emphasizes the role of energy efficiency and renewable energy as well as a more balanced national energy mix. The main objective is to reduce the energy demand by 30 percent in 2030 and to reach a share of 30 percent of RE in electricity generation in the same horizon, based on a BAU scenario.

These pioneering efforts to promote more sustainable energy systems shows that energy efficiency has the potential of drastically reversing current energy consumption trends with the least economic, social & political costs to Arab countries, without reducing energy services nor slowing down economic development efforts. And many Arab countries are starting to consider the demand side options of their domestic energy systems as a valuable alternative to only focusing on the energy supply side. However, a significant up scaling of current efforts is required in order to speed up this process, and reverse the current domestic energy consumption trends with the least costs to the regions' economies.

(b) Some initial steps towards reforming domestic energy prices and associated subsidies

Many Arab countries are becoming more aware of the socio-economic benefits of reforming domestic energy prices and associated subsidies. These benefits include a more sustainable fiscal system, freed up fiscal resources to invest in key socio-development areas such as health, education and other social programs, and overall a more efficient and equitable distribution of national resources. However, these reforms need to be accompanied by effective mitigating measures for low and middle-income households as well as some of the domestic economic players that may suffer from these reforms. Indeed, reforms of the energy subsidies in the Arab region should be tackled with utmost caution in order to avoid adverse political and economical repercussions. That is why many governments in the region are avoiding to address this pressing task.

Jordan is one of the countries that has been trying to reform domestic energy prices since 2008, but was met by a strong resistance from the population, civil society, political parties and even some members of the parliament[128]. However, in the period of 2011 to 2014, Seven Arab countries, including Jordan, Egypt, Mauritania, Morocco, Sudan, Tunisia, and Yemen, have engaged in an energy subsidy reform program. Most of these countries have included some accompanying measures to alleviate the negative social impacts of these reforms. But only four countries followed a gradual pace of adjustment. And some countries conducted a well designed and orchestrated media campaign to convince their population of the urgent need for such reforms, which helped ensuring a relatively smooth implementation process. The largest price adjustments were for fuel prices, where the increase rates reached 95-112 percent (Egypt). With Morocco even managing

[127]Agence Nationale pour la Maîtrise de l'Energie (ANME), 2014
[128] El-Katiri and Fattouh, 2015

to establish a scheme linking domestic energy prices to a regularly revised international price index.[129]. Table 3-10 presents a summary of the implementation status of the most recent subsidy reforms in Arab countries, as well as an indication of the key factors for their success. It should be noted that, Yemen, where rushed and very poorly-prepared reform efforts were conducted in 2014, shows an unfortunate example of largely failed domestic pricing reform endeavors[130].

TABLE 3-10 IMPLEMENTATION STATUS OF MOST RECENT SUBSIDY REFORMS IN ARAB COUNTRIES BASED ON KEY FACTORS FOR SUCCESS

	Preparation	Gradual Pace of Adjustment	Breadth of Reform	Consensus Building and Communications Strategy	Role of Partners	Mitigating Measures
Egypt	✔				✔	✔
Jordan	✔	✔	✔	✔	✔	✔
Mauritania	✔	✔	✔		✔	✔
Morocco	✔	✔	✔	✔	✔	✔
Sudan					✔	✔
Tunisia	✔	✔	✔	✔	✔	✔
Yemen	✔				✔	✔

Source: Sdralevich, C. and others, 2014

Finally, it should be noted that one of the most important mitigating instruments for domestic energy price reforms is the implementation of effective energy efficiency measures. These measures can substantially reduce the energy consumption at the end user level, hence reducing the amount of energy to be billed, and therefore alleviating the negative impacts of lifting energy subsidies.

2. *Energy Efficiency*

Most Arab countries started to consider energy efficiency as an essential aspect of their domestic energy strategies. However, with the exception of very few countries, most countries in the region are not effectively addressing existing EE opportunities to their full potential, with many of them setting up relatively limited EE objectives. In addition, stated EE targets are often formulated in a vague manner with no clear reference to a baseline year. Furthermore, the proposed instruments that are put forward to achieve the stated goals are in many cases not very clearly defined, nor are the monitoring and evaluation mechanisms.

Efforts to structure energy efficiency activities in the Arab region through a standardized format for national energy efficiency actions plans (NEEAP) have been undertaken by the League of Arab States (LAS), through its Energy Department, based on the "Arab Guideline for Improving Electricity Efficiency and Rationalize its Consumption at the End User"[131].

The following is a brief review of energy efficiency programmes and activities taken place in the region.

(a) Energy efficiency targets

Most of the declared targets were based on the LAS's NEEAP guideline and are focused on the power sector to reduce electricity consumption, and a majority of these targets concern the residential and commercial sectors. Table 3-11 provides a summary of energy efficiency targets that were adopted by some of the Arab countries. For many countries, however, these targets are not defined objectively and lack a clear roadmap for achieving, monitoring and evaluating them.

[129] Sdralevich, C. and others, 2014

[130] El -Katiri and Fattouh, 2015

[131] The guideline was approved by the Arab Ministerial Council for Electricity during the twenty sixth meeting of its executive bureau on 23/11/2010; resolution number 195

(b) Energy efficiency policies, regulations and standards

Many Arab countries have developed energy efficiency policies targeting the different economic sectors. Most of these policies focused on the building sector, and residential electricity consumption. Annex 2 provides a table summarizing most of the energy efficiency policies that were developed in the different Arab countries. The following is a brief description of the different types of energy efficiency policies that were developed.

i. Building energy efficiency codes

Twelve Arab countries, namely; Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Morocco, Saudi Arabia, Syria, Tunisia and UAE, have adopted either mandatory or voluntary energy efficiency building regulations (Annex 2). However, not all of these regulations and standards were developed based on whole building long term energy performance approaches, and enforcement mechanisms of these regulations and standards are in many cases not adequately designed and implemented.

In addition to minimum building energy performance, some countries require the integration of renewable energy features in the building. Jordan and UAE have mandatory requirements for solar water heaters (SWH) in new buildings. And Tunisia also requires that all new public buildings be equipped by SWH. The building regulation of Dubai further promotes renewable energy applications by requiring sourcing any additional lighting load that exceeds the specified light power density through renewable sources, such as photovoltaic systems.

ii. *Household appliances labeling and Minimum Energy Performance Standards (MEPS)*

Nine Arab countries; namely, Algeria, Egypt, Jordan, Kuwait, Qatar, Saudi Arabia, Syria, Tunisia and UAE, have adopted an energy labeling system and Minimum Energy Performance Standards (MEPS) for household appliances, mostly for refrigerators and/or air-conditioners (including 3 countries for Air conditioners only, 1 country for refrigerators only and 5 countries for both refrigerators and Air conditioners). Except for Tunisia, who started its energy labeling and MEPS programme in 2005, and have since witnessed the elimination of the least efficient equipment from the formal market and a shift in this market towards more efficient ones, most of these labeling systems and MEPS were fairly recently implemented and have yet to be monitored and evaluated. However, it should be noted that in many Arab countries, the informal market brings into the country a large share of household equipments that are not subject to any of these standards.

iii. *Efficient lighting*

Efficient lighting is one of the most cost effective energy efficiency measures and its available technologies make it one of the most simple to implement. Artificial lighting constitutes an important part of the electrical consumption in the residential and commercial sector in Arab countries. Indeed, it represents about 25 percent in Egypt, 20 percent in Jordan, 18 percent in Kuwait, 17 percent in Saudi Arabia and 14 percent in Oman. It also contributes to the peak electrical demand either through its own energy needs (it is responsible of up to 56 percent of the peak electrical demand in the residential sector in Morocco), or through its contribution to the building cooling loads, and therefore the electrical demand associated with air conditioning, especially in commercial and office buildings.

Three Arab countries adopted policies to phase out inefficient lighting technologies, namely Tunisia (2013), and Qatar and UAE (2014). Other Arab countries are making progress in that respect. Furthermore, many Arab countries have implemented, or are implementing, large-scale dissemination programmes of efficient lighting lamps and systems. Some Arab countries have also enrolled in the UNEP initiative on efficient

artificial lighting: ***en.lighten***[132]. Some policies are also being developed in some Arab countries to insure more efficient Street, and outdoor, artificial lighting.

iv. *Policies for industrial energy efficiency*

Five Arab countries (Algeria, Jordan, Morocco, Tunisia and Syria) have developed, and enforced, energy efficiency policies targeting the industrial sector. One or more of the following policy instruments is usually mandated, depending on the energy consumption level of the facilities: Mandatory periodic energy audits, dedicated energy management units, implementation of energy management systems and periodic energy consumption reporting. Tunisia also imposes mandatory pre-energy audit of project design work (in consultation with ANME) for new industrial facilities, if the projected energy consumption exceeds a certain threshold, and special authorization of the Ministry in charge of energy is needed if the projected energy consumption exceeds a certain limit. Tunisia also developed a regulatory framework to encourage the development of cogeneration to provide heat and power in industrial facilities

v. *Policies for energy efficiency in the transport sector*

Energy efficiency policies targeting the transport sector need to be integrated into a comprehensive set of transportation policies and infrastructures that aim to offer a "safe, efficient and affordable transportation system that meets society's need for environmentally sustainable transportation", and in the long run establish a sustainable mobility for passengers and freight.

Energy efficiency policies that were implemented in the transport sector in the Arab region mainly focused on road and rail transportation and can be summarized around four main axes: The improvement of public transportation, the enforcement of vehicle emission standards, the reduction of the fleet of old vehicles and the introduction of LPG or CNG as a fuel substitute.

Eleven Arab countries, namely; Algeria, Bahrain, Egypt, Jordan, Kuwait, Morocco, Oman, Qatar, Saudi Arabia, Tunisia and UAE, are engaged in large programmes to improve the infrastructure of public transportation through railways, metros, light rail or bus fleets.

Eleven countries, Algeria, Egypt, Jordan, Kuwait, Morocco, Palestine, Qatar, Saudi Arabia, Syria, Tunisia and Yemen have put in place regulations on the importation of used vehicles (more than 2, 3 or 5 years old vehicles).

Only three countries, Lebanon, Morocco and Tunisia have put in place emission standards and only four countries, Algeria, Egypt, Tunisia and UAE are developing the use of CNG or LPG in the transport sector.

Tunisia also requires mandatory, and periodic, energy audits for all transportation companies with energy consumption exceeding 500 toe.

As reported in the case study conducted by ESCWA on energy efficiency in the transport sector in Egypt133, the combination of an Old Vehicles Scrapping and Recycling Programme (OVSRP), that mainly focused on the Grand Cairo taxis fleet, and the use of Compressed Natural Gas (CNG) as a fuel by the replacement vehicles, led to considerable reduction in both energy consumption and air pollution.

[132] http://www.enlighten-initiative.org/CountryActivities/GlobalEfficientLightingPartnershipProgramme.aspx
[133] Korkor, 2014.

TABLE 3-11: DECLARED ENERGY EFFICIENCY TARGETS IN SOME ARAB COUNTRIES

Country	Sector	EE targets	Baseline year	Target year
Algeria[a/]	Buildings	30 mtoe reduction	2015	2030
	Industry	63 mtoe reduction		
	Transport	15 mtoe reduction		
Egypt[b/]	A new Energy Strategy is under preparation, including EE targets (Previous strategy: 20% of the final consumption in 2008 by 2022) [c/]			2035
Jordan	All sectors	20% of total national energy demand		2020
Morocco	All sectors	12% of total national energy consumption	2010	2020
		15% of total national energy consumption		2030
Palestine	Electrical Consumption	5 % of total electrical consumption (384 MWh)		2020
Qatar	Electricity	20% lower electricity per capita consumption level	2011	2017
Saudi Arabia	All sectors	Reduce energy intensity from 0.202 kWh/SAR to 0.140 kWh/SAR	2005	2030
Sudan	Electrical Consumption	15 % of total electrical consumption		2020
Tunisia[d/]	Primary energy in All sectors	17 % of total primary energy in BAU scenario	BAU scenario	2020
		34 % of total primary energy in BAU scenario		2030
UAE	Dubai[e/]	30 % of total demand		2030

Source: League of Arab States, 2013b, Unless specified otherwise,
a/ New NEEAP adopted by Algerian Government on 24/02/2015; http://www.energy.gov.dz/francais/index.php?mact=News,cntnt01,detail,0&cntnt01articleid=197&cntnt01returnid=15
b/ Mahina, 2015
c/ MVV Decon & Wuppertal Institut, 2009
d/ Agence Nationale pour la Maîtrise de l'Energie (ANME), 2014
e/ The Dubai Integrated Energy Strategy 2030, http://english.mubasher.info/news/2611550/DSCE-evaluates-progress-of-retrofitting-buildings-in-Dubai-for-energy-sustainability

(c) Financial incentives for energy efficiency

Lack of adequate financing for EE projects is one of the major barriers hindering the implementation of energy efficiency programmes and measures. This is further complicated by the heavily subsidized energy prices prevailing in the Arab region, which seriously impair the cost effectiveness of energy efficiency projects. This situation is best illustrated by the case study conducted by ESCWA on energy efficiency in the building sector in Kuwait[134]. The study concluded that based on current low electricity rates, the pay-back periods for retrofitting existing buildings would be over 37 years for the end-users, even for the best retrofit EE measures and that in order for these measures to be economically attractive for the end-users, electricity

[134] Krarti, 2014.

prices had to be at least 650 percent higher than the current prices. On the other hand, retrofitting all of the existing stock of residential buildings can reduce the state budget energy subsidy bill by as much as USD 136 million per year, and lower the peak electric loads by over 630 MW (about 8 percent of the current national installed capacity). The pay-back period for the state budget if these measures are fully paid for by the government, based on these reduced energy subsidies, would be around 6 years.

Two categories of policy instruments were proposed to overcome financial barriers:

- ✓ The creation of special sustainable and dedicated energy public funds to, partially, subsidize energy efficiency projects, either directly, and/or through the use of special credit lines with reduced or zero interest rates,
- ✓ The allocation of fiscal privileges or tax credits to energy efficiency projects.

Nevertheless, in many cases, the sizing of these financial incentives does not reach the necessary level to create the required leverage to make energy efficiency projects cost effective, because of the large economic viability gap induced by the subsidized conventional energy prices.

i. *Dedicated public funds for energy efficiency*

Six countries; namely Algeria, Jordan, Lebanon, Morocco, Palestine, and Tunisia, have established, or are in the process of establishing, EE funds to promote EE investments in their respective countries. Algeria was the first to establish a National Fund for Energy Conservation (FNME) in 2000, but this fund remained largely untapped because of the reasons discussed above. Tunisia established its special fund in 2005 and managed to use it as seed resources to attract international funding to promote both energy efficiency and renewable energy projects, in addition to promoting energy substitution from fuel to natural gas. The Tunisian fund provides a non-refundable subsidy representing up to 30 percent of the cost of EE projects, as well as the refund of 70 percent of the cost of technical expertise and engineering associated with the design and implementation of these projects. The case study conducted by ESCWA on energy efficiency in the industrial sector in Tunisia[135] showed that a special EE program, that was implemented using comprehensive technical and financial schemes, and that targeted 320 industrial companies, yielded a reduction of about 10 percent of the companies' annual energy consumption. The payback periods did not exceed 2 years for the investment made by these companies, and less than one year for the state budget to recover the national fund's contribution in financing the EE measures, based on reduced state energy subsidies resulting from the energy savings.
Three more countries; namely Jordan, Lebanon and Morocco, have established dedicated funds, under different names, to promote both energy efficiency and renewable energy while Palestine established a revolving fund for energy efficiency projects in 2012.

ii. *Fiscal incentives*

These types of incentives are based on providing fiscal privileges to energy efficiency projects. These privileges include tax credits, VAT and Custom duties weavers. Such incentives can encourage energy efficiency investments through reducing the overall costs of EE projects. While fiscal incentives for energy efficiency investments are widely used worldwide, only three Arab countries, namely; Jordan, Palestine and Tunisia, offer such incentives. Table 3-12 provides an overview of the fiscal privileges adopted in these countries.

[135] Missaoui, 2014.

TABLE 3-12: EXISTING ENERGY EFFICIENCY FINANCIAL INCENTIVES IN THE ARAB COUNTRIES

Country	Energy Efficiency Funds	Fiscal incentives
Algeria	National Fund for Energy Conservation (FNME) established in 2000 by Decree 2000-116. By the end of 2015 FNME will be merged with the National Fund for Renewable Energy and Cogeneration (FNERC)	
Jordan	Jordanian Renewable Energy and Energy Efficiency Fund (JREEEF) established by Law on Renewable Energy and Energy Efficiency (2012)	Exemption from sales tax and customs duties for EE equipment
Lebanon	National Energy Efficiency and Renewable Energy Action (NEEREA)	
Morocco	Energy Development Fund (EDF) with a total capital of one billion USD	
Palestine	Revolving Fund for EE projects established in 2012	Exemption from VAT/sales tax
Tunisia	Energy Transition Fund (FTE), established by Law No. 2013-54 of 12/30/2013, to promote the implementation of EE and RE. This fund replaces the National Fund for Energy Conservation (FNME) established by Law 2005-82 (2005) and Law 2005-106 (2005)	Exemption from VAT tax and reduction of customs duty for EE equipment to the minimum applicable rate

Source: League of Arab States, 2013b

3. *Renewable energy policies*

Many countries, especially those belonging to the NPEI group of countries are seriously considering building up a substantial share of RE in their energy mix by the 2030 horizon. Direct use of renewable energy, especially for solar water heating, has been largely disseminated in Jordan, Palestine and Tunisia during the last decade, and substantial targets are also announced by these and many other countries in the region, either in terms of installed thermal capacity, or collector areas[136]. Renewable energy for water pumping systems is also one of the other direct applications that are being disseminated in many countries in the region. Two Arab countries, namely, Morocco and Tunisia implemented, during the last two decades, very ambitious programs of rural electrification using stand alone photo-voltaic systems, therefore improving energy access in the targeted rural areas. Morocco used solar photo-voltaic systems to insure access to electricity in over 3600 villages[137] and Tunisia installed over 12500 photo-voltaic solar home systems, [138].

During the last decade, many renewable energy pilot projects were implemented throughout the Arab region, including for power generation, and particularly in the context of CDM projects for climate change mitigation[139] [140]. By mid-2013, almost all Arab countries had developed renewable energy policies, and formulated renewable targets as previously presented in chapter I. The League of Arab States' 3rd Arab Economic and Social Development Summit held in January 2013 in Riyadh, Kingdom of Saudi Arabia, consecrated this interest in RE and adopted a Pan Arabic strategy for the development of RE in the Arab region[141]. Table 3-13 summarizes the status of renewable energy policies in the Arab region. Most targets are based on projected contributions of renewable energy in the national energy mix at the 2030 horizon.

[136] League of Arab States, 2013a
[137] Hajroun, 2012
[138] Baraketi, 2012
[139] ESCWA, 2012
[140] ESCWA, 2013.
[141] League of Arab States, 2013a

TABLE 3-13: STATUS OF RENEWABLE ENERGY POLICIES IN THE ARAB REGION, 2013-2015

Country	RE target	RE Strategy[a/]	FIT	Net metering	Biofuel obligations	Heat obligation	Capital Subsidy	Investments tax credits	Reduction in taxes	Public investment	Tendering	RE Fund[a/]
Algeria	√	√	√				√		√		√	√
Bahrain										√		
Djibouti		√								√		
Egypt	√	√	√	√		√	√		√		√	√
Iraq		√									√	
Jordan	√	√	√	√	√	√			√	√	√	√
Kuwait	√										√	
Lebanon	√	√		√					√	√	√	√
Libya	√								√			
Morocco	√	√		√						√	√	√
Oman												
Palestine	√	√	√	√					√		√	
Qatar												
Saudi Arabia												
Sudan	√				√							
Syria	√		√	√					√		√	
Tunisia	√	√		√			√		√	√		√
UAE	√	√		√		√(*)				√	√	√
Yemen		√									√	
Total number of	12	11	5	8	2	3	3	0	8	7	11	7

Source: REN21, 2015
a/ REN21, 2013
(*) Dubai only

(a) Renewable energy targets

The renewable energy targets announced by Arab countries are, depending on each country, either expressed in terms of their contribution to the primary energy mix or their contribution to the electrical power generation, with a time frame horizon set for 2020 or 2030. Some of the targets are very ambitious, as in the case of Algeria with an announced 40 percent contribution in power generation by 2030, Morocco with a 42 percent of installed power capacity by 2020, and Tunisia with a 40 percent contribution to the primary energy mix by 2030. Less ambitious targets are announced by the other countries, with a contribution to power generation typically ranging between 5 percent and 20 percent by 2020. The least ambitious target is announced by Qatar, and amounts to 2 percent of electrical power generation by 2020. In terms of projected installed capacity, Saudi Arabia announced the most ambitious target with 54 GW by 2032 (this target was later on delayed to 2040[142]). Table 3-14 presents a summary of these targets in the different Arab countries.
With the exception of Palestine, which presented a clear rationale for the adopted renewable energy technology, there are no clear signals from the other Arab countries about the motivations behind choosing one or the other of the renewable energy technologies, nor the rationale for selecting centralized versus decentralized configurations.

Furthermore, most targets implicitly assume a business as usual scenario for the evolution of the energy consumption in the respective countries, and there are no indications that different scenarios of energy

[142] www.renewableenergyworld.com/news/2015/01/saudi-arabia-delays-109-billion-solar-program-eight-years.html

efficiency deployments, especially with the 2030 horizon, were considered in association with these renewable energy targets. Large scale deployment of energy efficiency, which is as previously indicated a top priority for the region, could considerably boost the contribution of renewable energy[143], and can even impact the renewable energy technological choices that countries should be making in conjunctions with these energy efficiency deployment scenarios.

(b) Tariffs' policies for electricity from RE

Tariffs for power generation from grid connected renewable energy systems can play a key role in the development of renewable energy in some countries. Several tariff's policies have been used worldwide to encourage private investment in renewable energy and induce the development of this sector. The most common tariff policies include the Feed-in-Tariff, the Independent Power Producer public competitive bidding and the Net Metering.

i. *Feed-in-tariffs (FIT)*

The Feed-in-Tariff (FIT) is an economic policy developed to encourage renewable energy investment by offering long-term electricity purchasing contracts to renewable electricity producers. The contracts offer preferential and guaranteed pricing rates, based on cost compensation, which takes into account the cost of the renewable power generation technology that is used. Thus, FIT provides a price certainty and long-term agreements that can attract renewable energy investments.

Seven countries in the Arab region have adopted or proposed FIT as a key mechanism for meeting their ambitious targets. The same mechanism is under consideration or development in few NPEE countries such as Saudi Arabia. Algeria and Egypt have moved forward and issued FITs, while Palestine has taken a step back and cancelled its FIT scheme for solar PV deployment. Syria, who also issued its FIT, has put on hold all of its RE development programmes because of its ongoing conflict.

The Egyptian FIT scheme, which was introduced in October 2014, is an example of such arrangements that applies to both solar PV and wind projects. Tariff rates per kWh are technology-specific, and the adopted schemes were as follows:

- ✓ For Solar PV, the FIT would be granted according to a fixed rate for 25 years. The rates are set according to the installed capacity.
- ✓ For wind, the FIT would be granted for 20 years in two steps: A fixed rate for the first 5 years, than a site specific revised rate for the following 15 years. The rates are set according to the number of full operating hours.

All FITs projects in Egypt are guaranteed priority access to the grid, and the transmission company (EETC) has to compensate the RE generator for any losses if access is not granted. Land access is provided against a land fee of 2 percent of the project income.[144]

Palestine has developed FITs for different RE technologies. However, only the Palestinian Solar Initiative, introduced in 2013, made use of the developed schemes. This program offered small-scale (< 5kW) solar PV installers a feed-in tariff that annually decreased by 7 percent under a 20-year power purchase agreement. The programme was interrupted because of the high associated costs[145].

Feed- in tariffs do however introduce significant market distortions and offer investors abnormal returns on investment that are denied other contributors to the energy market dynamics. A far more effective strategy is

[143] IRENA and C2E2, 2015
[144] EgyptERA, 2014.
[145] RCREEE, 2015b

to remove existing subsidies, introduce a liberal market with competing suppliers and enable real dynamic market pricing.

Removing any degree of price subsidy, and then requiring an integrated resource planning assessment prior to any supply side investments allow a fair and equitable engagement for all supply and demand side options and minimize distortions from subsidies.

ii. *Independent Power Producer (IPP) public competitive bidding*

IPP Public competitive bidding refers to the process that a government uses to select a renewable energy developer through a tendering process. A Power Purchase Agreement (PPA) is then signed with the successful bidder. This mechanism was one of most important instruments to promote large-scale RE projects in the region.

However, such a scheme requires a high level of transparency with respect to governments' future development plans of large-scale RE markets, as well as the competitive bidding process. So far, Egypt, Morocco, and Saudi Arabia are the only three countries in the region that have set clear targets for the total installed capacity of RE to be developed through a competitive bidding process.

In 2014, Morocco awarded 1,000 MW of large-scale renewable energy projects, wind and solar, through an IPP public competitive bidding process. In addition, Morocco awarded a USD 2 billion contract for the development of 350 MW of CSP plants.

At the end of 2014, Egypt enacted its Renewable Energy Law, which establishes IPP public competitive bidding process, as one of the instruments to promote RE. With the adoption of this law and FITs schemes, Egypt is making an important step in shifting from only state-developed, operated and owned renewable energy projects to privately financed projects.

The current political situations in Iraq and Syria have hindered their ability to make progress in RE bidding processes. Nevertheless, in 2014, Iraq announced tenders for the first four pilot renewable energy projects through an IPP public competitive bidding process.

iii. *Net metering*

Net metering is a mechanism, which allows individual entities to produce electricity from RE for their own needs, and transfer any excess production through the grid for financial compensation based on their net contribution to the power distribution system. The net contribution is evaluated on the basis of the balance between the power obtained from the grid and the power delivered through it. Contractual fixed, or market-based prices, are applied to the net contribution. This enables the development of decentralized RE power generation systems, transforming electricity end users into a network of small-to-medium scale energy producers.

TABLE 3-14: ANNOUNCED RENEWABLE ENERGY TARGETS IN ARAB REGION

Country	As reported in the LAS RE Strategy document (2010-2030)	As reported in other sources, including REN21
Algeria	10% of primary energy by 2030	6% of electricity generation by 2015; 15% by 2020; 40% by 2030, of which 37% is solar (PV and CSP) and 3% is wind
Bahrain	N/A	5% by 2020
Djibouti	N/A	30% of rural electrification from solar PV by 2017 100% renewable energy by 2020
Egypt	20% of electricity generation by 2020	20% of electricity generation by 2020, of which 12% is wind
Iraq	N/A	2% of electricity generation by 2016
Jordan	10% of primary energy by 2020	7% of primary energy by 2015; 10% by 2020
Kuwait	5% of electricity generation by 2020	5% of electricity generation by 2020; 10% by 2030
Lebanon	12% of electricity generation capacity by 2020	12% of electrical and thermal energy by 2020
Libya	10 % of electricity generation by 2020 25 % of electricity generation by 2030	3% of electricity generation by 2015; 7% by 2020; 10% by 2025
Morocco	42% of electricity generation by 2020	42% of installed power capacity by 2020
Oman	N/A	10% by 2020
Palestine	N/A	25% of energy from renewables by 2020; 10% (or at least 240 GWh) of electricity generation by 2020
Qatar	N/A	At least 2% of electricity generation from solar by 2020
Saudi Arabia	N/A	24 GW by 2020 54 GW by 2032 (delayed to 2040)
Sudan	1% of electricity generation capacity by 2011	1004 MW by 2031
Syria	4.3% of primary energy by 2030	Biopower: 140 MW by 2020; 260 MW by 2025; 400 MW by 2030 Solar PV: 45 MW by 2015; 380 MW by 2020; 1.1 GW by 2025; 1.8 GW by 2030 CSP: 50 MW by 2025 Wind: 150 MW by 2015; 1 GW by 2020; 1.5 GW by 2025; 2 GW by 2030
Tunisia	30% of electricity generation by 2030	11% of electricity generation by 2016; 25% by 2030; 16% of installed power capacity by 2016; 40% by 2030.
UAE	Abu Dhabi: 7% of electricity generation capacity by 2020	Dubai: 5% of electricity by 2030; Abu Dhabi: 7% of electricity generation capacity by 2020
Yemen	N/A	15% of electricity by 2025

Sources: League of Arab States, 2013a, REN21, 2013and REN21, 2014

Seven Arab countries; namely, Egypt, Jordan, Lebanon, Palestine, Syria, Tunisia and UAE (Dubai) have developed net metering arrangements. However, only several of them have actually implemented these schemes. And the schemes differ from one country to another.

Jordan's net metering scheme applies to RE systems up to 5 MW, but the size of the system making use of the scheme cannot exceed the consumer's average monthly consumption. An end of month balance evaluates the electricity that was produced in excess of the RE system's owner needs, and the surplus is transferred as credit to the next month. At the end of the year, a yearly balance is calculated and the surplus can either be compensated based on a fixed price per kWh, or be transferred as credit to the next year.

Egypt adopted a net metering scheme in 2013. The scheme applies to solar PV projects, with no limit imposed on the installed capacity for systems connected to the low voltage grid. The scheme has a very complex lay out where surplus electricity can only be credited in the highest tariff bracket for each month. However, due to the existing low electricity tariffs, the scheme in its current design doesn't seem to have a high attractiveness potential.

Tunisia offers different net metering conditions depending on the grid voltage to which the system is connected. For customers connected to the low-voltage grid, no financial compensation is ever involved for the excess energy provided to the grid, and any net excess electricity at the end of each billing period is rolled over as credit to the next period. For the customers connected to the medium or high-voltage grid, surplus electricity, which should not exceed 30 percent of the annually produced electricity by the RE system, are allowed to receive financial compensation based on a fixed price per kWh. The Tunisian net metering scheme was packaged, for PV systems, with a financial mechanism. The financial mechanism covers the acquisition of the PV system, by the net metering subscribers, from accredited PV systems' suppliers, through a combination of a grant and a bank loan with preferential interest rates. The bank loan is paid directly via the electricity bill.

It is clear that such net metering schemes, if properly designed and implemented, can be a powerful instrument for ensuring that a large portion of the additional capacity required for the power generation infrastructures can be developed while mobilizing little public resources. Furthermore, technology choices, i.e. PV solar systems, can play a substantial role in meeting the peak electric load periods that, for the Arab region, usually coincide with the peak output from PV systems, allowing the centralized power generation plants to handle the base loads with higher efficiencies. This solution would require a large-scale implementation of such systems, and therefore the implementation of very motivating financing, and legal, schemes to attract a large segment of the end users to subscribe to such programmes. However, a long-term cost-benefit analysis assessing the comparative advantages of such schemes is required, in order to properly size and design the programmes.

(c) Grid access

The conditions for renewable energy systems' access to the grid are crucial for their development. Indeed, it is essential that the energy produced by renewable energy be able to be delivered, according to demand, through the existing electrical grids. In the Arab region transmission and distribution are usually public monopolies. Clear and consistent policies are essential to allow such access, in order to encourage private investment in RE power generation. Furthermore, some technical features; namely smart grids and transnational interconnectivity, as the share of electricity from renewable energy increases, are required to manage the dispatching of the produced electricity from RE, which are intermittent by nature. Priority access should always be granted in order to prevent dumping of the produced renewable electricity.

Only a few countries in the region have specified grid access details to renewable energy in their policies and regulations. Algeria and Jordan currently have the most preferential grid access conditions for RE projects and the UAE (Abu Dhabi and Dubai) developed regulations to allow feed-in at household levels. Egypt, Morocco, and Palestine have committed to grant grid access to RE projects. Tunisia has grid access regulations that are somewhat restrictive, and is in the process of reviewing these regulations within the

context of its new national energy transition strategy. Most other countries in the region need to develop comprehensive national policies, in order to guarantee grid access to renewable energy projects. It is critical to get these underlying connection and enabling access features functional prior to looking at incentives for renewable energy.

(d) Financial incentives for renewable energy

The need for financial incentives for renewable energy projects depends on the size, and type. Large-scale renewable energy projects should obey to the same financial rules as other infrastructure projects, and their project developers usually rely on international financing schemes, and their projects are generally not in need for national financial incentives, apart from eventual fiscal privileges to alleviate the local costs of the projects.

Medium and small-scale renewable energy projects, as well as renewable energy programmes based on large dissemination of small RE systems, need financial support and incentives in order to overcome two important barriers: The initial investment required for the project and the low conventional energy prices due to the high conventional energy subsidies prevailing in the region. In that respect, the financial incentives' instruments for these types of RE projects are in many ways similar to those designed for EE projects and programmes, as discussed previously.

Many Arab countries designed and implemented one or both, of the two financial instruments discussed earlier; namely special sustainable energy public funds and fiscal incentives. These on-off stimulus costs are preferable to the long-term market distortions and public budget commitments that are associated with feed in tariffs.

i. *Dedicated public funds for renewable energy*

Seven countries in the region; namely Algeria, Egypt, Jordan, Lebanon, Morocco, Tunisia and UAE, have established, or are in the process of establishing, renewable energy funds, often within a common dedicated sustainable energy programme "basket" including energy efficiency, to promote sustainable energy rather than just renewable energy investments in their respective countries. At least four of these countries (Algeria, Jordan, Lebanon and Tunisia) have these funds dedicated to support both renewable energy and energy efficiency in an integrated way. This set-up allows these funds to respond to the most economic or best options to deliver sustainable energy outcomes, without the artificial constraints of sector demarcations. To work well the allocation process must ask for and respond to the valuation of multiple benefits to society and the economy as well as environmental outcomes.

Furthermore, Tunisia has set up two nation-wide dissemination programmes for solar water heaters (PROSOL) and for grid-connected individual PV solar systems (PROSOL-ELEC), whereby the national fund is used, in conjunction with international funding, to provide a grant covering 30 percent of the cost of the system, when purchased from accredited suppliers. A system of accreditation of equipment, suppliers and installers is associated with these two programmes, and loans with preferential interest rates, recovered through the electricity bills, are offered to cover the remaining 70 percent of the cost of the system.

ii. *Fiscal incentives*

These types of incentives are based on providing fiscal privileges to renewable energy projects. These privileges include tax credits, VAT and Custom duties weavers, or reductions. As was pointed out when discussing these types of incentives in the case of energy efficiency projects, fiscal privileges can also be used to encourage RE investments by reducing the overall costs of RE projects, thus supporting a wider deployment of RE policies and financing frameworks.

Eight Arab countries; namely Algeria, Jordan, Lebanon, Libya, Morocco, Palestine, Syria, and Tunisia, offer such incentives.

4. *Energy policies as a tool to mainstream GHG mitigation actions*

At COP19 in Warsaw, the UNFCCC adopted the decision that all countries submit their contribution to GHG mitigation with the objective of limiting the world emissions to a level restraining the global temperature increase to a maximum of 2 °C by 2100 (IPCC 2°C scenario). These voluntary commitments made by the parties to UNFCCC would serve as a basis for the Post 2020 agreement to be signed during the COP21 in Paris.

Almost all Arab countries have submitted their Intended Nationally Determined Contributions (INDCs) and eleven of them announced quantitative mitigation targets by 2030. The remaining countries have only submitted a list of mitigation actions, most of which are not quantified.

Most of the announced mitigation targets were in the energy sector through energy efficiency and renewable energy actions. Therefore, Arab countries would have to mainstream their GHG mitigation INDCs into their energy policies in a structured manner. Mechanisms of Measurement, Reporting and Verification (MRV) systems would need to be implemented to monitor the fulfillment of their commitments.

INDCs and the expected post 2020 agreement to be signed in Paris (COP 21) often distinguished between targets to be achieved by the countries' own means (unconditional) and conditional objectives with targets requiring financial and technological support from the international community, as shown in Table 3-15.

The mainstreaming of the GHG mitigation INDCs into the energy policies of Arab countries would contribute to the international efforts to reduce GHG emissions. It could also enable the Arab countries to attract the required and appropriate financing to their EE and RE programs, particularly through the Green Fund expected to be one of the pillars of the new post 2020 agreement.

TABLE 3-15: INTENDED NATIONALLY DETERMINED CONTRIBUTIONS (INDCS) SUBMITTED BY ARAB COUNTRIES DURING COP 21

Countries	Target by 2030	Unconditional target	Conditional target
Algeria	Reduction of the carbon intensity in 2030 by 22% compared to a business as usual scenario	7%	15%
Bahrain	Not clearly announced. Proposals of list of mitigation measures		
Djibouti	Reduction of the carbon intensity in 2030 by 40% compared to a business as usual scenario	20%	20%
Egypt	Not clearly announced. Proposals of list of mitigation measures		
Iraq	Reduction of the carbon intensity in 2030 by 14% compared to a business as usual scenario	1%	13%
Jordan	Reduction of the carbon intensity in 2030 by 14% compared to a business as usual scenario	1,5%	12,5%
Kuwait	Not clearly announced. Proposals of list of mitigation measures		
Lebanon	30% compared to a business as usual scenario	15%	15%
Mauritania	22,3% compared to a business as usual scenario	12%	10,3%
Morocco	32% compared to a business as usual scenario	13%	19%
Oman	2% compared to a business as usual scenario	2%	
Qatar	Not clearly announced. Proposals of list of mitigation measures		
Saudi Arabia	Reduction of 130 million tons of CO2eq by 2030 compared to a business as usual scenario	130 million tCO2eq	
Sudan	Not clearly announced. Proposals of list of mitigation measures		
Tunisia	Reduction of the carbon intensity in 2030 by 41% compared to 2010	13%	28%
UAE	Not clearly announced. Proposals of list of mitigation measures		
Yemen	Reduction of the carbon intensity in 2030 by 14% compared to a business as usual scenario	1%	13%

Source: UNFCCC, www.unfccc.int/focus/indc_portal/items/8766.php

C. OVERVIEW OF EXISTING INSTITUTIONAL FRAMEWORKS

1. *Institutional frameworks for domestic energy management*

The domestic energy sector often operates, in Arab countries, in the context of a seeming lack of policy harmonization, with legal and regulatory frameworks scattered among different authorities. In about half of the Arab countries, domestic energy policies and associated institutions are not handled by the same ministry. Indeed, these countries; namely, Bahrain, Egypt, Iraq, Kuwait, Libya, Oman, Saudi Arabia, Sudan, Syria and Yemen, have two ministries that are in charge of managing the domestic energy sectors: A ministry in charge of hydrocarbon resources (oil & gas), and a ministry in charge of electricity, often in association with water[146].

This domestic energy "dichotomy" is even reflected at the regional institutional levels, where, for instance, the department of energy in the League of Arab States, which is acting as the secretariat of the Arab Ministerial Council of Electricity, only focuses on the electrical sector in Arab countries, even when dealing

[146] League of Arab States, 2013b

with EE and RE issues, confining the extent of the regional debate and work conducted under its attention to the electrical sector[147].

In most Arab countries, the institutional framework for domestic energy continues to focus mainly on the energy supply side, developing plans and policies to secure energy supply to the population and the different economic sectors, by increasing electrical production capacities and expanding energy transport and distribution systems. Few countries in the region are starting to make the necessary efforts to assess their energy demand dynamics and to develop ambitious plans and policies, and developing the associated institutional framework, to reshape their energy demand profiles, and reduce the pace of the ever increasing needs for additional energy supply.

The oil sector is fairly mature in most Arab countries, especially in the oil producing countries, with very well structured national public companies dominating the scene. Private companies, which often are affiliates of international firms, are playing an important role in the domestic supply of oil products, mainly for transportation, but also for industries, other economic entities and households.

Natural gas, considered by many experts to be the bridge fuel towards a cleaner, greener future, is not yet developed to its full potential in the national domestic energy systems in the Arab region, and gas flaring is still practiced in many of its countries. Although natural gas is replacing oil products in power plants, only some Arab countries have networks of natural gas distribution, usually well managed by national public companies, to households, industries and other end users. However, the use of compressed natural gas (CNG) in the transport sector is still in its very first stages, even in these countries.

The Electricity sector in Arab countries mainly remains state-dominated, and is currently undergoing different important reforms in many countries in the region, including opening the sector for Independent Power Producers (IPP).

Independent electricity regulatory authorities, an important institutional arrangement for the development of the electrical sector and its market, are only in place in seven Arab countries; namely, Algeria, Egypt, Jordan, Palestine, KSA, Sudan, and UAE. However, only the Jordanian Energy and Minerals Regulatory Commission (EMRC) can be considered relatively independent in terms of its decision making processes[148]. In contrast, the regulatory bodies of Algeria, Egypt, Palestine, Sudan, and Saudi Arabia mainly play an advisory role, and governments make the final decisions. In the rest of Arab countries, where no independent regulatory bodies exist, public utility companies often perform the regulatory functions.

Annex 3 provides a summary of national energy institutions in the Arab countries, based on an ESCWA report on *"Current Status of the Institutional Frameworks Responsible for Managing the Electric Power Sector in Arab Countries"*[149].

2. Institutional framework for energy efficiency and renewable energy in the Arab Region

There are ten Arab countries with a dedicated governmental entity for Energy Efficiency and/or Renewable Energy; namely, Algeria, Djibouti, Egypt, Libya, Mauritania, Morocco, Palestine, Saudi Arabia, Syria, and Tunisia. These entities have been created through specific legislation, and some of them are either dedicated to only RE or EE (Table 3-15). Two more countries, namely Jordan and Lebanon have particular arrangements. For Jordan, the National Energy Research Council (NERC), a research centre, is in charge of

[147] The guidelines adopted by the League of Arab States for preparing National Energy Efficiency Action Plans (NEEAPs) only focuses on EE related to electricity production, transport, distribution and consumption, as clearly indicated in the title of the supporting document; "Arab Guideline for Improving Electricity Efficiency and Rationalize its Consumption at the End User", and most NEEAPs that were, so far, developed by the Arab countries mainly dealt with electricity. Furthermore, work conducted on RE is also almost exclusively on RE for power generation.

[148] Cambini and Franzi, 2013.

[149] ESCWA, 2014b.

Performing studies, research, and experimental projects related to sustainable energy, with no clear mandate to develop or implement government related policies. For Lebanon, the Lebanese Center for Energy Conservation (LCEC), a non-governmental entity, has been mandated by the Ministry of Energy and Water to play the role of a national EE and RE agency.

Five Arab countries; namely, Algeria, Egypt, Jordan, Morocco and UAE have a dedicated ministry department for energy efficiency[150] and the ministries in charge of electricity in Egypt and Libya, include Renewable Energy in their denomination, indicating that these two ministries have a particular mandate for promoting RE in their respective countries.

Egypt is one of the pioneering Arab countries in the development of RE. In this country, the New & Renewable Energy Authority (NREA), established in 1986, played an essential role in achieving these results. NREA acts as the national focal point for the commercial development and introduction of RE technologies in the country[151]. NREA launched several wind and solar projects where it acted as a developer. It owns and operates all existing wind farms in Egypt and several more projects are planned. NREA also acts, in practice, as a regulator for RE; establishing rules and procedures for allocating land to wind farms' developers. But NREA also acts as a public facilitator and supporting body for private project developers to promote their involvement in the development of the sector. In that sense, it actively contributes to removing some of the main risks associated with such projects. In addition, it acts as a national planning agency for the development of renewable energy in the country. The success reached by NREA contributed to the establishment of more ambitious targets for RE in the country.

Although NREA has substantially contributed to the development of RE in the country so far, the new emphasis on higher private involvement in RE projects, would suggest a readjustment in some of its prerogatives, and even a restructuring, in order to eliminate possible sources of conflicts of interests that may arise between its commercial activities and its promotional and legislative role. These conflicts of interests may discourage some of the private sector from getting involved in the development of the RE field[152].

With respect to EE, and as was discussed previously, Tunisia is the only Arab country that succeeded in decoupling the increase of its energy needs from its economic growth. This was partly due to the development of a realistic EE strategy, and its implementation over more than twenty years. The Tunisian National Energy Conservation Agency (ANME), the dedicated national entity for Energy Efficiency and Renewable Energy in Tunisia was a key player in this success story. It conducted all the necessary studies, developed and implemented all the policies and engaged all stakeholders in the process. It developed and implemented several national EE and RE programmes, including:

- A programme for mandatory energy audits in industrial units, large hotels, hospitals and office buildings, which were, often, concluded by contract-programmes for the implementation of subsidized EE measures.
- An energy labeling and minimum energy performance standards (MEPS) for refrigerators and room air conditioners, the first implemented programme in the region, that was enforced in coordination with the Ministry of Commerce and the manufacturing department of the Ministry of Industry, while engaging the suppliers and vendors of theses equipment
- An energy building code programme that was developed for the residential sector and office buildings, as a first step, which was enforced in coordination with the Ministry of Public Works and Housing, as well as the authorities in charge of issuing buildings' permits and the firms in charge of works' control.

It also managed the National Fund for Energy Conservation (FNME) and set up two flagship programmes: One for up-scaling EE programmes in the industrial sector, including the promotion of co-generation,[153] and

[150] World Energy Council, 2015.
[151] http://www.nrea.gov.eg/english1.html
[152] MVV Decon and Wuppertal Institut, 2009.
[153] Missaoui, 2014.

PROSOL, a large-scale dissemination programme for solar domestic water heaters. Two ad-hoc management units, hosted by ANME, were specifically created to run these two programmes and monitor their implementation. Two high level task forces helped in setting up the first programme and tackling the different associated barriers.

Nevertheless, it is important to note that ANME largely benefitted from the database on large consumers end-use electricity and gas consumption held by STEG, the national public utility company, as well as a survey on household end-use energy consumption conducted by STEG every five years. These data were essential in designing and sizing the EE programmes. Finally, despite this rich experience, ANME will not be able to manage, alone, the implementation of the new ambitious EE strategy. New implementing arrangements are need, in order to reach the new targeted goals and objectives.

Another type of institutional instruments, based on Public Private Partnerships (PPP), is being developed in the region to allow the upscale of the implementation of RE and EE projects. These new models are pioneered by Morocco for, the UAE and Saudi Arabia.

The Moroccan model is based on the creation, in 2010, of a specialized public financing company, the Energy Investment Company (SIE)[154], representing s the state financial instrument for the implementation of its energy strategy at the 2020 horizon, and mandated to operate in both the investment and development of renewable energy projects and energy efficiency. It operates as an investor, financial leverage and project co-developer.

For RE, another company was created, MASEN, the Moroccan Agency for Solar Energy, which is 25 percent owned by the Government of Morocco, ONE (the national utility company), the Hassan II Fund for economic and social development, and the Energy Investment Company (SIE). MASEN is responsible for "*feasibility assessment, design, development, and financing of solar projects in Morocco, along with contributing to expertise and research in the solar industry. Its aims are both to develop energy but also to support the development of a new industrial sector in Morocco through training, capacity building, and research and development (R&D)*"[155]. An innovative financing architecture allows MASEN to play the role of contract holder in the power purchase agreements with ONE and the role of an equity partner in the Solar Power Company, along with the winning bidders. "*MASEN also acts as a consolidator of concessional loans provided by the Clean Technology Fund (CTF), African Development Bank (AfDB), the World Bank (WB), and the European Investment Bank (EIB) which reduce the cost of capital for the SPC, and lower the overall cost of energy generated.*"[156]

The UAE model involves the development of the concept of a Super Energy Services Company (Super ESCO). A Super ESCO is a public or public-private-partnership company mandated to create and organize a sizeable market for energy services, by resorting to private energy services companies, ESCOs, mostly SMEs, through an accreditation system and a bidding process. Super ESCOs are a valuable instrument for mobilizing public funds, attracting high EE expertise and building capacities in the energy services sector. Super ESCOs seem to be the optimum solution in an environment where high end use energy subsidies are prevailing. In this situation, EE measures are only economically attractive to the states' budgets, but not to the end users in the majority of the situation. This is particularly the case where the end user is a public institution that systematically fails to pay its energy bills, as is the case in many Arab countries. In which case, the development of market driven ESCO activities simply becomes a wishful expectation.

"*In 2013, Al Etihad Energy Services Company (abbreviated as Etihad ESCO) was established as an initiative by the Dubai Electricity and Water Authority (DEWA) under the leadership of the Dubai Supreme Council of Energy (DSCE) to create a viable market in Dubai for building energy efficiency services. Etihad*

[154] http://www.siem.ma/en/the-sie
[155] http://www.ggbp.org/case-studies/morocco/moroccan-agency-solar-energy-and-moroccan-solar-plan
[156] Ibid.

ESCO is the official Dubai [Super ESCO]"[157]. Etihad ESCO is mandated to target 30,000 existing buildings, operating as a Super ESCO on a commercial basis with a goal to generate 1.7 TWh of energy savings and reduce CO2 emissions by 1M tons by 2030[158]. The contractual model used by Etihad ESCO is the "Energy Performance Contracting" (EPC) model, and involves contracting accredited ESCOs, so that Etihad ESCO is acting as an effective facilitator between building owners, ESCOs and Financial Institutions in order to remove the market barriers. These activities are carried out within an ESCO market operational framework based on (1) An ESCO Accreditation Scheme, (2) Standard Contracts for Energy Performance Contracting, (3) Measurement & Verification Guidelines and (4) A dispute resolution mechanism.

The Moroccan and UAE models need to be further monitored and assessed, since they can offer valuable solutions for achieving the required frog-leap in terms of EE and RE deployment in the Arab region. Indeed, with the present ambitious objectives in the Arab countries, public structures presenting a certain critical size, which enables them to mobilize the required financial and human resources, are essential to manage the RE and EE implementations processes and meet the challenges. A simple comparison between the present size of the dedicated public institutions in charge of EE and RE in Arab countries; and their respective public utilities counterparts is very revealing of the existing resources' gaps (Table 3-16).

[157] Etihad Energy Services Co, 2014.
[158] Etihad Energy Services Co, 2013.

TABLE 3-16: DEDICATED GOVERNMENTAL NATIONAL ENERGY AGENCIES IN THE ARAB REGION

Country	Name of the agency	Total Employees [a/]	Remarks	Total Employees in National Utility Companies [b/]
Algeria	APRUE: Agence Nationale pour la Promotion et la Rationalisation de l'Utilisation de l'Energie	60		28,200
Djibouti	Agence Djiboutienne de Maîtrise de l'Energie (ADME) ; the Energy Conservation Agency of Djibouti		EE only	
Egypt	New & Renewable Energy Authority (NREA)		Mainly RE	179,000
Libya	Renewable Energy Authority of Libya (REAOL)		RE only	40,000
Mauritania	Agence Nationale de Développement des Energies Renouvelables (ANADER) ; National Energy for the Development of Renewable Energy		RE only	
Morocco	Agence pour le Développement des Energies Renouvelables et de l'Efficacité Energétique (ADEREE); Agency for the Development of Renewable Energy and Energy Efficiency	130		8,800 [c/]
Palestine	Palestinian Energy and Environment Research Center (PEC)			
Saudi Arabia	Saudi Energy Efficiency Center (SEEC)		EE only	35,400
Syria	National Energy Research Center (NERC)	80		39,400
Tunisia	Agence Nationale pour la Maîtrise de l'Energie (ANME) ; National Agency for Energy Conservation	142		13,000 [c/]

Source: ESCWA, 2014b
a/ World Energy Council, 2015.
b/ Arab Union of Electricity, 2014.
c/ Arab Union of Electricity, 2013.

CHAPTER IV
CONCLUDING REMARKS AND RECOMMENDATIONS

The present chapter outlines the major findings of this publication on energy policy trends in the Arab region and proposes some suggestions on the way forward regarding the following:

- ✓ The domestic energy policies that need to be introduced, enhanced and promoted, to reinforce of a sustainable energy pathway to enable the countries in the region to power a sustainable social and economic development.
- ✓ The main issues that need further assessment and /or future development.
- ✓ The key issues that will need a regional outlook in addressing energy policies and regional energy cooperation.

A. SUSTAINABLE ENERGY FOR SUSTAINABLE DEVELOPMENT

"Energy is the golden thread that connects economic growth, increased social equity and an environment that allows the world to thrive. Access to energy is a necessary precondition for the achievement of many development goals that extend far beyond the energy sector: eradicating poverty, increasing food production, providing clean water, improving public health, enhancing education, creating economic opportunity and empowering women. The transition to sustainable energy systems also presents one of the greatest investment opportunities of the twenty-first century. In short, ***development is not possible without energy, and sustainable development is not possible without sustainable energy****."*[159]

The last sentence of this powerful statement by the Secretary General of the United Nations can be used as a "*modus-operandi"* for developing domestic energy policies everywhere and in particular in the Arab region. This statement is further materialized by the UN SE4All decade and the SDG 7, which is part of the 2030 Agenda for Sustainable Development adopted on 25 September 2015 by the 193-Member of the United Nations General Assembly. SDG7 aims to *"Ensure access to affordable, reliable, sustainable and modern energy for all"*.

1. *The need for a transition to new energy systems*

Ensuring an adequate supply of energy to power the social and economic development plans was the main focus of energy policies in the Arab region, with little efforts to address the effectiveness of the ways energy was produced, transported/distributed and used. Indeed, the possibility to "*sustainably*" manage the demand-side has only been on the agenda of energy policies, for most countries in the region, during the second half of the last decade.

There is a need in each country to engage a national debate on its energy strategy and subsequent policies, involving all stakeholders; public and private sectors, civil society, experts, and representatives of other relevant parties. The debate would consider the different energy supply options and assess the current modes of production, processing and consumption to strengthen its security of energy supply, maintain the competitiveness of its economy, insure quality access to energy services and protect the environment. The debate would allow the sketching of a strategy for the transition to a new domestic energy system that better serves the country's social and economic development goals, based on realistic technical and economic facts, but also on ways to change energy consuming behaviors. The new energy system should be able to meet the future social and economic needs of the country, emphasize the role of energy efficiency and renewable energy, as well as a more balanced national energy mix.

It is important to inform this exercise by thoroughly evaluating the economic, social and environmental costs of the different options to provide the required energy services, at the individual and national levels. Only a

[159] United Nations General Assembly, 2012.

comprehensively developed "dashboard" of energy options from the supply and demand sides will allow the development of a sustainable national energy strategy.

In the long term, domestic energy strategies should encourage the emergence of a new energy market model, based on a market of energy services, i.e. energy utilities and end uses, using a systems perspective that meets future energy services' needs comprehensively in the most efficient way. This new model would eventually replace the present energy market offering the different forms of energy as commodities.

2. *Improving energy efficiency / productivity as a top national priority in each Arab country*

There is a very significant potential to improve energy productivity in the region, through energy efficiency. The total annual Primary Energy Supply for the region can be drastically reduced by such actions. Furthermore, harvesting these energy efficiency benefits, will considerably reduce the need for additional electrical production capacity, at a lower cost for the nation than the cost of increasing conventional power generation plants. Furthermore, energy efficiency is associated with many positive impacts at the individual, sectoral, national and international levels[160], among which:

- ✓ Improving people's health and well being by reducing pollution and improving people's comfort;
- ✓ Improving the competitiveness of local businesses by reducing their energy bills and improving the working conditions of their employees (all economic sectors) and the comfort of their clients (hotels, commercial spaces, etc);
- ✓ Generating an important number of direct and indirect jobs to implement energy efficiency solutions and induced jobs through the increased disposable income;
- ✓ Alleviating energy poverty by reducing the energy bills of low income households;
- ✓ Reducing the financial burden of energy subsidies on state budgets, and mitigating the financial impacts, on end users, of eventual energy subsidy reforms;
- ✓ Protecting the environment by reducing pollution and greenhouse gas emissions.

Making energy efficiency a top priority in the Arab region will, in addition, free up important amounts of energy that can be used to enhance exports in net energy exporting countries and substantially reduce the need for energy imports in net importing countries. Indeed, only EE has the potential of drastically reversing the frantic energy consumption trends, currently prevailing in the region, with the least costs, without reducing energy services or slowing down their economic development efforts.

In the European Union, improving energy efficiency, which is a main pillar of its energy strategy, allowed it to make an additional 17 percent of economic growth, in the last decade, while keeping the same level of energy consumption. And, Europe -based on its energy patterns, rules and systems that are currently in place- can reach an economic expansion of 35 percent by 2030, with about the same level of energy requirements that year as that of today. Furthermore, energy savings made by the world's largest economies, in the last 10 years, allowed them to produce, on average, an additional 18 percent of GDP[161].

The Arab region, with even greater energy efficiency potential than Europe had in the last decade, could drastically improve its energy productivity performance based on a more aggressive approach for implementing energy efficiency measures and programmes. Policymakers, in the region, should set ambitious targets and use their vested powers to mobilize all stakeholders around national agendas that make energy efficiency a top national priority. Adequate financial and human resources, similar to those dedicated to energy supply, should be made available to fulfill this national agenda as a matter of urgency.

The following energy efficiency gaps require immediate attention and comprehensive national plans of actions:

[160] Ryan and Campbell, 2012.
[161] Blok and others, 2015.

- Improving the effectiveness of the electrical energy supply systems:
  - ✓ Improving the overall power plant efficiencies, from a current average power-generation efficiency around 35 percent in the Arab region to best available technologies of about 55 percent, for new power plants equipments, and anticipating the replacement of existing ones near their retirement life.
  - ✓ Reducing distribution and transportation losses. These losses average about 12 percent in the Arab region with figures over 20 percent for many Arab countries, compared to 5 to 8 percent in most developed countries.
  - ✓ Promoting the demand side management of peak electric loads, by introducing smart network management and stimulating peak load displacement by appropriate electricity pricing tariffs and technologies. These strategies can free up substantial electrical capacities from electrical peak demand periods, postponing the need for additional power generation capacities, and shifting the production of substantial amounts of the electrical supply from low efficiency ancillary generators to high efficiency base-load generators.
  - ✓ Promoting cogeneration / tri-generation as a mean of providing energy services where feasible, especially in large industrial facilities, commercial centers, hotels and airports. Such systems can reach an overall energy efficiency of over 75 percent, with practically no associated power transmission or distribution losses. Furthermore, if properly designed and generalized through a coherent national programme, it can free-up needed electrical capacity for the grid and inject additional electrical power in the national electrical system[162].

- Improving energy efficiency in existing and new buildings:

The residential and services sectors accounted for about 60 percent of the electricity consumed by all Arab countries in 2013, of which 73 percent consumed by the domestic sector alone. Immediate attention should focus on the following:

- ✓ For new buildings: Developing, *or* ***reviewing***, building energy codes and standards using adequate whole building energy performance detailed simulation tools, and devising the appropriate instruments to enforce the developed standards. In fact, many of the developed building codes in the Arab region were developed using simplistic envelope thermal analysis approaches that are not at all appropriate for the climatic conditions prevailing in the Arab countries for all building types, nor any climate for non-residential buildings. Furthermore, the enforcement of the developed building energy codes has not yet been operationalized in many Arab countries.
- ✓ For the existing building stocks: Upscaling, through nationally designed and implemented programs, building energy retrofits using generic EE measures in all types of buildings, and using detailed energy audits in energy intensive buildings (large office and commercial buildings, airports, etc.). And systematic designation of energy managers in each public institutional building, or large office or commercial building.
- ✓ For all residential buildings, Develop/enforce energy labeling and minimum energy performance standards (MEPS) for household equipment, with priority work focusing on refrigerators and room air conditioners. Particular dispositions should be provided to deal with the informal market, representing a very large share of the market for these equipments in many Arab countries.
- ✓ Develop/enforce minimum energy performance standards (MEPS) for lighting equipments and systems.
- ✓ Develop/enforce MEPS for cooling and air conditioning equipment and systems, for all types of buildings.

- Improving energy efficiency in the industrial sector, by upscaling, through nationally designed and implemented programmes:
  - ✓ industrial energy retrofits using generic EE measures per branch of industrial activity for all branches of the industrial sector;
  - ✓ industrial energy retrofits of energy intensive industrial facilities (total share of energy consumption representing 80-85 percent of the industrial sector), through detailed energy audits;

[162] IEA, 2011.

- ✓ industrial energy management systems where appropriate (EMS), and systematic designation of energy managers in each industrial facility.

- Improving energy efficiency in the transport sector:

In the Arab region, more than 50 percent of petroleum products are consumed by the transport sector. Immediate attention should focus on the following:

- ✓ For the existing fleet, improving energy performance of operating vehicles through systematic maintenance and control
- ✓ For new vehicles, Fuel Economy Standards and Labeling
- ✓ Detailed energy audits for transport companies with sizable fleets of vehicles
- ✓ Support for sound management of freight transportation (creation of road freight hubs / terminals to reduce empty returns, etc.)
- ✓ Sound management of public transportation
- ✓ Fuel switching to LPG / CNG where feasible (higher energy efficiency and lower air pollution)

Appropriate energy efficiency policies should be developed to backstop these efforts, some of which can be based on current experiences in the Arab region and elsewhere. [163] [164]

3. *Appropriate renewable energy solutions to improve the energy mix and enhance energy security*

Many renewable energy solutions are technologically mature, and their costs on the international market have reached a very economically competitive level, when compared to conventional energy sources, and many technological options exist, ranging from individual to highly centralized systems. These systems can also be stand-alone type or grid integrated.

Also, many energy services can be directly provided by dedicated RE systems, without the need for producing electricity, as an intermediary step. Mature RE solutions for thermal applications, whether for domestic, commercial, recreational, industrial or agricultural uses, exist and offer much more efficient solutions for providing these services than RE power generation. Such solutions also exist for water pumping, whether for agricultural or other uses, as well as outdoor and street lighting.

Grid-connected individual systems, mainly PV, can offer an immediate and cost effective alternative for increasing power generation capacities in the Arab region. These types of systems provide electricity at the peak-load periods, when very inefficient conventional generating equipments are operated, and can be deployed gradually, with a high participation from end users in covering their costs, offering and additional relief to state budgets.

Micro-, mini- and off-grid renewable energy options can also offer a cost effective alternative for improving access to energy services in remote areas.

Each country, based on its own energy systems configuration and energy needs, can consider a panoply of RE options to provide sustainable energy solutions to its energy requirements. These options should be based on a through, and well informed, analysis of the energy demand side, and effective policies should developed, along with adequate implementation instruments, to encourage the most appropriate options to improve the energy mix in the country and enhance its energy security.

4. *Energy access beyond connection to the grid*

Despite the Arab countries' remarkable performance in terms of access to energy services (most of the countries with low performance are countries going through geopolitical crisis), some disparities between rural and urban areas still persist in many Arab countries. Also, being connected to the grid in the region is

[163] IEA, 2014c.
[164] UN ECE, 2015b.

no longer a guaranty of getting undisrupted electrical supply, and some countries, on a regular basis, or in particular circumstances, are rationing the hours of electrical supply to the grid connected end users. Also, several countries are simply discontinuing some public services, such as outdoor and street lighting in many locations. This is mainly due to lack of available electrical capacity.

Switching the perspective to providing quality energy services, rather than providing energy, would allow the consideration of a wider range of solutions to insure these energy services. National programmes based on up-scaling EE can allow more energy services to be provided with the existing capacities. Stand-alone or grid connected RE sources, whether through direct or indirect uses, can also free up electrical capacity at a very interesting cost for each nation, as well as extend energy access to rural areas.

Furthermore, up-scaling the use of appropriate renewable energy technologies in rural areas can contribute to the reduction of poverty and the reinforcement of gender equality. Indeed such solutions can provide many energy services and offer improved economic opportunities, associated with the new energy solutions, for rural men and women. This approach will require innovative energy planning, supportive political will and flexible enabling mechanisms. It also implies improving the access to financing, information, capacity building and markets. RE can therefore become a catalyst for greater equity in rural areas, in addition to being a sustainable source of energy..

Policies, and subsequent implementation instruments, to encourage energy substitutions are also to be considered. Indeed, electricity is used in many Arab countries to provide thermal energy services, whether in the domestic or industrial sectors. Water heating, cooking and other industrial thermal processes are mainly provided through electrical equipments in many Arab countries. Switching to GPL or natural gas where available, will free up a substantial amount of electrical capacity and will improve the overall efficiency of using primary energy at the national level.

Electrical pricing tariffs, based on time-of-use, can also play a significant role in displacing electrical consumption from time of peak loads to time of low loads, freeing up additional electrical capacity at the time it is most needed.

B. BARRIERS TO SUSTAINABLE ENERGY FOR SUSTAINABLE DEVELOPMENT AND POSSIBLE SOLUTIONS

There are several barriers hindering the progress of sustainable energy solutions in the Arab countries. The following is a presentation of some of the most important ones and various proposed ways forward to address them, based on lessons learned from experiences that are already taken place in the region.

1. *The need for a rationalization of energy subsidies in the region*

Energy subsidies can either be explicit, involving explicit transfers from the governments to either the energy producers or consumers, and registered on the state budgets as such. Or, implicit, occurring in oil and gas producing countries where governments mandates energy producers to sell energy to domestic consumers at prices that are above production costs but below international prices. In this case the implicit subsidies reflect the opportunity costs, or loss of revenues, due to wasting the possibility to sell the oil products at higher international market prices. These two types of subsidies, in their present indiscriminate way of allocation, present a serious distortion to the energy pricing system that constitute a heavy burden for the state budgets, and a hindering barrier for the development of sustainable energy solutions, and economic and social development in general as was discussed in earlier chapters.

Reforming the domestic energy pricing systems in the Arab region, by rationalizing the allocation of energy subsidies, will help in establishing more sustainable energy consumption patterns. This, in turn, will have very positive repercussions on the countries' economies, in both the NPEI and NPEE groups of countries. The NPEI group of countries will be able to free up fiscal resources to invest in key social development areas, such as health and education. And rationalizing domestic energy consumption in the NPEE group of

countries will increase the share of energy left for export, which still remains the main source of revenues for this group of countries to finance their socio-economic development.

Several Arab countries have engaged in such reforms, but many challenges needs to be met in the remaining Arab countries in order to tackle such endeavor.

Energy subsidies are a sensitive issue in the Arab region, and each country has a complex fiscal system to allocate them. With time, the energy subsidy systems have become, in most cases, black boxes with very little governance transparency, even within each country's institutions. It is therefore essential that each country proceeds with a thorough auditing and assessment of its current energy subsidy system, in order to evaluate its social and economic impacts, and propose the most appropriate means, and pace, for its reform. Experiences from Arab countries that already started the process, as well as others in the region, can provide some valuable insights regarding this process.

These past experiences show that it is highly recommended that the reforms be implemented gradually, and be accompanied by mitigating measures for the segments of society that will be negatively affected by these reforms, and a well designed communication campaign explaining the need for such price restructuring.[165] [166] One of the mitigating measures can consist of subsidizing substantial EE measures at the consumer level, during the transition period to market based energy prices. These subsidies can be sized in such a way to allow a reasonable pay-back period for the state budget, based on avoided subsidies resulting from the reduction of energy consumption associated with the EE measures. And, at the same time, provide an acceptable pay-back period for the consumer. This process should be implemented on a large scale to reach the largest share of targeted consumers, through an implementation mechanism that allow consumers to finance the EE measures, and insure their payments through reasonable monthly installments. This mitigation option is a win-win situation for all concerned parties: The state will simply have the amount of subsidies corresponding to the energy that would be saved dropped from its subsidy bill. And the consumer will have a substantial reduction in the energy that would be billed, and therefore can better accommodate the energy price increase due to the subsidies reforms.

Other transitional options can include a conditioned allowance of subsidized energy prices to businesses for a certain period of time, in return of implementing substantial energy efficiency measures during that period.

2. *The need for appropriate implementation instruments for sustainable energy solutions*

Developing and implementing sustainable energy solutions require the development of suitable policies, institutional frameworks and effective implementation instruments. In an environment, where conventional energy is heavily subsidized, as is the case in most Arab countries, classic market instruments for RE and EE cannot take off because the low conventional energy prices skew the energy market and prevent sustainable solutions from being economically viable. This is one of the main reasons why the market for classic Energy Services Companies (ESCOs) never took off in the region, despite more than a decade of attempts. Indeed, regulatory measures, alone, are not enough to create the mutation that is needed for sustainable energy solutions to be adopted on a large scale. In addition, sustainable energy solutions usually require important upfront investments and, in the absence of functioning market mechanisms, cannot have access to financing resources.

Some governments in the region have realized this dilemma and set up special national funds and other financial incentives to boost the implementation of EE and RE solutions. However, these instruments need to be largely scaled-up in order to meet the challenges that the domestic energy sector faces in the region. In fact, what is needed are public, or public-private partnership, structures presenting a certain *critical size*, which enables them to mobilize the required financial and human resources that are necessary to manage the RE and EE implementations processes and meet the associated challenges. These super-structures will also

[165] El-Katiri and Fattouh, February 2015.
[166] Sdralevich and others, 2014.

be able to mobilize a network of SMEs, through a system of accreditation, to insure the actual implementation of the EE and RE solutions on the field, thus creating a viable market for a body of small and medium size ESCOs, and new sustainable job opportunities in these fields.

And, since in most of the Arab region, state budgets are the main beneficiaries from the implementation of sustainable energy solutions, because of their radical impact on reducing energy subsidy burdens, governments should mobilize and funnel local and international financial resources through these proposed super-structures. EE, and to a lesser extent some RE technologies, also offer a source of energy that is at a lower cost to the nation than conventional sources, and therefore should mobilize similar financial and human resources as public utilities.

Two countries; namely Morocco and the UAE are leading the way in this respect as was discussed in Chapter III, and lessons learned from their experiences should allow the development, and generalization, of such models.

Morocco set up a sophisticated arrangement based on a specialized public financing company, representing s the state's financial instrument for the implementation of its energy strategy, operating as an investor, financial leverage and project co-developer. For RE, another public-private partnership company was created, MASEN, to carry out "*feasibility assessment, design, development, and financing of solar projects in Morocco, along with contributing to expertise and research in the solar industry. Its aims are both to develop energy but also to support the development of a new industrial sector in Morocco through training, capacity building, and research and development (R&D)*"[167]. An innovative financing architecture allows MASEN to play the role of contract holder in the power purchase agreements, and the role of an equity partner in the Solar Power Company, along with the winning bidders.

UAE set up a publically owned super ESCO, Etihad ESCO, mandated to target 30,000 existing buildings by 2030, and operating as a Super ESCO on a commercial basis, using the "Energy Performance Contracting" (EPC) as a contractual model, and involving accredited private ESCOs, so that Etihad ESCO is acting as an effective facilitator between building owners, ESCOs and Financial Institutions in order to remove the market barriers.

The two models differ from other experiences implemented in the Arab region by their creation of a viable independent, public or public-private, structure specialized in their respective activities and capable of managing large portfolios and inducing an important energy services market. The other experiences, based on setting up dedicated funds run by ad-hoc teams within an EE or RE national institution, stayed limited to the particular project for which they were created and did not have a commercial setting allowing them to insure certain sustainability in the market they initiated. However, these experiences were, and still are, a good starting point for implementing sustainable energy projects.

It is clear that timely and well designed policy reforms play an essential role in promoting investment in sustainable energy solutions, and their dissemination on a large scale[168].

For many Arab countries, well designed national action plans for sustainable energy solutions can also benefit from international climate change financing, particularly through the process of NAMAs (Nationally Appropriate Mitigation Actions).

3. *The need for a reliable energy information base to design, monitor and evaluate the implementation of sustainable energy solutions*

Policy trends and their macroeconomic, social and environmental impacts need to be monitored through pertinent macro policy indicators that are based on reliable energy and socio-economic data. These indicators

[167] http://www.ggbp.org/case-studies/morocco/moroccan-agency-solar-energy-and-moroccan-solar-plan
[168] UN ECE, 2015a.

are essential in evaluating the effectiveness of the designed policies in attaining the broad national goals set for the energy sector.

Collection of energy data statistics is not properly conducted in many Arab countries. Most data is available at the aggregate level, and only electrical data is available on a more desegregate levels. End use energy data is practically unavailable in most Arab countries, as well as the data related to the driving variables of these end uses. There is an urgent need to implement the following recommendations included in the Hammamet Joint statement[169], signed by the Secretary executives of the Five UN Regional commissions:

- ✓ ***"Establish** energy statistics programmes that monitor and report key energy production and consumption variables, and that are fully integrated into other economic and social national statistical efforts.*
- ✓ ***Collect** data on energy production and consumption patterns consistent with the desired future energy system. Monitor or make reliable estimates of energy consumption patterns in all economic sectors per energy source and for each of the main end uses.*
- ✓ ***Strengthen** analytical capacity of the different interactions involving energy policy, especially the water-energy nexus and the water-food-energy nexus, in order to provide innovative sustainable policy approaches to address these multidisciplinary energy-related issues."*

Planning for national energy options should be based on reliable energy data and well estimated key energy performance indicators. Benchmarking of energy performance, and setting of national targets for the level of uptake of energy efficiency and renewable energy, should be consistent with global ongoing programmes and initiatives, such as SE4LL[170] and the 2030 Agenda for Sustainable Development.

4. *The need for an adequate capacity development programme*

The transition to domestic sustainable energy systems and solutions in the Arab countries require targeted capacity development and building for all stakeholders: Policy makers, public institutions, utilities and private operators. Raising public awareness is also essential to accompany this transition and gain full adherence to the programmes to be implemented.

Capacity development programmes should be well designed and timely programmed. Particular attention should be given to the adequate qualification of all people involved in the design and implementation of the programmes and solutions, including suppliers and installers of associated equipments.

Full institutional and financial support should be provided to research and development in related fields, as well as training and education programmes preparing for the commercial introduction of new technology, and all capital and management skills to support the needed transitions.

Formal accreditation programmes for technicians and workers involved in the design and implementation of energy efficiency and cleaner energy solutions should also be put in place, as well as the associated verification instruments for the works to be conducted.

C. REGIONAL COOPERATION AS AN ESSENTIAL COMPONENT OF THE NEW SUSTAINABLE ENERGY SYSTEMS AND THE ROLE OF REGIONAL ORGANIZATIONS AND OTHER REGIONAL ENTITIES

Regional cooperation can be a key factor in facilitating, and speeding up, the transition to more sustainable domestic energy systems in the Arab region. This cooperation can take place at different levels:

[169] Joint Statement of the Executive Secretaries of the United Nations Regional Commissions for the 5th International Forum on Energy for Sustainable Development – Hammamet, Tunisia, 4-7 November 2014

[170] United Nations, 2013.

- Establishing interconnectivity between national electrical grids, or natural gas networks, in order to allow transnational energy exchange, and therefore virtually increase the installed capacity of the involved nations and enhance their energy security.
- Developing regional renewable energy and efficiency markets, and the deployment of renewable energy and other energy sources at a regional level.
- Exchanging experiences and developing common frameworks to serve as common instruments for the energy transition.

All these actions, if conducted successfully, can prepare the ground for a regional market for the new sustainable energy systems.

There are several regional institutions and programmes already operating in collaboration with each others, and with the majority of countries in the Arab region, to provide technical support related to sustainable energy systems and regional cooperation on energy issues in general. These include ESCWA, the Department of Energy of the League of Arab States, IRENA, the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) and MED-ENEC, and the EU project for promoting energy efficiency in the construction centre.

However these efforts should be further streamlined, and focused to insure the following:

- ✓ Conduct regional strategic studies related to the transition to new sustainable energy systems
- ✓ Develop and harmonize, at a regional level, standards for equipment energy performance labeling and MEPS
- ✓ Develop and harmonize, at a regional level, building energy performance codes, that are based on internationally recognized approaches
- ✓ Develop regional databases for energy data statistics and energy performance key indicators
- ✓ Develop and adopt at a regional level, *scientifically validated*, detailed energy performance analysis tools
- ✓ Develop and adopt at a regional level, *scientifically validated*, monitoring, reporting and verification tools
- ✓ Develop and conduct, at a regional level, related capacity-building programmes
- ✓ Develop web-based regional knowledge sharing and e-learning hubs for sustainable energy solutions, providing, for example, the following :
  - · A comparative knowledge base for proven and easy to implement technologies
  - · guidelines for developing successful programme implementation schemes
  - · A platform for consumers from the different countries to relate their experiences and inquiries
  - · A platform for professionals from the different countries to share their experiences
  - · A platform for suppliers from the different countries to publicize their products
  - · A database of available international financing mechanisms and best practices
  - · A database of proposed and approved institutional and policy reforms implemented in each country
  - · A database for other related information and documentation: financing schemes, capacity building, institutional strengthening, etc.

These regional institutions and programmes should also collaborate to play a stronger role in streamlining international cooperation programs, funded by different international donors, and taking place in the region, so that efforts are joined to achieve the common goals, and better serve the interest of the countries in the region. This requires that the necessary joint efforts are made to convince the active donors of the added value that can be brought by this course of action.

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Annex 1
Development status of national nuclear power program in Arab countries embarking on a nuclear power

	UAE	Jordan	Egypt	KSA	Algeria
National Position	First NPP of 1600 MW to start operation by 2017, 3 others NPP to follow	Bidder selected	bid invitation submitted	A knowledgeable commitment to nuclear energy made	Close to a knowledgeable commitment to nuclear energy
Milestone Reached	3	2	2	1	1
NEPIO Establishing	ENEC, 2009	JAEC, 2007	NPPA, 2006	KA-CARE, 2010	COMENA, 2006
Regulatory Body	FANR, 2009	JNRC, 2008 Converted to EMRC, 2014	NCNSRC, 1991	SAARA, 2014	under establishment
Issuing of Nuclear law	2009	2007, new one under drafting	2010	Under preparation	Under preparation
Site Selection for 1st NPP	Barakah	Al Amra	El Dabaa	site candidates: Jubail, Tabuk, Jizan	site candidates: 9 potential locations
Financial Approach	Construct-Operate-Privatize Full government financing	BOO Government 51% and supplier 49%	joint approach: internal and external resources with government guaranty	Expected to be Full government financing	Expected to be Full government financing
Funding Capacity	Very strong	week	week	Very strong	Very strong
Status of HRD[a/]	Under development	Well developed	Very Well developed	Under development	Very Well developed
Nuclear Research Facilities	Under development;	1 RR under construction	well developed nuclear R&D infrastructure, 2 RRs	Limited to radiation activities	well developed nuclear R&D infrastructure, 2 RRs
Main Events in 2015	Operating license application for Barakah units 1&2 sent, March 2015	cooperation agreement with Rosatom signed, March 2015	cooperation agreement with Rosatom signed, June 2015	cooperation agreement with Rosatom signed, June 2015	cooperation agreement with China CNNC signed, April 2015
Experience in big Project Construction	Excellent	limited	Good	Very good	limited
Model of nuclear fuel cycle	Open-end cycle with imported FE	Open-end cycle	Open-end cycle with FE fabrication	Under consideration	Under consideration

	UAE	Jordan	Egypt	KSA	Algeria
Waste Management	dual track	Model to be defined	national responsibility	Model to be defined	Model to be defined
Total installed capacity[b/]	27280 MW	3333 MW	31039 MW	58462 MW	15098 MW
Status of Electrical Grid	Very well developed	Well developed	Well developed	Well developed	Fair developed

a/ Availability of adequate staff in nuclear engineering and radiation protection

b/ *Source*: Arab Union of Electricity, 2013.

Annex 2
Regulatory instruments for Energy Efficiency

Country	Building codes	Mandatory MEPS for Appliances	Phasing out of inefficient lighting	Industrial EE Policies
Algeria	Thermal Regulations for new Buildings (1997)[a/]	Refrigerators; air conditioners	Mandatory EE labeling of EE light bulbs for residential use	Industrial establishments whose total energy consumption exceeds 2,000 toe • Mandatory energy audits • Mandatory energy management system • Mandatory energy reporting every three years
Bahrain	Thermal insulation implementation for buildings (1999)	Air conditioners[b/]	Minimum energy performance standards for household light bulbs	
Egypt, Arab Rep.	EE code for residential and commercial buildings	Refrigerators; air conditioners; washing machines	Technical Standards for EE light bulbs (CFLs, fluorescent and LEDs)	
Iraq	Reference EE specifications for Buildings (2012)[a/]			
Jordan	Thermal Insulation Code (1998)	Refrigerators; air conditioners; washing machines	Technical regulations for lighting products with minimum EE classification requirements	Any entity, whose annual energy consumption exceeds 50 toe per year, shall be subject to the mandatory and periodic energy audit carried out by the licensed entities.
Kuwait	Mandatory Energy Conservation Code of Practice for Buildings No R-6, (2014)	Air conditioners		
Lebanon	EE building code[a/]			Proposed energy audits for establishments whose annual energy consumption exceeds 400 toe.(Draft legislation under preparation)

Country	Building codes	Mandatory MEPS for Appliances	Phasing out of inefficient lighting	Industrial EE Policies
Morocco	Thermal Regulation for Construction in Morocco (mandatory from November, 2015)		Mandatory energy labeling of household electric lamps.	Energy intensive industries to undergo mandatory energy audits.
Qatar		Air conditioners	Banning the import of incandescent light bulbs starting from January 1st, 2014.	
Saudi Arabia	Saudi Energy Efficiency Building Code (2007)	Air conditioners		
Syria	Building Thermal Insulation Code (2006), effective since 2009	Refrigerators		Mandatory energy audits for state-owned industries
Tunisia	EE specifications for office buildings EE specifications for residential buildings Minimum EE performance specifications for hospitals and hotels[a/]	Refrigerators; air conditioners	The sale of incandescent light bulbs with an electric power superior, or equal, to 100 watt with a voltage superior, or equal, to 100 volt is banned, effective from January 1st, 2011. Mandatory energy performance labeling of electric lamps	Industrial establishments with annual energy consumption exceeding 800 toe • Mandatory energy audits • Mandatory dedicated energy manager • Mandatory energy reporting system every year. For new industrial projects whose total projected energy consumption exceeds 800 toe • Mandatory prior consultation with ANME For new construction projects for residential and tertiary sectors whose total projected energy consumption exceeds 200 toe • Mandatory prior consultation with ANME

Country	Building codes	Mandatory MEPS for Appliances	Phasing out of inefficient lighting	Industrial EE Policies
				For new industrial projects or expansion of existing industrial facilities whose total projected energy consumption exceeds 7,000 toe • Prior authorization from the ministry in charge of energy
UAE	Green Building Regulations and Specifications in Abu Dhabi (2011) Regulations on the Technical Specifications for Thermal Insulation Systems in Abu Dhabi (2003)	Air conditioners; refrigerators; washing machines	Banned the import of traditional incandescent light bulbs effective from July 1st., 2015	
Total Number of Countries that have developed legislation	12	10	8	6

Source: RCREEE, 2015a.

a/ Voluntary

b/ Under preparation

Annex 3
Energy institutions in Arab Countries

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
Algeria	Ministry of Energy and Mines (MEM)	National oil and gas company (SONATRACH) National refining company (NAFTAL) National oil production (NAFTEC)	SONELGAZ New Energy Algeria (NEAL)	Renewable Energy and Energy Conservation Directorate within the Ministry of Energy and Mines (MEM) Sharikat Kahraba wa Takat Moutadjadida «SKTM», Subsidiary of Sonelgaz Group Center for Development of Renewable Energy (CDER) Silicon Technology Development Unit (UDTS) Unit Development of Solar Equipment (UDES) Center for Research & Development of the Electricity & Gas (CREDEG)	National Agency for the Promotion and Rationalization of Energy Use (APRUE)	Commission de Régulation de l'Electricité et du Gaz (CREG)	Société de Gestion du Réseau de Transport de l'Electricité (GRTE)
Bahrain	Ministry of Energy	National oil and Gas Authority (NOGA)	Electricity and Water Authority (EWA)		Electricity and Water Authority (EWA)		Electricity and Water Authority (EWA)
Comoros			National Society for Water and Electricity (MAMWE)			National Society for Water and Electricity (MAMWE)	

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
Djibouti	Ministry of Energy and Natural Resources National Energy Commission (CNE)	International Hydrocarbon Company (SIDH)	Djibouti Electricity Company (EDD) A ten-year National Strategy and five-year Action Plan for the development of the electricity sectors under development.	Geothermal Energy Development Office(ODDEG) Center for Studies and Scientific Research of Djibouti (CERD) Social Development Agency of Djibouti (ADDS)	Agency for Energy conservation of Djibouti (ADME)		
Egypt	Supreme Council of Energy Ministry of Petroleum Ministry of Electricity and Renewable Energy (MOERE)	Egyptian General Petroleum Co., Egyptian Natural Gas Holding Co., Egyptian Petrochemicals Holding Co., Ganoub El-Wadi Holding Co., Egyptian Geological Survey and Mining Authority	Egyptian Electricity Holding Company (EEHC) Hydropower Project Authority	New and Renewable Energy Authority (NREA) Green Tourism Unit under the Ministry of Tourism	Energy Efficiency Unit (EEU) under the Cabinet of Ministers	Electricity Regulatory and Consumer Protection Agency (EgyptERA)	Egyptian Electricity Transmission Company (EETC)

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
Iraq	Ministry of Oil, Ministry of Electricity (MOE)	Iraq National Oil Company (INOC)	Ministry of Electricity (MOE)	Center for R E and Environment under the Ministry of Science and Technology, Research Center under the Ministry of Higher Education and Scientific Research (universities and institutes), Energy and Environment Research Center under the Ministry of Industry RE at the Ministry of Electricity	working group on EE at the Ministry of Electricity	Regulatory Authority, affiliated to Ministry of Electricity (MOE)	Directorate of Transmission Directorate of Transmission Project
Jordan	Ministry of Energy & Mineral Resources (MEMR)	Directorate of oil and products Directorate of national gas Jordan Petroleum Refinery Company Jordan Oil Shale Company (JOSCO)	National Electric Power Company (NEPCO)	Directorate of Renewable Energy and Energy Efficiency Fund under MEMR National Energy Research Center (NERC)	Directorate of Renewable Energy and Energy Efficiency Fund under MEMR	Energy and Mineral Regulatory Commission (EMRC)	National Electric Power Company (NEPCO)
Kuwait	Ministry of Oil Ministry of electricity and water (MEW)	Kuwait Petroleum Corporation (KPC) Kuwait Oil Company	Ministry of Electricity and Water (MEW)	Kuwait Institute for Scientific Research (KISR)	KISR		Ministry of Electricity and Water (MEW)

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
Lebanon	Ministry of Energy and Water	General Directorate of Oil Lebanese Petroleum Administration (LPA)	Electricity of Lebanon (EDL)	Lebanese Centre for Energy Conservation (LCEC) CEDRO (Empowering Lebanon with Renewable Energy), Industrial Research Institute (IRI), National Council for Scientific Research (CNRS) Lebanese Standards Institution (LIBNOR) Higher Council for Privatization (HCP) Lebanese Solar Energy Society (LSES) Lebanese Association for Energy Saving and Environment (ALMEE)	Lebanese Centre for Energy Conservation (LCEC) Lebanon Green Building Council (LGBC) Lebanese Association for Energy Saving and Environment (ALMEE)		Electricity of Lebanon (EDL)
Libya	Ministry of Oil and Gas, Ministry of Electricity and Renewable Energy	National Oil Corporation (NOC)	General Electricity Company of Libya (GECOL)	Renewable Energy Authority of Libya (REAOL) Centre for Solar Energy Studies		Electricity regulatory Department has been established, but not active	General Electricity Company of Libya (GECOL)

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
Mauritania	Ministry of Petroleum, Energy and Mines, Department of Minerals and Energy	Mauritanian Society for Gas Distribution (SOMAGAZ) Mauritanian Company of Refining Industries (SOMIR)	Mauritanian Society of Electricity (SOMELEC)	National Renewable Energy Agency (ANADER)		Ministry of Energy and Power (MEP) Regulatory Authority (ARE) Agency for the Promotion of Universal Access (APAUS) Rural Electrification Development Agency (ADER)	

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
Morocco	Ministry of Energy, Mines, Water and Environment (MEMEE)	Directorate of Fuels Directorate of Mines and Hydrocarbons National Office of Hydrocarbons and Mines (ONHYM) SAMIR: Private Refining Company 15 private distribution companies of petroleum products	National Office for Electricity and Water (ONEE)	Directorate of RE & EE under the Ministry of Energy, Mines, Water and Environment (MEMEE) Moroccan Agency for Solar Energy (MASEN) Agency for the Development of Renewable Energy and Energy Efficiency (ADEREE) Information Centre for Renewable Energies and the Environment (CIEDE) Association of Solar and Wind Power Enterprises (AMISOL) National Center for Scientific and Technical Research (CNRST) Institute for Research into Solar and Renewable Energy (IRESEN) Energy Investment Company (SIE)	Directorate of RE & EE Agency for the Development of Renewable Energy and Energy Efficiency (ADEREE) Energy Investment Company (SIE)	No agency up to now but implementation is planned later on	National Office for Electricity and Water (ONEE)

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
Oman	Ministry of Oil and Gas, Ministry of Electricity and Water	Oman Oil Company (OOC) Oman Oil Refineries and Petroleum Industries Company (ORPIC)	Rural Area Electricity Company (RAECO)	General Organization for Electricity and Water-Universities	General Organization for Electricity and Water-Universities	Authority for Electricity Regulation	
Palestine	Palestinian Energy Authority (PEA)	Palestinian Energy and Environment Research Center (PEC)	The Palestine Power Generating Company (PPGC)	Palestinian Energy and Environment Research Center (PEC) Energy Research Center (ERC) at An-Najah National University	The Energy Efficiency Directorate (EED)	Palestinian Electricity Regulatory Council (PERC)	Palestinian Electricity Transmission Company Ltd. (PETL)
Qatar	Ministry of Energy and Industry Department of Energy	Qatar Petroleum(QP) QATARGAS RasGas	Qatar General Water and Electricity and Corporation (Kahramaa)	Qatar Science and Technology Park (QSTP), Qatar Energy and Environment Research Institute (QEERI), Qatar Solar Technologies (QST), Qatar Electricity and Water Company (QEWC)	Qatar Electricity and Water Company (QEWC)		Qatar General Electricity and Water Corporation "KAHRAMAA"

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
Saudi Arabia	Ministry of Petroleum and Mineral Resources Ministry of Water and Electricity	Saudi Arabia oil Company (Saudi Aramco) King Fahd University of Petroleum and Minerals (KFUPM)	Saudi company for Electricity	King Abdallah City for Atomic and Renewable Energy (K A CARE) King Abdallah City for Science and Technology (KACST)	Saudi Energy Efficiency Center (SEEC)	The Electricity and Co-Generation Regulatory Authority (ECRA)	Saudi Electricity Company (SEC)
Somalia		Somalia Petroleum Corporation (SPC)	Nugaal electric Co-operative (NEC)	Association for Sustainable Energy and Development	Association for Sustainable Energy and Development-NGOs		
Sudan	Ministry of Oil, Ministry of Water Resources and Electricity	Sudan Corporation of oil	National Electricity Corporation (NEC)	Directorate of Renewable and Alternative Energy within the Ministry of Water Resources and Electricity Research Institute in RE at the National Center for Research (NCR)	Energy Research Institute (ERI)	Electricity Regulatory Authority (ERA)	Sudan Electric Transmission Company (SETCO)

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
Syria	Ministry of Oil and Mineral Resources	Syrian Petroleum Company (SPC) General Corporation for Oil General Corporation for Refinery and Oil Products,	Public establishment for electricity generation (PEEG) Public establishment for electricity transmission (PEET) Public establishment for distribution and exploitation of electrical energy (PEDEEE) Syrian Engineering Company for Solar Power (SECSP)	National Energy Research Centre (NERC) Scientific Studies and Research Center Higher Institute for Applied Sciences and Technology Research centers in universities, mainly Damascus University Industrial research and Testing Center	National Energy Research Centre(NERC)		Public establishment for electricity generation (PEEG) Public establishment for electricity transmission (PEET) Public establishment for distribution and exploitation of electrical energy (PEDEEE)
Tunisia	Ministry of Industry, Energy and Mines	Tunisian National Oil Company (ETAP) Tunisian Refining Industries Company (STIR)	Tunisian Electricity and Gas Company (STEG)/STEG-ER	Tunisian Electricity and Gas Company (STEG)/STEG-ER Research and Technology Center of Energy (CRTEN)	National Agency for Energy Conservation (ANME)	Directorate General for Energy of the Ministry	Tunisian Electricity and Gas Company (STEG)

Countries	Concerned Energy Entities	Hydrocarbons directorates /companies	Concerned Electricity utility	RE (Dedicated RE Department, Agency, R&D Unit, Center, etc.)	EE	Independent Electricity Regulatory	Power Off-taker for Large-scale RE Projects
UAE	Ministry of Energy (MOE) Ministry of Electricity and Energy	Abu Dhabi National Oil Company	Abu Dhabi Water and Electricity Company (ADWEA) Dubai Electricity and Water Authority (DEWA) Sharjah Electricity and Water Authority (SEWA) Federal Electricity and Water Authority (FEWA)	Department of Clean Energy and Climate Change at the Ministry of Energy (MOE)Dubai Carbon Center of Excellence (DCCE), MASDAR (the Abu Dhabi Future Energy Company)	MASDAR Institute of Science and Technology (MIST) Dubai Carbon Center of Excellence (DCCE)	Abu Dhabi Regulation and Supervision Bureau (RSB)	Dubai Electricity and Water Authority (DEWA) Abu Dhabi Water and Electricity Authority (ADWEA)
Yemen	Ministry of Oil and Minerals Ministry of Electricity and Energy	Yemen Oil and Gas Corporation Yemen LNG Company	Public Electricity Corporation (PEC)	RE Department at the Ministry of Electricity and Energy, Public Electricity Corporation (PEC)	University of Science and Technology Technical Center for Training and Registration – Dhahban, Global Green Growth Institute	Regulatory Body assigned by electricity law 2009 (not functioning yet)	Public Electricity Corporation (PEC)

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This report analyses past trends in domestic energy policy in the Arab region and the capacity of today's policies and institutions to reverse current unsustainable production and consumption patterns, and meet development and energy security needs. It also contains recommendations for more effective policies and greater regional cooperation on the development of sustainable energy systems.

15-00568