Energy Efficiency

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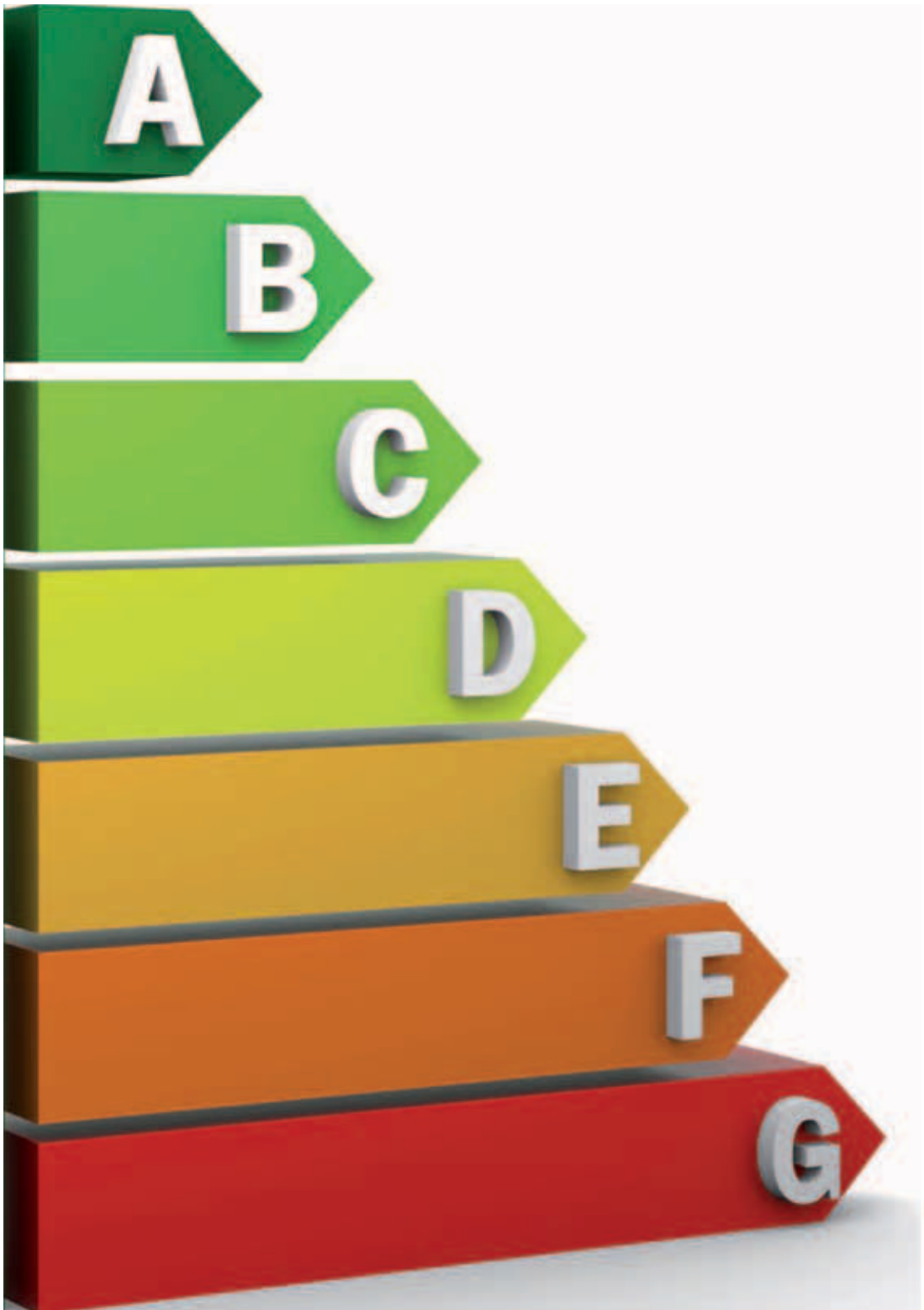

Current trends in patterns of energy use put the Arab economies among the least efficient ones in global comparisons. There has been no decoupling between economic growth and energy demand in the Arab region in the past decade. Growth in energy consumption has been faster than economic growth during the past decade; average annual GDP growth was around 4%,while the increase in primary energy and electricity demand has been about 8%. This trend implies energy is not being used effectively to produce value within the regional economies. The average primary energy intensity in the region in 2010 constituted about 0.2 Tons of Oil Equivalent (Toe)/$1000, which is slightly above the world average of 0.19 and about 31% higher than the European average of 0.14 Toe/$1000.

Fossil fuel subsidies are a contributing factor to this inefficient use of energy. In Arab electricity markets, price subsidies represent one of the major challenges to progress of efficiency measures. The Arab residential markets are the most heavily subsidized, with some countries offering an implied subsidy of up to 95%. In the transport sector, the average specific energy consumption of private cars in the region remains notably higher than the average consumption in EU countries.

Another factor is the prevalence of inefficient electricity infrastructure in most countries of the region. Average Arab electric energy losses in generation, transmission and distribution (19.4%) are higher than the world average (8.3%) and much higher than the EU average (5.8%), presenting ample opportunity for achieving energy savings.

The potential gains from economically feasible efficiency measures are substantial. Various studies estimated that with implementation of energy efficiency building codes in the Mediterranean countries, the total primary energy savings could constitute 183 Million Toe over the period of 2012 to 2030, with annual CO2 reductions of 82 Million Tons. Reducing losses in the transmission and distribution of electricity to 10% in all countries would save the region some 7,300 MW of power, equivalent to US$5.5 billion of new investments. Transition to efficient lighting (CFLs) in the whole region would generate energy savings of 1.67 TWh per year, and result in 2.56% reduction of CO2 emissions.

Making the transition to more energy efficient economies requires substantial effort. The chapter presents and discusses several recommendations on making this transition through: careful energy planning, introducing cost-reflective electricity tariffs, strengthening compliance and enforcement, and instituting strong institutional framework. Experiences from the region show that countries with dedicated energy efficiency agencies tend to have stronger EE regulatory framework and better EE performance.

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I. INTRODUCTION

The Arab world is generally characterized by a relatively high level of consumption that, although offset by significant energy production, represents an unsustainable long-term pattern. The region relies almost entirely on fossil fuel for meeting its energy demands and most countries heavily subsidize energy prices. Despite rapidly growing energy demands and declining reserves of fossil-fuel, the region continues to be one of the most energy-intensive regional economies in the world resulting in an increase of associated greenhouse gas (GHG) emissions. With rapid urbanization, and population and economic growth, the trend is towards an even greater rise in energy intensity (El-Katiri, 2012).

Recognizing the importance of energy efficiency (EE), the League of Arab States on 25 November 2010 adopted the Arab Energy Efficiency Guidelines in order to promote cost-effective improvements of end use electricity in its member states through guiding targets, mechanisms, incentives, and institutional framework. However, despite pronouncements by Arab leaders for more sustainable energy development, today only few countries in the region have published energy efficiency strategies with quantified targets and supporting policy measures. There are still many social, economic and political barriers to EE that need to be overcome. This chapter discusses the current trends of energy efficiency in the region, outlines major factors contributing to inefficiency, provides overview of current efforts to overcome challenges and presents pathway to pursue energy efficiency in the region.

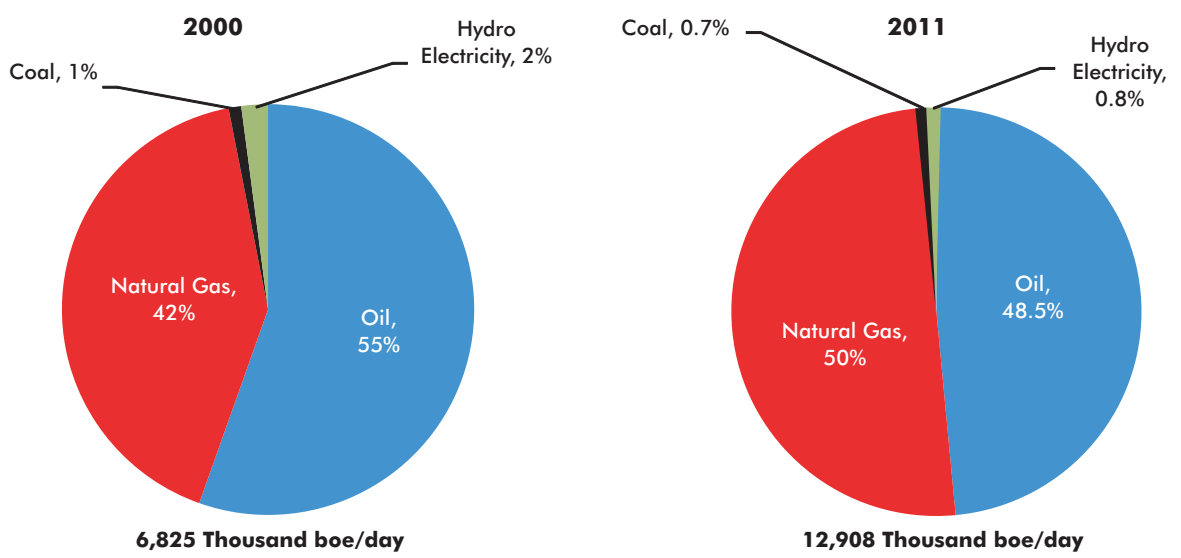
II. CURRENT TRENDS OF ENERGY SUPPLY AND DEMAND

A. Primary and Final Energy Consumption

Energy consumption in the region continues to be dominated by fossil-fuels. In 2011, the primary energy consumption mix was dominated by oil products (48.5 percent) and natural gas (50 percent), with coal (0.7 percent) playing a minor role and hydro electricity (0.8 percent) being the only form of renewable energy to make a measurable impact. As can be observed from Figure 1, the situation has not changed significantly since 2000. The main trend is the increasing use of natural gas, with a relative reduction in share amongst all other sources.

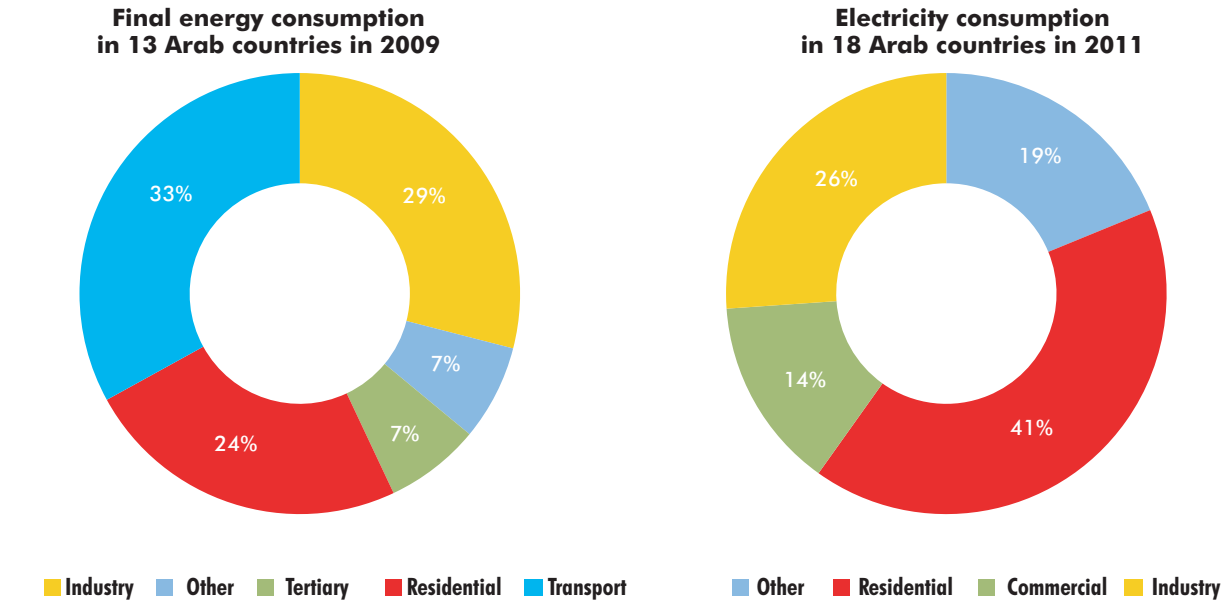
On an absolute basis during the 2000 to 2011 period, the annual regional consumption grew by 89 percent, from 6,825,000 to 12,908,000 barrels of oil equivalent per day (boe/day). Consumption

FIGURE 1 **ARAB COUNTRIES' PRIMARY ENERGY CONSUMPTION SOURCES (2000 AND 2011)**



Source: OAPEC Annual Statistical Report (2005, 2012)

FIGURE 2 ARAB COUNTRIES FINAL ENERGY AND ELECTRICITY CONSUMPTION



Source: RCREEE & Plan Bleu study (2012); AUE (2011)

of all forms of energy increased over the period, with the exception of hydroelectricity. Such high growth in energy demand has resulted in increased air pollution and concentrations of GHG emissions. In thirteen selected Arab countries, CO_2 emissions from fuel combustion in 2009 constituted three times higher than OECD average (RCREEE & Plan Blue study, 2012). The region has also high levels of local airborne pollution. It is estimated that urban air pollution causes 40,440 premature deaths per year in 8 selected Arab countries. In Egypt alone, the costs of harm due to air pollution constituted 2.1 percent of GDP, accounting for 44 percent of the total costs of environmental degradation in the country (ESMAP, 2009).

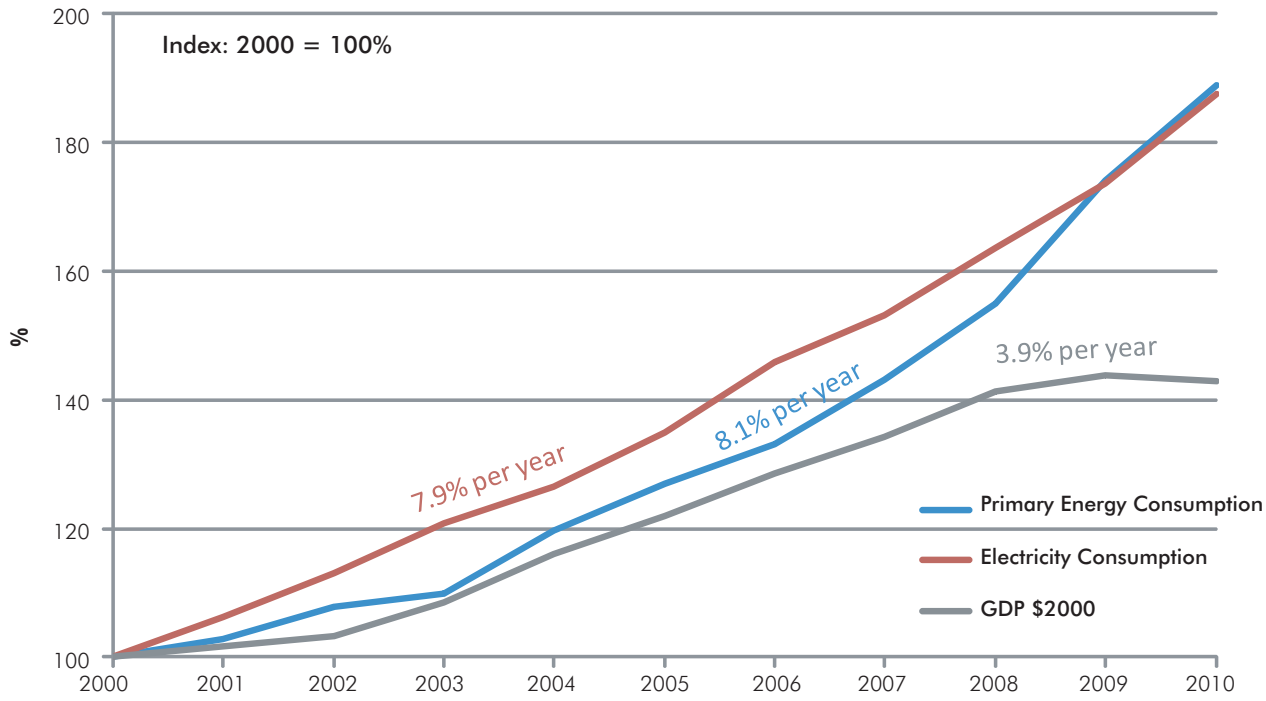
Figure 2 illustrates final energy consumption by sector in 2009 in 13 selected Arab countries. As can be observed from this figure, transport sector accounted for the largest share of total final energy consumption with 33 percent. By fuel type, final energy consumption was dominated by oil products (67 percent); followed by natural gas (15 percent); electricity (17 percent) and coal (1 percent). In the electricity consumption residential sector represents the largest consumer group (41 percent) followed by industry (26 percent).

B. Energy Intensity and Economic Decoupling

As illustrated in Figure 3, there has been no decoupling between economic growth and energy demand in the Arab region in the past decade. In fact, growth in energy consumption has been faster than economic growth during the past decade; average annual GDP growth was around 4 percent, while the increase in primary energy and electricity demand has been about 8 percent. This trend implies energy is not being used effectively to produce value within the regional economies.

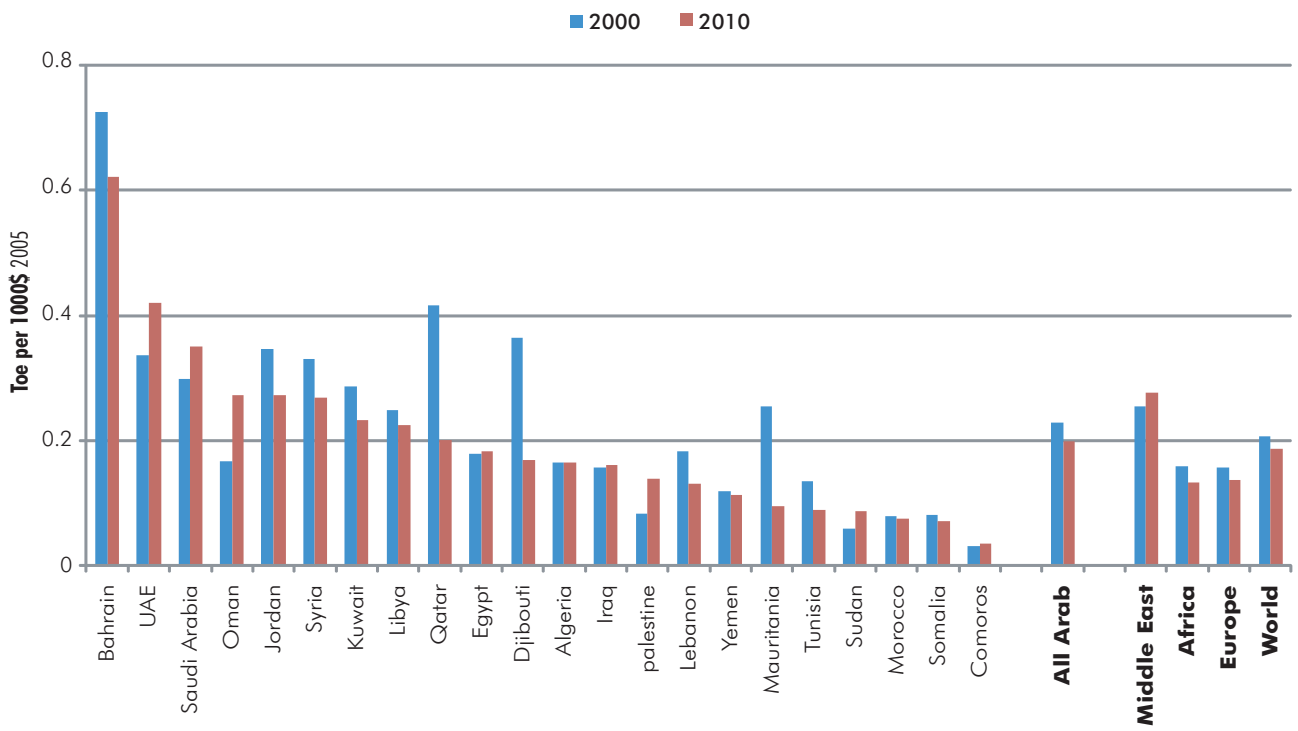
Figure 4 illustrates primary energy intensity of the countries at the macro level. Primary energy intensity is measured as the ratio between the total primary energy consumption and the country's Gross Domestic Product GDP. It measures the amount of energy input required to generate one unit of GDP. By expressing at Purchasing Power Parity (PPP), GDP is adjusted to reflect the differences in the cost of living in different countries (ENERDATA, 2012). The average primary energy intensity in the region in 2010 constituted about 0.2 tons of oil equivalent Toe/1000 US$ 2005 value, which is slightly above the world average of 0.19 and about 31

FIGURE 3 **PRIMARY ENERGY CONSUMPTION, ELECTRICITY CONSUMPTION AND GDP TRENDS (2000 TO 2010)**



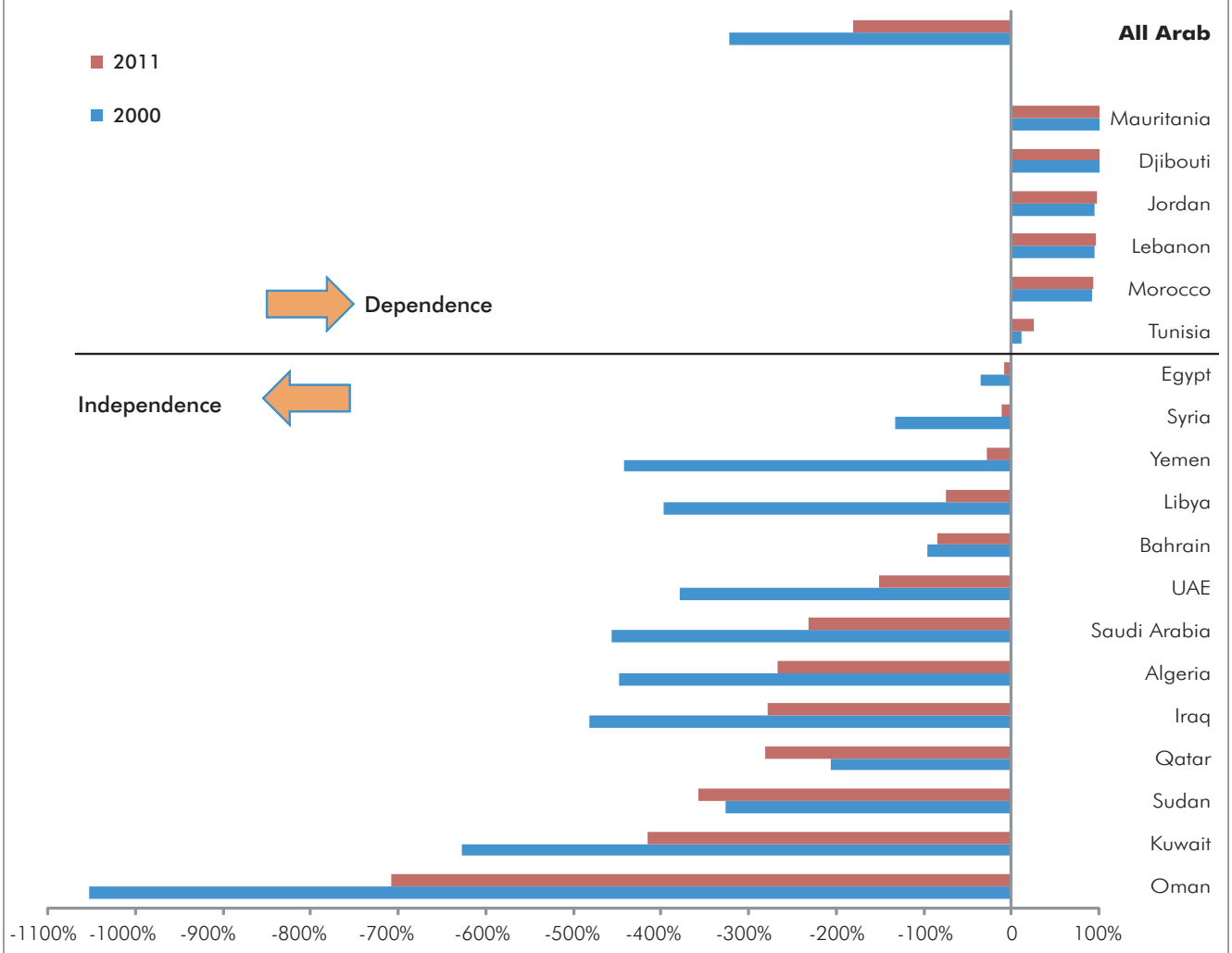
Source: OAPEC (2005, 2007, 2012); EIA (2013); World Bank (2013)

FIGURE 4 **PRIMARY ENERGY INTENSITY (TOE/1000 US$ 2005 VALUE) FOR ARAB COUNTRIES (2000 AND 2010)**



Source: U.S. Energy Information Administration

FIGURE 5 **ENERGY DEPENDENCY RATIO FOR ARAB COUNTRIES (2000 AND 2011)**



Source: OAPEC Annual Statistical Report (2005, 2012).

percent higher than the European average of 0.14 Toe/1000 US$ 2005 value. Within the group, results are widely divergent with a factor of 17 separating Bahrain on the high end and Comoros on the low end of energy intensity.

While the trend among most of the Arab countries is a decrease in primary energy intensity, the Middle East region shows an upward trend over the past decade. This can be attributed to the energy-intensive industries in countries that are rich in petroleum resources. Even with this in mind, however, the data indicate that the energy efficiency of these activities is not improving in relation to their contribution to GDP.

C. Energy Dependency

In light of trends of rising energy consumption and declining reserves of fossil fuel, the status of countries as net energy importers and exporters is also changing. Energy dependency ratio is a measure of a country's ability to supply its primary energy consumption needs through domestic energy sources.

As illustrated in Figure 5 below, the general trend for nearly all countries is shifting toward greater energy dependence, including the net exporting states. This dependence is occurring due to a combination of demographic, supply and

demand forces. In some cases, declining domestic energy reserves are the main factor, and elsewhere increasing demand is driving the trend. The only countries with rising energy independence are Qatar and Sudan; in the case of Qatar, it is due in large part to the recent increased exploitation of natural gas liquids, and Sudan began commercially producing oil only in 1993. The general trend invites a serious discussion in Arab countries of the required shift for their economies, and the role that alternative fuels and energy efficiency might play in substituting for their depleting oil resources.

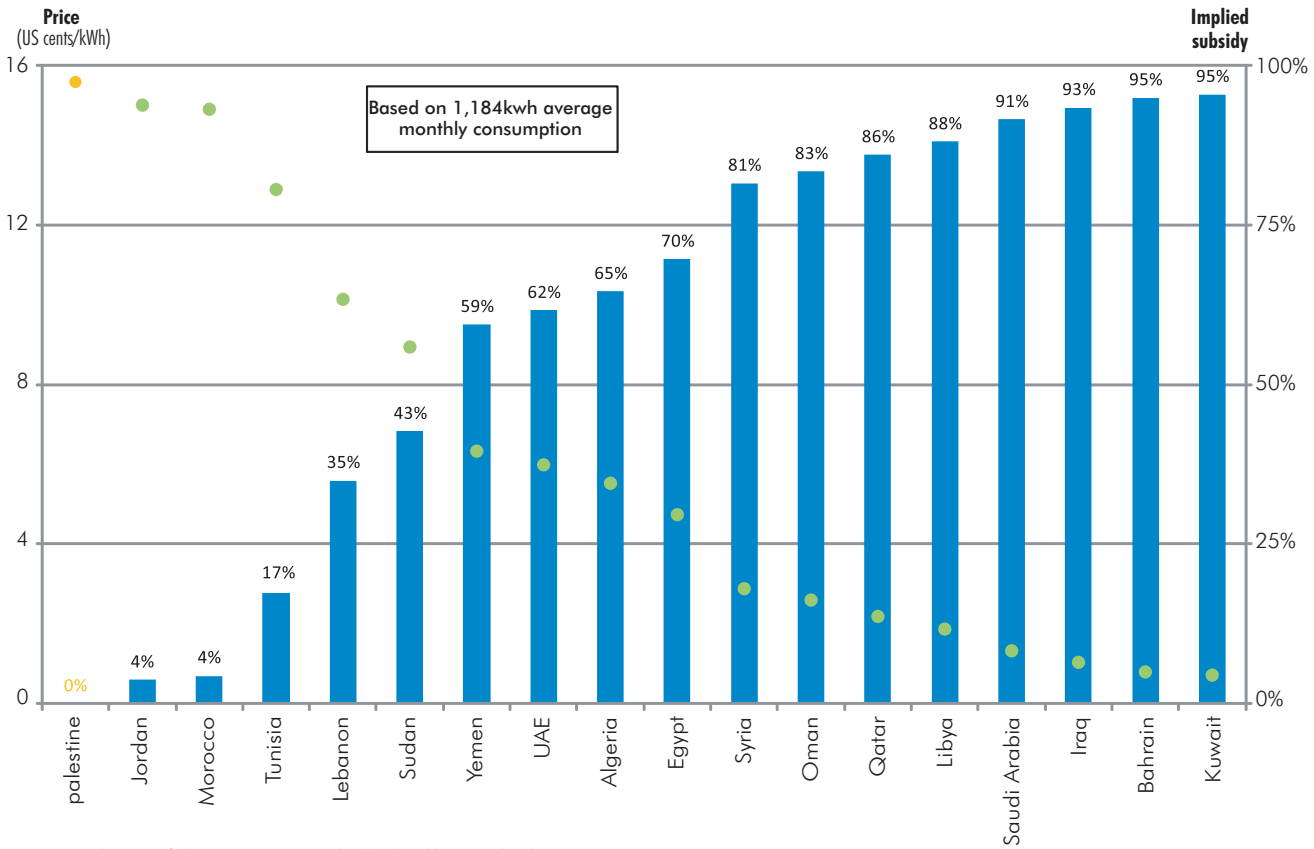
Countries with a high degree of energy independence generally have low motivation to conserve their oil or to switch to another energy source for domestic consumption. The appeal of energy efficiency might be to reduce the lost sales revenue caused by ineffective utilization of energy. For countries in a balanced position, the maintenance of current production levels will allow the national energy bill to be covered. But most of those countries are experiencing declining oil output along with consumption growth, so the trend is downward for self-sufficiency. A third group is almost totally reliant on imports to meet their energy demand, which creates strain on government finances and leads to uncertainty regarding future pricing and availability. Motivation should be high to improve the performance of all energy consuming aspects of their societies, if the price is reasonable. So the motivations can be different between the various Arab countries, but some type of efficiency-related driving force can exist for each.

III. ENERGY PRICING SCHEMES

Appropriate energy pricing is an essential part of energy efficiency policy. Energy subsidies are a major reason for lack of energy efficiency progress in the Arab world. The region has a strong tradition of maintaining relatively low consumer prices for fossil fuel, and subsidies in general constitute on average more than 20 percent of governments' expenditures (ESMAP, 2009). In Egypt, energy subsidies in 2010 constituted 21 percent of the fiscal year's budget and 73 percent of total subsidies (Castel, 2012). All countries in the region subsidize fossil fuel products, and most subsidize electricity (ESMAP, 2009). Fossil fuel subsidies encourage inefficient allocation of scarce resources, wasteful and irrational consumption of energy. Furthermore, they discourage investments and efforts to develop more efficient systems. A natural consequence includes smuggling of petroleum products across countries' boundaries due to price disparities between neighboring countries (El-Katiri, 2012). In 2012, media reported that Gazans had resorted to buying Egyptian black market diesel, which cut the price from US$ 1.85 to as little as US$ 0.67 (Naylor, 2012).

Fossil fuel subsidies constitute a heavy burden on national budgets. In the Arab region, six countries are already experiencing a significant annual budget deficit: Egypt, Syria, Yemen,

FIGURE 6 **RESIDENTIAL ELECTRICITY PRICES AND SUBSIDIES BENCHMARKED TO PALESTINE (2011)**



Source: Arab Union of Electricity (2012a, 2012b), developed by B. Samborsky/RCREEE

Jordan, Lebanon and Tunisia. The general increase in oil prices is further exacerbating the situation (ESMAP, 2009). In Lebanon, it has been estimated that the electric power utility offers an average subsidy of around 9.78 US cents per kilowatt-hour (kWh) (NEEAPs). At total annual production of around 11,500 gigawatt-hour (GWh) (Policy Paper, MOEW, 2011), the annual deficit created by fuel subsidies is around US$ 1.1 billion. This value is expected to have surpassed US$ 1.4 billion currently, given the increases in prices over the past three years.

In Arab electricity markets, price subsidies represent one of the major challenges to progress of efficiency measures. In almost all segments some subsidy is evident, based on prices paid by end users. This has a negative effect due to the challenge it poses to investment in efficiency. Basic conservation efforts also appear less attractive in markets where subsidies distort the value of energy.

Data on Arab electricity prices for residential and industrial customers are presented in Figures 6 and 7, respectively. These represent a typical customer, based on average monthly consumption from 18 countries in the region. For residential customers the average is 1,184 kWh per month, and for industrial customers the average is 50,113 kWh per month. The price per kWh has been identified for the same consumption level in all countries using local utility rate structures.

The left scale denotes the electricity prices paid in each country. Palestine's prices are used as benchmarks. Palestine has very little generation capacity and receives its electricity from Israel[1]. Energy prices in Palestine are close to international prices and represent approximate actual electricity cost passed through by Israel, which can be compared to neighboring countries. The difference between Palestine's market price and price paid in each country is referred to as the implied subsidy, shown on the right scale.

DEAD SEA DEVELOPMENT ZONE PROJECT – JORDAN

Florentine Visser

The Dead Sea is a unique landscape with great cultural and economic significance for Jordan. Its tourism sector is expected to increase by 14,000 new rooms over the next 20 years. In this fragile ecosystem, such a development needs to be handled with care, which explains why Jordan Development Zones Company sets high environmental standards in the Dead Sea Development Zone Master Plan. For the energy part of it, MED-ENEC provided support through an Energy Efficiency Study, identifying three energy saving packages for the Corniche District, the first stage of the development. Five reference building types were indentified (residential, hotel/3-star, hotel/5-star, resort, and mixed use). For each, three packages (Baseline, Economical and Ecological) were assessed by the Energy Balance Model, based on the EN 13790 standard for thermal performance of buildings.

The baseline package was initially based on the practice of the Jordan Building Code only. The first simulations showed that the cooling and the hot water supply (especially for the hotels and resorts) represent the most significant energy demands.

To reach out above national standards, as part of the environmental ambitions of the project, this baseline was improved with passive, almost no-cost, measures on the design level as optimized orientation, use of light colors, (absorbance rates less than 0.350), window-wall ratio of maximum 15% for west and east facades, 20% for facing elevations, 30% for north orientation, and window shading indicated by a Solar Heat Gain Coefficient (SHGC) of maximum 0.25.

A remarkable finding in this case was that, due to specific climatic conditions (high solar gains resulting in dominant cooling loads and hardly a need for heating), there was no need to increase the thermal resistance of the building envelope. These improvements resulted in a reduction of the final energy consumption of 7% for a 3-star hotel (mainly due to the reduction of the wall window ratio), and 29 % for a residential building (mainly due to external shading). This improved baseline package is to be mandatory for all buildings in the project

The Economical package showed a reduction of the final energy consumption, compared to the Jordanian Building Code, of 47% for the 3-star hotel (mainly due to the solar water heaters), and 64 % for the residential building.This package includes all the passive measures of the baseline plus energy efficient options, stated by certified label, for lighting, ventilation, cooling, and solar thermal for hot water.

The Ecological package includes international best technical practices and increased renewable energy measures, minimizing the final energy consumption to

Arab residential markets are the most heavily subsidized, with some countries offering an implied subsidy of up to 95 percent. Predictably, the countries with the highest energy dependency ratios – Jordan, Lebanon, Morocco, and Tunisia – provide the least subsidies due to economic necessity.

The case of Morocco is noteworthy, specifically in its industrial pricing. Users there are actually paying a premium compared to the price in Palestine, with the highest prices of all Arab countries. This policy decision in Morocco has several drivers, such as proximity and connection to the Spanish market, and legitimate attempts at market reform through progressive policies.

The subsidies of today are the result of policy decisions in the past. It is an inherited problem that both dictates and limits future choices. Keeping electricity prices low is considered a form of social assistance, allowing those who would otherwise not afford it to have access. Despite the clearly understood negative impacts of fossil fuel and power subsidies on the national economy

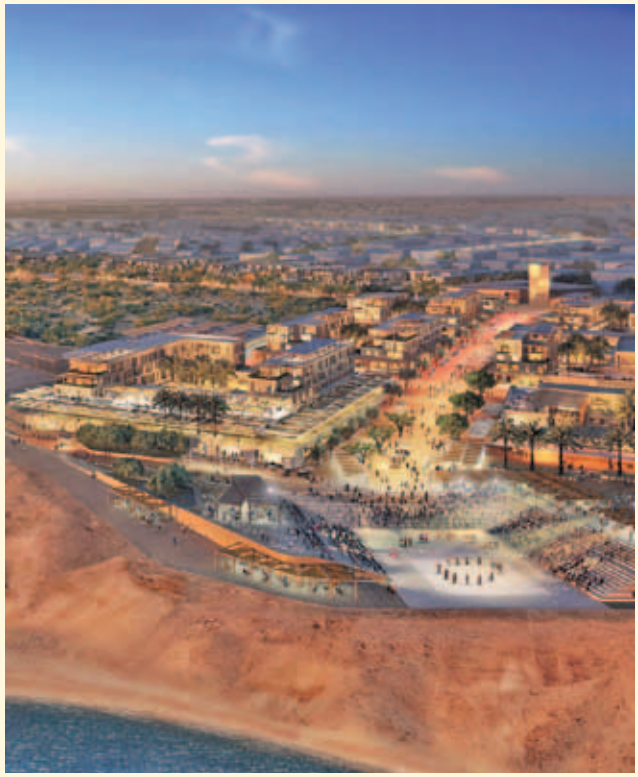
91% for the 3-star hotel, and to 125% for the residential building (becoming an energy supplier to the grid).

The following measures are included on top of the economical package: building envelope air-tightness improvement, lighting systems with LED applications and occupancy sensors, HVAC system with demand controlled ventilation (CO_2 or VOC), heat/cold recovery and most efficient (high temperature and surface) cooling systems (COP 5.5), and Photo Voltaics (PV) for electricity generation.

To make the 'Economical' and 'Ecological' energy saving packages visible, the study proposed to market the packages as Gold (economical) and Platinum (ecological) levels, with a related possible benchmark of final energy consumption in kWh/m²y, for innovation in design and technology development, as indicated in the below table:

Final Energy Benchmark (kWh/m²y)	**Economical (Gold level)**	**Ecological (Platinum level)**
Residential (detached or free standing)	50	10
Tourism facility	150	50
Retail (extracted from mixed use)	200	100

More Info:
Dead Sea Development Zone Project by the Jordan Development Zones Co. www.jdz.jo/page.php?pageName=dead-Sea-Development-Zone&pageTitle=Dead Sea Development Zone



Dead Sea Development Zone Commission - Jordan

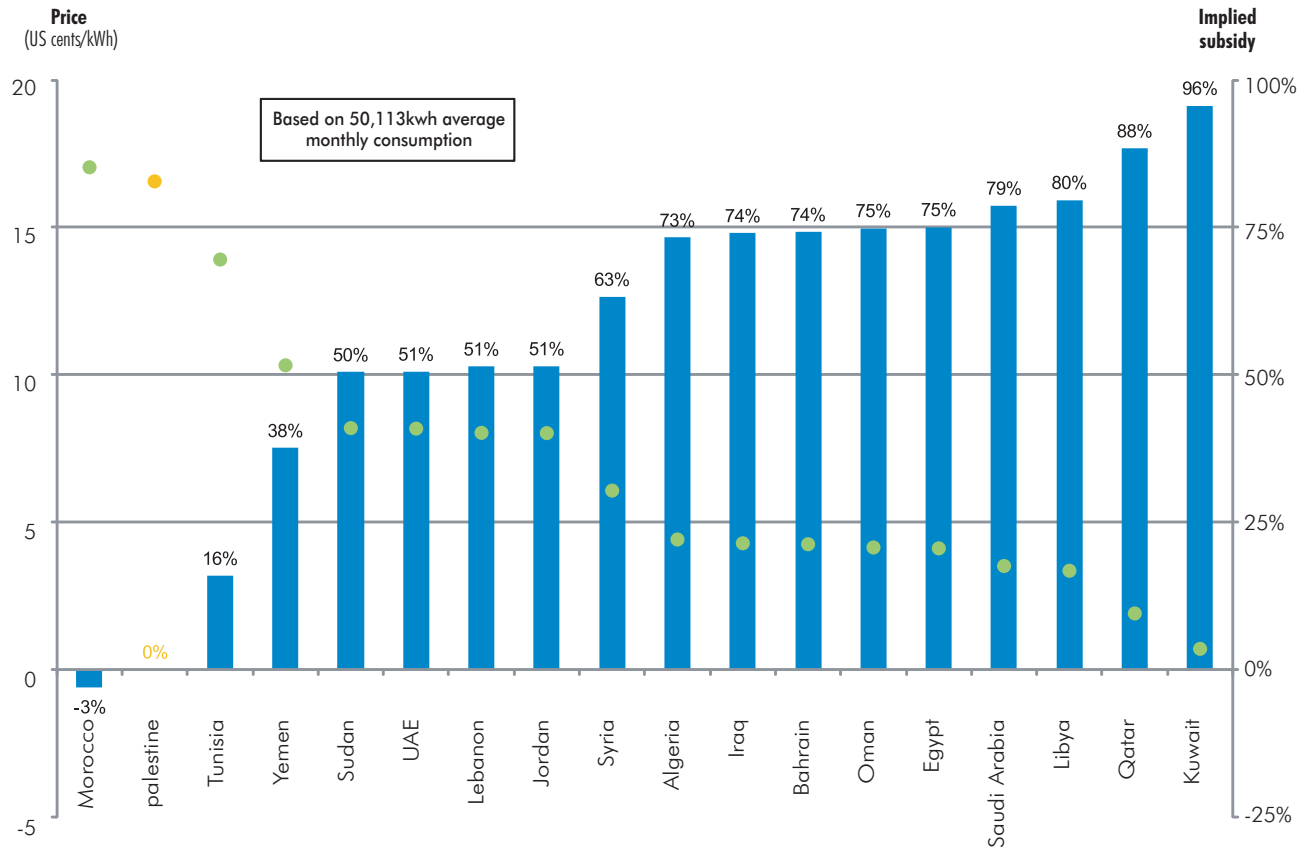
The Dead Sea master plan energy efficiency study was carried for MED-ENEC by Ecofys (Riadh Bahr) can be downloaded from: www.med-enec.eu/sites/default/files/user_files/downloads/2013.03.11%20-Large%20Building%20Projects-%20MED-ENEC%20Report%20EE%20for%20Dead%20Sea%20Masterplan%20JOR.pdf

Florentine Visser, architect, is key expert at Energy Efficiency in the Construction Sector in the Mediterranean (MED-ENEC)

and welfare system, reform of subsidies remains a highly challenging task in most Arab countries. Policy makers often fear public resistance and the impact of increased energy prices on the social well being of the community in general, and the poor in particular. In addition, the lack of transparency about the size of subsidies, their social and economic impacts and the difficulties in identifying the main beneficiaries further complicate initiation of effective and comprehensive energy pricing reform. However, today these reforms are necessary in addressing not only pressing energy needs of the countries, but also in moving toward a more sustainable energy development path in general.

Few of the governments have publicly announced plans to phase out fossil fuel subsidies. In October 2011, Egypt's trade and industry minister announced that government would start the phase-out of subsidies with energy-intensive industries, such as steel and cement (Blair, 2011). The Lebanese government announced, through the Policy Paper for the Electricity Sector

FIGURE 7 **INDUSTRIAL ELECTRICITY PRICES AND SUBSIDIES BENCHMARKED TO PALESTINE (2011)**



Source: Arab Union of Electricity (2012a, 2012b), developed by B. Samborsky/RCREEE

prepared by the Ministry of Energy and Water in 2010, that the electricity tariff will be gradually restructured and increased (by up to 50 percent) in conjunction with planned improvements in the sector until undisrupted power supply is achieved together with the abolishment of the deficit and a balanced budget for the power utility.

IV. EFFORTS TO IMPROVE ENERGY EFFICIENCY, AND ASSOCIATED CHALLENGES

A. Building Sector

With high rates of urbanization, the building sector represents an important avenue for tapping EE potential and mitigating GHG emissions. Today two thirds of the populations in the Mediterranean countries live in an urban area (MED-ENEC EE building code study, 2012). It is forecasted that this trend will grow to over 75 percent by 2030 (MED-ENEC EE building code study, 2012). Mandatory EE regulations for buildings, if enforced properly, can constitute a strong driving force for the construction industry to start integrating more EE solutions in buildings. Similarly such regulations can have strong leverage on the entire supply chain to start producing more EE construction materials (Feng Liu, 2010). It is estimated that with implementation of EE building codes in the Mediterranean countries the total primary energy savings could constitute 183 million tonnes of oil equivalent (MToe) over the period of 2012 to 2030 with annual CO_2 reductions of 82 million tons (MT) (MED-ENEC EE building code study, 2012).

In the region, many countries have either adopted mandatory and voluntary EE regulations or are in the process of preparing them, but the main problem remains lack of their implementation and enforcement. Responsibility for enforcement usually lies with

TABLE 1 **ENERGY EFFICIENCY REGULATIONS FOR BUILDINGS IN ARAB COUNTRIES**

	Mandatory		
Algeria	Thermal regulations for new buildings (2005)	**Jordan**	EE building code (2009)
Bahrain	Thermal insulation implementation (TII) for buildings above 4 stores (2000)	**Syria**	Building thermal insulation code (2007), effective since 2009
Egypt	EE code for residential buildings (2006); EE code for commercial buildings (2009); EE code for governmental buildings (2011)	**Tunisia**	Minimum EE specifications for administrative buildings (2008); Minimum EE specifications for residential buildings (2009)
	Voluntary		
Iraq	Voluntary reference EE specifications for buildings (2012)	**Palestine**	Voluntary EE building code (2004)
Morocco	Technical specifications for thermal regulations in building (2010);		
	Under preparation		
Lebanon	EE building code	**Tunisia**	Minimum EE performance specifications for hospitals and hotels
Morocco	Technical specifications for building's passive and active components		

Source: RCREEE (2013)

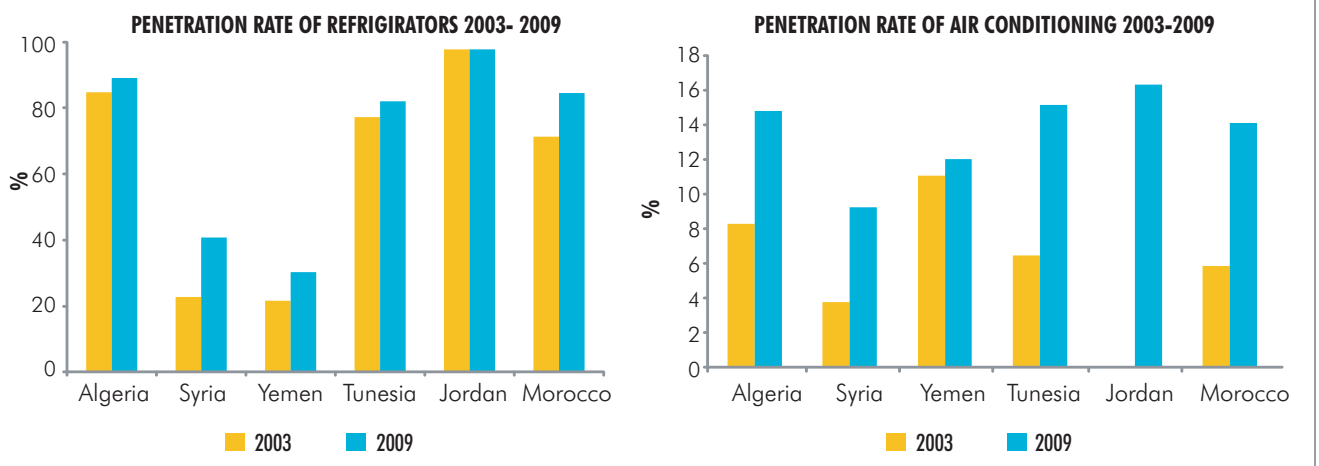
municipalities, which often lack capacity to properly inspect and review site plans, building designs and construction sites. Table 1 illustrates the current status of existing EE regulations for buildings in the region.

Designing, constructing, and renovating buildings according to EE specifications requires upgrading skills, knowledge, and expertise of professionals in the building sector, including architects, designers, contractors, installers and others, which is currently still lacking in the most of the region. In some less developed regions situation is further exacerbated by presence of large number of informal unregulated housing stocks. It has been estimated that in the Mediterranean region such self-constructed houses roughly account for about 30 to 60 percent of existing urban housing stock (MED-ENEC EE building code study, 2012).

In order to ensure compliance with mandatory regulations it is necessary to dedicate sufficient resources to support enforcement, training, and educating stakeholders to meet the technical specifications, developing fair and transparent enforcement mechanisms (Feng Liu, 2010). Experience shows that introducing complementary policies such as financial incentives for EE projects and spreading information about benefits of EE improvements enhances the rate of compliance. In the early stages of market development, demonstration projects play an important role in enhancing the capacity of stakeholders and fostering the uptake of EE solutions in the construction.

As can be observed in Figure 8, with economic growth in the countries the diffusion rate of household appliances has been also steadily growing, contributing to greater energy consumption. In 2009 in Jordan, the growth rate constituted 16 percent, in Tunisia 15 percent, and in Morocco 14 percent. According to the International Energy Agency (IEA) calculations, global energy savings potential in lighting and appliances constitutes approximately 3.7 Gigaton (Gt) CO_2 emissions per year (IEA, 2010). A

FIGURE 8 **PENETRATION RATE OF REFRIGIRATORS AND AIR CONDITIONING 2003-2009**



RCREEE & Plan Bleu Study: EE Indicators in the Arab Mediterranean Countries (2012)

study conducted in Lebanon by the Lebanese Association for Energy Saving and Environment (ALMEE) evaluating the impact of energy efficient housing estimated the electricity savings of 2,442 kWh per year with net value of US$ 3701 for introducing EE washing machines and refrigerators class A. (MEDENER, n.d.).

To reduce energy consumption of household appliances, many countries around the world have introduced the minimum energy performance standards (MEPS) for household appliances often followed by labeling schemes. MEPS define EE performance threshold for appliances, thereby preventing the entry of inefficient products into the market. The current state of MEPS in the region's countries is shown in Table 2. In the region only a few countries have adopted MEPS for household appliances with relevant labeling schemes and testing facilities, and only one country – Tunisia – monitors the market share of EE appliances. Given the rapid development of the appliance market in the region, governments should promptly address this issue in order to gradually phase out inefficient products from the market.

Greater diffusion of energy efficient lighting technology can significantly contribute to energy savings and reduce peak loads. Various initiatives have been launched in the region to improve EE in the lighting, but these initiatives vary in scale and stages of development (Gelil, 2011). Measures aimed at reducing the cost of compact fluorescent lamps (CFLs) have been the most preferred approach in the region to phasing-out incandescent lamps. Most of such measures include bulk distribution of CFLs at considerably low price or even for free. Lack of high quality CFL bulbs in the market remains one of the challenges to large-scale deployment of CFLs in the region. Poor quality CFLs in the market significantly taints the image of CFL, resulting in great disappointment and distrust among customers, and negatively affecting efforts to promote efficient lighting technologies (Dilip R. Limaye, 2009).

B. Industrial Sector

The industrial sector accounted for almost 30 percent of total final energy consumption in thirteen Arab states in 2009. As can be observed in Figure 9 below, energy sources within the industrial sector are dominated by fossil fuels. On average, 40 percent of the sector's energy needs in 2009 were met by oil products and 37 percent by natural gas. Electricity represented around 22percent of the final energy consumption.

Industry also represents a great avenue for tapping EE potential. For example, in Morocco between 1990 and 2006, 57 energy audits identified 411 EE projects. Twenty five percent of these EE projects had a payback period of less than one year, 50 percent of the projects had payback between 1 to 3 years, 11 percent of projects between 3 and 5 years, and only 14 percent of the projects had payback periods of more than 5 years (Lahbabi, 2013).

TABLE 2 **ADOPTION OF MINIMUM ENERGY PERFORMANCE STANDARDS (MEPS) AND LABELS FOR APPLIANCES**

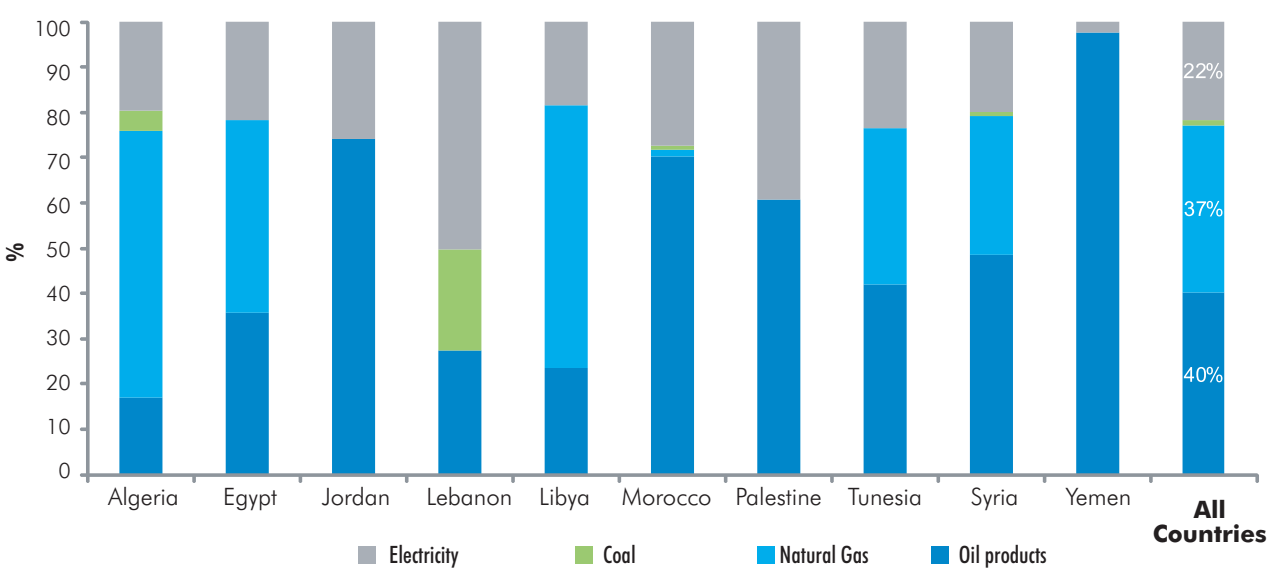
Appliance	Algeria	Bahrain	Egypt	Iraq	Jordan	Lebanon	Libya	Morocco	Syria	Sudan	Tunisia	Palestine	Yemen
Refrigerators	X		X			X			X		X		
Washing machines			X						X				
Air conditioners	X		X			X			X		X		

Source: RCREEE (2013)

\In Tunisia, ETS Nejma Huiles Company (formerly known as Slama Frères) - has experienced benefits by implementing various EE measures. These resulted in energy savings of 2,257 toe/year equivalent to 32 percent of the company's energy consumption, and reducing the energy bill by 36 percent. The payback period was 2 years and 10 months. Implementing a co-generation project in the same plant resulted in energy savings of 1,249 toe/year, which is 17 percent of energy consumption, and reduced energy costs by 25 percent. Payback period was 3 years and 7 months (MEDENER).

Looking ahead, there is EE potential throughout the industrial sector. In Saudi Arabia, converting 3 GW of power generation capacity from open-cycle gas turbines to combined cycle units would increase efficiency from 30 percent to around 50 percent. This could provide oil savings of 14 to 15 million barrels per year and reduce costs by US$ 1.2 billion per year at current oil prices. In desalination and other energy-intensive industries, anticipated reduction in energy consumption through EE is in the range of 5 to 10 percent (Alyousef & Abu-ebid, 2012).

FIGURE 9 **FINAL ENERGY CONSUMPTION OF THE INDUSTRIAL SECTOR IN SELECTED ARAB COUNTRIES IN 2009**



Source: RCREEE & Plan Bleu Study: EE Indicators in the Arab Mediterranean Countries (2012)

ENERGY EFFICIENCY MEASURES AT PETROFAC SHARJAH OFFICE: 18 PERCENT LESS ELECTRICITY

The energy reduction at Petrofac's Al Khan tower building in Sharjah, UAE, led to a saving of more than US$150,000. This cut followed an even larger reduction in 2011, when energy consumption fell by almost a quarter, saving more than US$230,000. The savings resulted from carbon-saving measures that cost little to implement.

Petrofac aims to go on saving energy, and money, at Al Khan. In 2013, to ensure the building management system runs at optimum efficiency, daily reviews will be conducted to check electricity consumption and heating, ventilation and air conditioning. It is hoped that this will lead to further savings of at least 3 percent.

The tower building gross area is 42200 m^2. It has a rentable area of 33000 m^2 (rentable area is Gross area excluding covered parking) with a headcount of approximately 2,200.

Based on material provided by Petrofac, an AFED member.

Taking action through industrial consumers can generate results with a relatively small number of participants, if the appropriate ones are targeted. For instance in Egypt, where more than 40 percent of total energy is consumed by the industrial sector, the energy intensive industries represent 1percent of the number of factories and consume 65 percent of the industry energy share. Clearly, these few consumers can significantly contribute to EE efforts.

To assess energy savings opportunities in regional industries, it is necessary first to collect data about energy consumption patterns through proper energy audits. Energy audits provide the foundation on which future management plans are built and usually constitute data about baseline consumption, operational practices, infrastructural condition of the plant, and potential energy savings opportunities. Energy audits are generally performed by energy service companies (ESCOs), and offer attractive cost savings solutions especially when low- interest loans are available to upgrade the process. In Lebanon, for example, zero- interest loans are being offered by the Central Bank in association with the National Energy Efficiency and Renewable Energy Action (NEEREA). Also, a draft energy conservation law is being discussed that would oblige establishments that consume more than 40 toe annually to conduct energy audits periodically every five years. So far, 58 companies have been audited in Lebanon since 2005 (Lebanese Center for Energy Conservation, LCEC). Other initiatives in the region to improve energy efficiency in the industrial sector include obliging industrial facilities to install energy efficient equipment by charging higher tariffs for reactive power exceeding certain power factors (National Energy Efficiency Action Plan of Sudan).

C. Transport Sector

Population growth in the Arab region, mainly in major cities, paralleled with increased industrialization and economic growth have led to a substantial increase in the size of the transport sector in most countries. According to a study performed by RCREEE jointly with Plan Bleu in 2012 on the Arab Mediterranean countries[2], with results shown in Figure 10, the total vehicle ownership in the thirteen selected Arab countries increased from 8.7 million cars in 2003 to 13.1 million cars in 2009, resulting in a growth rate of 7 percent per year. Although there has been a general decrease in specific energy consumption of cars over the years mostly due to improvements in technology and auto industry manufacturing, the average specific energy consumption of private cars in the region remains notably higher than the average consumption in European Union (EU) countries.

In most countries of the region, the old and inefficient vehicle fleets pose a significant challenge

in terms of fuel consumption, safety issues and excessive emissions to the atmosphere. The effects of this trend are increased energy consumption, traffic congestions, deterioration of already limited agricultural communities, reduction in human safety, and resources depletion. Studies have indicated that in mass transport and improved conversion efficiencies of vehicles could have high payback in terms of energy conservation and emissions reduction.

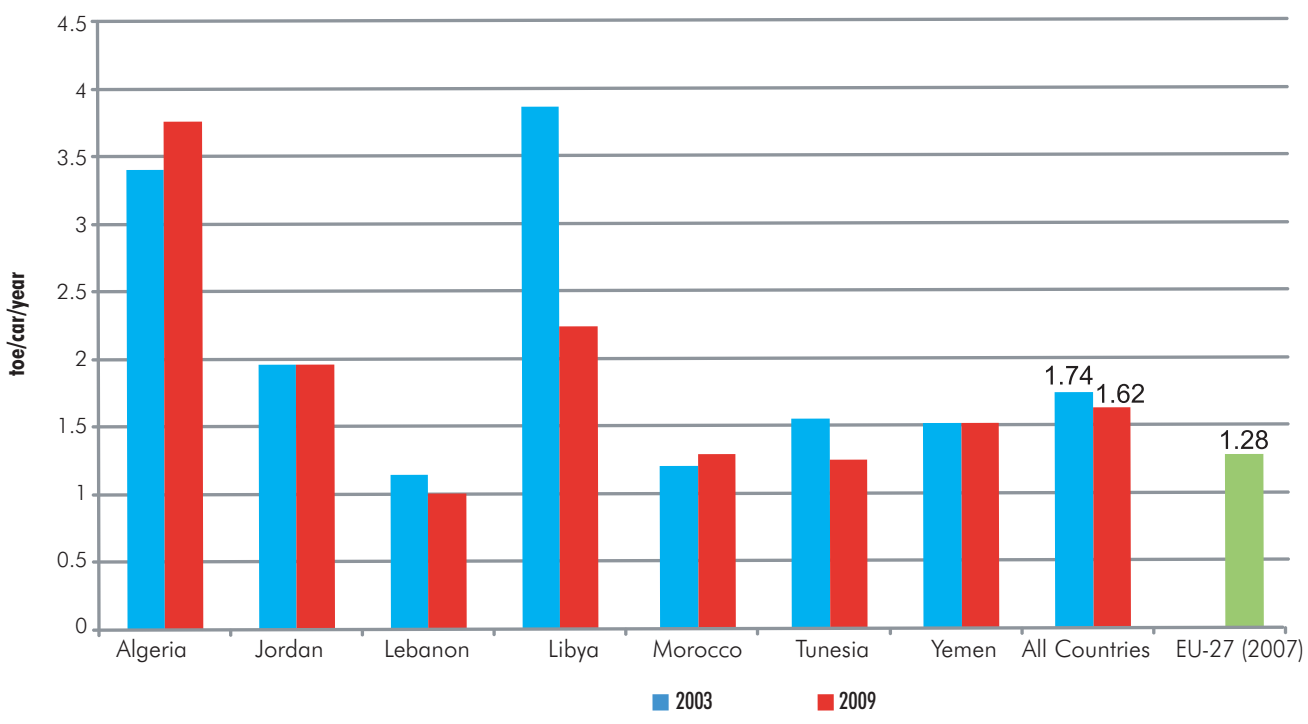
Measures to improve the quality of the fleet have been limited to bans on imports of used vehicles that are older than a set number of years. In Algeria, Tunisia, Palestine and Egypt, used vehicles should not be older than 3 years. Jordan, Yemen, Qatar, and Kuwait set a 5-year limit, whereas Lebanon has an 8-year limit. Other countries have no such restrictions (AFED report, 2011). Most Arab countries have established inspection and maintenance programs to upgrade the fleet, but the effectiveness of these programs vary from one country to another.

Regulations suggested to improve the transport sector include adopting national fuel economy standards, regulating vehicles emissions, and mandating mixed urban planning to institutionalize public and mass transport.

D. Utility and Demand Side Management Initiatives

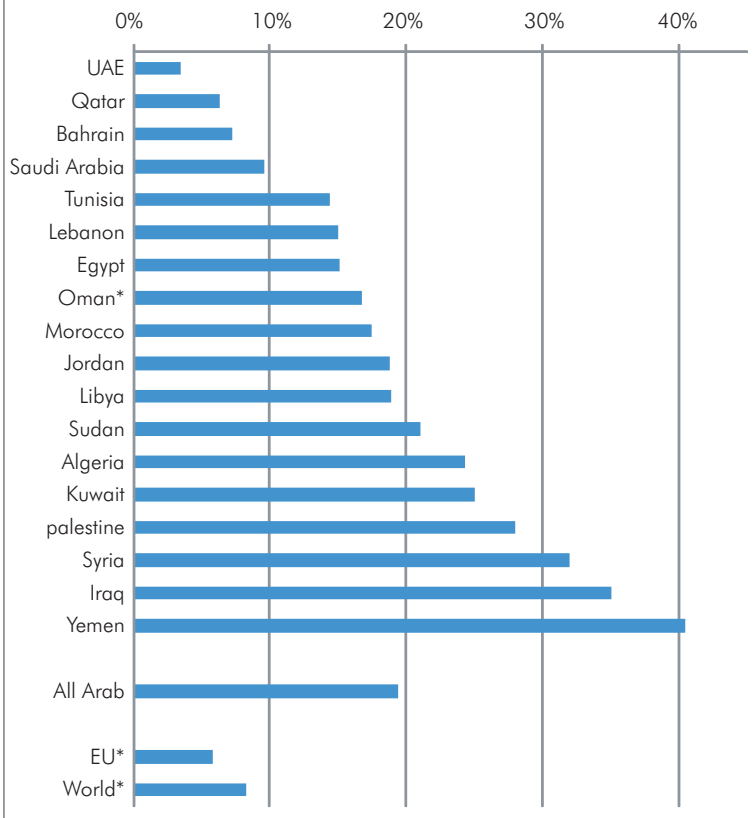
The power sector in general in the region can be characterized as a monopoly. In the most countries the generation, transmission and distribution of electricity largely remain state-owned and state-administered. With general trend of increased energy consumption growth, the share of energy consumption for power generation is also increasing. In selected ten Arab countries, this share has risen from 30 percent in 2003 to 34 percent in 2009. The highest growth has been particularly observed in Lebanon, Jordan, Libya, and Syria with 49 percent, 45 percent and 40 percent respectively (RCREEE & Plan Bleu study: EE Indicators in the Arab Mediterranean Countries 2012).

FIGURE 10 **SPECIFIC CONSUMPTION OF PRIVATE CARS IN SELECTED ARAB COUNTRIES**



RCREEE & Plan Bleu Study: EE Indicators in the Arab Mediterranean Countries (2012)

FIGURE 11 **ELECTRIC ENERGY LOSSES IN GENERATION, TRANSMISSION AND DISTRIBUTION (2011)**



* Data for Oman, EU and World 2010.
Source: AUE (2012a); World Bank (2013).

As can be observed in Figure 11 below, average Arab electric energy losses in generation, transmission and distribution (19.4 percent) are higher than the world average (8.3 percent) and much higher than the EU average (5.8 percent), presenting ample opportunity for achieving energy savings.

Decreasing the losses in generation and rehabilitating old transmission and distribution networks constitutes a key measure in countries' national energy efficiency action plans. Palestine aims to lower network losses by 3 percent by 2020, which is estimated to save approximately 42 GWh, Sudan identified 8 out of total 23 measures to improve energy efficiency, which is estimated to produce energy savings of approximately 3,349 GWh through improving network loss rates and about 152,116 toe through improving capacity generation of existing power plants during the 2013 to 2016 period (NEEAP of Sudan).

Demand side management activities in the residential sector are almost absent in the region. Very few utilities have taken actions in this area so far. The most notable example has been developed in Morocco, where their 20/20 tariff incentive rewards households that reduce their electricity consumption by 20 percent compared to the same month in the previous year. These customers receive a reduction on their bills of an additional 20 percent of the value of their saved energy costs. By the end of 2011, this incentive had resulted in total electricity savings of 1,770 GWh. The bonus savings are paid by Morocco's Energy Development Fund.

In the industrial sector, demand side management is being mostly implemented through the use of time-differentiated price structures. Table 3 provides details of the countries that have implemented time-of-use pricing, with several different approaches being applied. Results for Morocco indicate that their program has had an impact. The change in consumption patterns at three industrial facilities – the cement producers HOLCIM Settat and HOLCIM Oujda, and steel company SONASID – has reduced system peak load requirements by 76 MW (New National Energy Strategy progress review, January 2013).

E. Potential for Efficiency Gains

A realistic challenge in the drive for energy efficiency is simply quantifying the potential it can offer. Forecasts offer incentives to pursue efficiency activities at all levels – consumer, generator, and state. However, any projections will always provide an incomplete picture of the potential for efficiency gains because the outcomes rely on the creative problem solving of the industry participants.

Some research has estimated that even moderate improvements in energy efficiency could reduce total energy consumption somewhere between 25 to 50 percent below current levels, by 2030. (Hormann, Kuntze & Dib, 2012) Similarly, estimates of improving energy efficiency in the region by 20 to 50 percent could generate an additional 1 percent of GDP. Reducing losses in the transmission and distribution of electricity to 10 percent in all countries would save the region some 7,300 MW of power, equivalent to US$ 5.5 billion of new investments (ESMAP, 2009).

TABLE 3 **TIME-DIFFERENTIATED PRICE STRUCTURES**

Country	Customers	Time-differentiated rates				
Lebanon	High voltage	Night 00:00 - 7:00	Day 7:00- 18:30	Peak 18:30- 21:30	Night 21:30- 23:00	Night 23:00- 00.00
Tunisia	High and medium voltage	Day	Peak	Evening	Night	
Morocco	Extra high and high voltage	Mid-peak	Peak	Off-peak		
Syria	Extra high, high and medium voltage	Day	Night	Evening		
Jordan	High and medium voltage	Day	Night			
Algeria		Regular hours	Peak	Night		
Egypt	Extra high voltage and high voltage	Peak	Off-peak			

Source: Electricity Tariffs of States

One example of potential savings is the use of compact fluorescent light bulbs (CFLs). Switching 5 million incandescent bulbs to CFLs in Lebanon would result in savings of about US$ 250 million of investment equivalent of a 250 MW power plant (ESMAP, 2009). Transition to CFLs in the whole region would result in 2.56 percent reduction of CO_2 emissions and generate energy savings of 1.67 terawatt hour per year (TWh/year) (Gelil, 2011).

In Saudi Arabia, considering current growth rates, oil consumption is expected to reach 800 million barrels per year by 2030. If efficiency achieved a 10 percent annual reduction in oil consumption within the Kingdom, by 2030 this would equate to 80 million barrels of oil per year available for export instead of being consumed internally. The additional revenue from oil would be around US$ 6 billion per year at current prices (Alyousef & Abu-ebid, 2012).

Results from Tunisia show the successful implementation of their EE program has achieved energy savings of more than 2,800 kToe since 2004. As a result, over 3,000 new jobs have been created in the energy efficiency and renewable energy field (Lehr, Monnig, Missaoui, & Marrouki, 2012). Adoption of various energy efficiency measures led to a drop in energy intensity from 0.15 Toe/1000 US$ 2005 value in 1990 to 0.12 Toe/1000 US$ 2005 value in 2008 (United Nations, 2013).

For the construction industry, an estimate exists relating to EE building codes in the Mediterranean countries. During 2012 to 2030, 183 MToe can be saved through implementation, with annual CO_2 reductions of 82 MT.

These figures provide guidance for what is possible through EE activities. The true outcomes will be decided by the various actors in the Arab region, who can influence the outcome through their policies and actions.

V. TOWARDS EFFECTIVE ENERGY EFFICIENCY PLANNING IN THE ARAB REGION

Effective energy planning is a critical step in pursuing EE. Energy planning involves various activities including estimating potential for EE, identifying barriers to cost-effective EE investments, setting long-term and intermediate

MORE JOBS WITH ENERGY EFFICIENCY

Kurt Wiesegart

Implementation of Energy Efficiency (EE) offers opportunities for millions of jobs. It also has the potential to provide a boost to local economies, while helping families afford their energy bills, according to MED-ENEC (the program on Energy Efficiency in the Construction Sector in the Mediterranean). For this, investing in EE has a triple win effect: saving energy costs, reducing emissions, and creating jobs. However, attracting investments for sustainable development and combating global warming needs a strong governmental commitment.

Looking at successful experiences, OECD countries are revealing huge opportunities for EE. The 2011 investments in EE amounted to € 140 billion, estimated to create twice as many jobs per each Euro invested compared to fossil fuel-based energy. EE is «big business» for exporting countries such as Germany, Denmark or Netherlands. An example for emerging markets in the MENA region is Turkey. Some 65,000 jobs were created over the past 10 years only by the MED-ENEC pilot project RMI Turkey in the field of efficient building, insulation and geothermal technologies. More than 10,000 craftsmen were trained at the centre. In 2012, more than 50 million m^2 insulation material was applied to building facades making Turkey one of the biggest insulation material markets in Europe/Asia.

It is in the genuine interest of the MENA region to open itselve to such emerging markets. Even more as MENA countries are facing substancial challenges detemined by rising costs for energy imports and subsidies. The main question is: How will investments in energy saving technologies and products be attracted?

Regulation of energy standards and non-subsidised price systems are necessary. Energy audit shemes need to be

enforced. Higher efficiency of energy consumption will reduce depencence on fossil energy imports. And a clear political commitment of the Government for EE will foster the economy, industrial activities and employment.

National Energy Efficiency Action Plans (NEEAPs) play an important role in materialising the large potential for EE and jobs. In cooperation with MED-ENEC, the Lebanese Government has developed and approved the NEEAP. This has been done by MED-ENEC for Palestine, Jordan and Algeria. Rough estimates of job effects of the Lebanon NEEAP are: .

TABLE **ESTIMATE OF EMPLOYMENT EFFECTS OF SELECTED INITIATIVES FROM THE LEBANESE NEEAP(1)**

Initiative	Measure	Duration	Installed Capacity	Saved energy	created jobs
1	EE CFL lamps	2010 – 2012	160 MW	239 GWh/yr	50 -100
4	Solar thermal water heaters	Sept. 2010 -2012	190,000 m^2	26.35 GWh/yr	100 – 150
6	Wind	2010 - 2014	60-100 MW	120-200 GWh/yr	5 – 15
7	Photovoltaic	2011 – 2015	100-200 MW	263-526 GWh/yr	150 – 250
10	EE measures in buildings	2010 – 2015		815 GWh/yr	15,000 - 20,000

Large-scale renovation programmes have multiple benefits:[2]

- 85 percent reduction of energy consumption and carbon emission reduction;
- Energy security enhancement by reducing up to 39 percent annual import needs of natural gas;
- Up to 131,000 (direct, indirect) net jobs created by 2020;
- 38 percent of this value: indirect and induced effects in other sectors than construction.

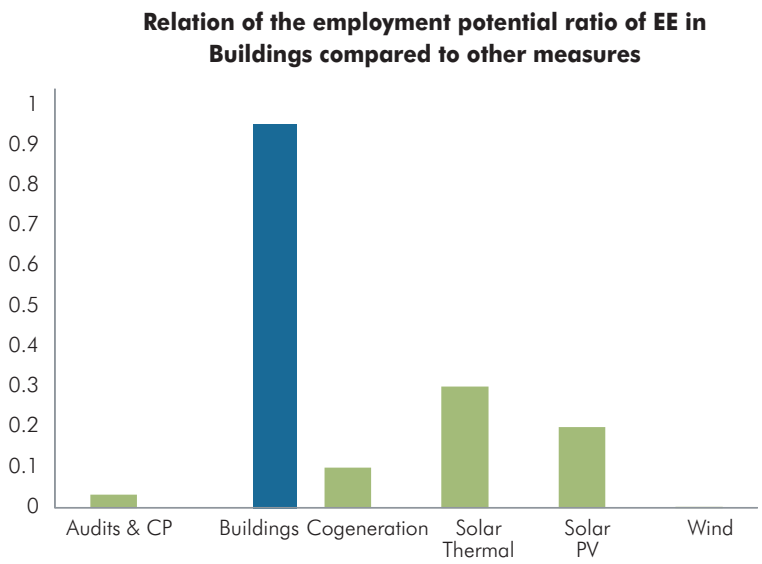
Jobs potencials from efficiency

Implementing EE creates more jobs than «producing» energy. This is true as local production of insulating materials, double glassed windows, solar water heaters and EE lighting are relevant areas of the local economy with side effects for other businesses such as installation, services and maintainance. Such investments pay back by lowering the energy bill and are sustainable, along side boosting local industries and know-how.

A recent study by GIZ concluded that EE creates more than three times as many jobs in MENA than investment in any renewable energy technology.[3] Figure 1B confirms that investments in building efficiency measures are highly efficient in generating jobs.

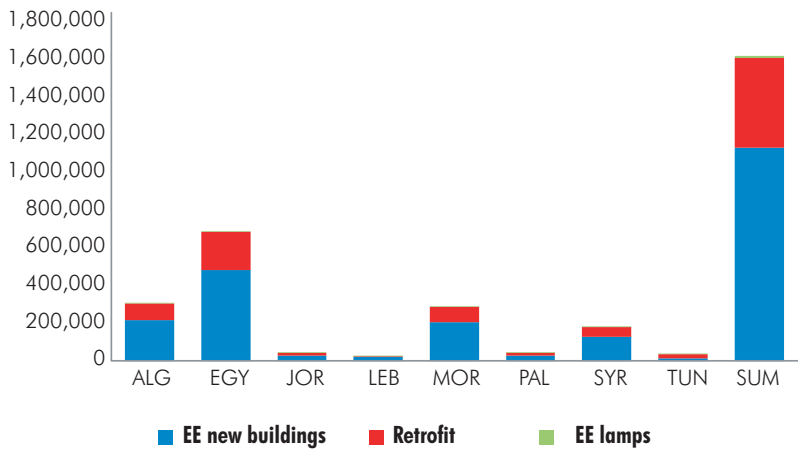
Of course, for people's income, revenues by taxes and advances by education, infrastructure development and transport investments in local production count more than investments based on imported high-tech products. In fact, EE technologies can mostly be manufactured locally, applying, architecture traditions and handcraft knowledge. And comprehensive renovation of buildings is much more labour intensive than other economic recovery activities, e.g. five times more jobs are created than with the same investments in road construction. Developing skills of human resources «at home» will attract other investors in related businesses. The lesson learnt in OECD and newly industrializing countries including Turkey or Bulgaria is: EE has become an important locational factor.

FIGURE 1 B **EMPLOYMENT POTENTIAL OF DIFFERENT EE AND RE TECHNOLOGIES**



(Source: GIZ 2012)

FIGURE 2 B **ESTIMATED JOB CREATION OF INVESTMENT IN EE IN BUILDINGS**



(Source: GIZ 2012)

1 Lebanese Ministry of Energy and Water, LCEC (2011) NEEAP 2011-2015

2 Ürge-Vorsatz, D. et al 2010

3 GIZ 2012

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THE ARAB ENERGY EFFICIENCY AND CONSERVATION FRAMEWORK

The Arab Energy Efficiency and Conservation Framework is the first document on the right path towards energy efficiency in the Arab region. It comes as a realization of the increasing demand for different forms of power on one hand, and its increasing prices on the other, which contributes to achieving significant energy savings that could be utilized in economic and social development.

The Framework is a guideline for energy efficiency in terms of action plans and procedures. It offers a 10 year roadmap including goals to be achieved, through setting and implementing a bundle of national plans composed of several procedures.

A 3 year energy efficiency plan kick starts the Framework to realize a short term goal, followed by another 3 year plan before the first one expires, along with implementing the technical procedures implied. That also requires state identification of implementation and monitoring responsibilities for one or more of the new or current bodies or institutions, and after an annual review of the plan, to ensure meeting its goals. In 23/11/2010, the 26th meeting of the Executive Office of the Arab Ministerial Council for Electricity adopted the Framework in Resolution 195.

The previous period has witnessed a lot of achievements related to implementing the Framework and designing national plans for energy efficiency in the Arab countries. The Lebanese Government has officially adopted the national plan for energy efficiency 2011-2015, through Resolution 26 issued in 2011. That was the first comprehensive strategy for energy efficiency and renewed energy in an Arab country. Other Arab countries followed later. The General Secretariat of the Palestinian Government adopted a national plan for energy efficiency and conservation at the end-consumer. Egypt's Government also adopted a plan for the electricity sector in 2012, and Sudan launched the national campaign for energy efficiency. Jordan in turn has set forth a first draft in a workshop with all stakeholders before officially adopting and launching at the national level.

The General Secretariat of the Arab League has received a number of official letters from several Arab countries declaring adoption of the Framework, and expressing willingness to put national plans for energy efficiency. These countries are Bahrain, Algeria, Libya, Kuwait and Yemen. It is projected that all Arab countries would have put their national plans for energy efficiency by the end of 2015.

** The text is based on information from the General Secretariat of the Arab Ministerial Council for Electricity in the Arab League.*

national EE goals and objectives, prioritizing measures, formulating policies, and developing specific action plans. Strategic energy planning allows more efficient tackling of pervasive market barriers and failures that cannot be cured on ad-hoc basis and require strategic holistic approach.

On 25 November 2010, the Arab Energy Efficiency Guidelines were adopted based on the European Directive 2006/32/EC on energy end-use efficiency and energy services (Arab Electricity Ministers, 2010). According to this Guideline Arab states are required to develop National Energy Efficiency Action Plans (NEEAPs) to achieve comprehensive energy savings by 2020. The NEEAPs are to be prepared for a period of three years with an indicative target for energy savings. Countries are also required to assign the responsibility for oversight coordination and reporting to one or more new or existing authorities or agencies (Arab Electricity Ministers, 2010). The NEEAP is to be reviewed annually to make sure that it fulfills its objectives. Additionally Arab Guidelines prescribe Member States to:

- Identify suitable energy efficiency measures to achieve the target (Article III:1)
- Ensure an exemplary role of the public sector (Chapter III)
- Ensure that energy distributors, distribution system operators, and retail energy companies contribute to EE through various measures (Article V)
- Ensure that information about EE measures and mechanism reaches the relevant stakeholders (Article VI)
- Need to revise national legislation impeding or restricting the use of financial instruments (Article VIII)
- Emphasize the need of member states to consider restructuring electricity tariffs to encourage EE (Article IX)
- Provide necessary financial resources to support EE measures (Article X)
- Ensure availability of effective programs for energy audit services by independent bodies such as energy service companies (ESCOs) or electric power distribution companies. (XI)

Today, in the region only five countries officially adopted NEEAPs with specific EE targets: Tunisia, Lebanon, Egypt, Palestine and Sudan. Those countries, along with their targets and responsible agencies, are shown in Table 4. Syria and Jordan have prepared drafts of NEEAPs, but have not officially approved them yet. NEEAPs in Morocco, Libya, Algeria and Bahrain are

currently under preparation. Yemen, Iraq, Kuwait, Saudi Arabia and Qatar are in early stages of mobilizing initiatives on preparing NEEAPs.

VI. CONCLUSION AND RECOMMENDATIONS

The Arab region is undergoing many social, political, and economic challenges. Heavy reliance on fossil-fuel in light of rapidly growing population and declining oil reserves makes the region only more vulnerable. Without both an increase of renewable energy share and the pursuit of effective energy efficiency policies, the region might soon face serious energy supply challenges and bigger socio-economic vulnerability. Substantial efforts need to be made in this region to embed energy efficiency in the societies without further harming the already suffering economies. This requires:

a. Careful Energy Planning:

- Measuring energy consumption and estimating EE potential: Solid data on

PHILIPS: SUSTAINABLE LIGHTS AT AL-AIN'S DIABETIC CENTER

Imperial College London Diabetes Centre (ICLDC) is a joint venture between Mubadala, Abu Dhabi and the Imperial College, London to collaborate in healthcare, education and research. The Centre is vital in the efforts to tackle this condition throughout the United Arab Emirates, which has the second highest prevalence of diabetes in the world. In 2011, Mubadala and ICLDC opened their second facility in the UAE, located in Al Ain. Philips was commissioned to provide indoor and façade lighting. The result is a building with 100% energy efficient lighting that truly deserves to be called a green building.

The main lighting challenge was to help achieve higher energy efficiency. At the same time, the required levels of functional lighting for healthcare applications had to be met, whilst incorporating designer's creative inputs. Being a new build project, Philips was able to work with the consultant from inception on the lighting design. This incorporated aspects such as glare free, indirect lighting for indoor and dynamic architectural lighting for outdoor.

LEDALITE Pique recessed luminaires produced by Philips were selected for their semi-indirect, high light-output ratio and optimum power consumption features. This lighting solution gives the ICLDC low light power density, reduced glare (in accordance with local and international standards for healthcare facilities) and quality of light necessary to allow medical staff to perform their tasks comfortably.

In addition, Philips used LuxSpace LED luminaires in the design for the corridors. This application reduced the required light power density (LPD), which was set at 40% lower than ASHRAE standards.

To light the building's unique façade, Color Kinetics Powercore was installed, which combines dynamic scene setting capabilities with a sustainable LED solution. The dynamically illuminated façade and the sustainable light solution with which the interior of this splendid building is equipped unite the harmonious interaction between the attractive architecture and the interior.

The second ICLDC facility in Al Ain now has a cost-effective LED lighting solution suitable for medical staff, patients and visitors. A solution that also helps the facility to establish an iconic image in the Al Ain and set a benchmark within the local healthcare industry for green buildings.

Based on material provided by Philips, an AFED member.

energy end-uses constitutes a basis for proper energy planning. It is recommended making all possible efforts to collect data on energy end-use before formulating energy efficiency policies. Reliable, timely and detailed data on energy end-uses allows proper estimation of energy efficiency potential, understanding the current state of energy consumption, defining baseline and setting proper priority energy efficiency targets (UNDP, 2010). Estimating energy efficiency potential allows identifying areas where the biggest energy efficiency improvements can be made at the lowest economic costs.

- Setting clear EE targets: Extensive review of energy efficiency policies around the world conducted by IEA and the World Energy Council identified clearly defined energy efficiency objectives with specific timelines as one of the attributes of successful energy efficiency strategy (IEA, 2010). Experience in the region with Tunisia has also demonstrated importance of effective energy planning resulting in real energy savings. It is thus recommended for states that have not officially adopted NEEAPs to speed up the process and ensure adopting SMART targets: specific, measureable, ambitious, but realistic and time bound.

b. Introducing Cost-Reflective Electricity Tariffs

When energy prices are low, higher financial incentives are required to stimulate investment in EE projects, more efforts are needed to educate and raise awareness, and greater efforts are needed to ensure the compliance with mandatory EE regulations. Phasing out fossil-fuel subsidies is a precondition to faster and more effective attainment of EE. The good examples from the region to illustrate are cases of Morocco and Palestine. Despite the absence of a

TABLE 4 **ADOPTED NEEAPS IN THE ARAB REGION**

	NEEAP implementation period	EE targets	Mandated Agency overseeing implementation
Egypt	2012-2015	5 percent or 5565.69 GWh	Ministry of Energy and Electricity
Lebanon	2011-2015	5 percent reduction in growth rate	Lebanese Center for Energy Conservation (LCEC)
Palestine	2012-2014	1 percent or 54 GWh	Palestinian Energy and Natural Resources Authority (PEA)
Sudan	2013-2016	12 percent or 775 GWh	Electricity Regulatory Authority (REA)
Tunisia	2005-2007 2008-2011 2013-2016 under preparation	Decrease of energy intensity 3percent per year	National Agency for Energy Management (ANME)

Source: NEEAPs of Egypt, Lebanon, Palestine, Sudan and Tunisia

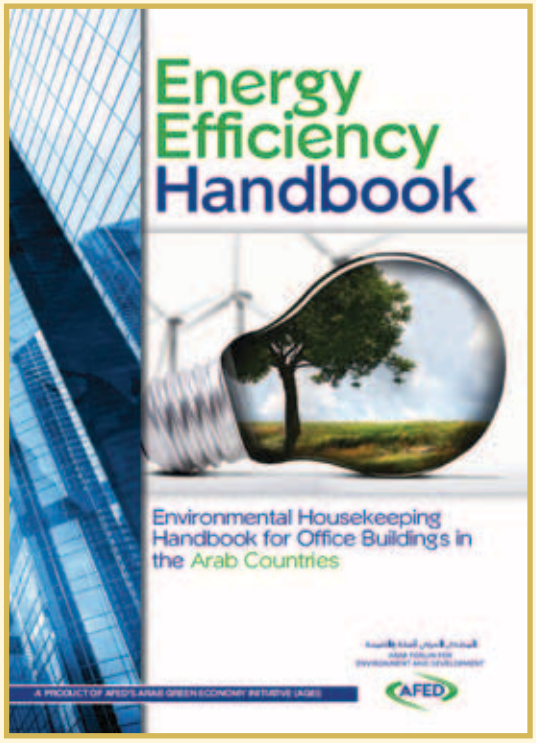
AFED ENERGY EFFICIENCY HANDBOOK

The Energy Efficiency Handbook, produced by Arab Forum for Environment and Development (AFED) in 2012, assists occupants of commercial buildings in Arab countries capture unrealized financial and environmental gains. The handbook presents methodologies for systemically identifying and prioritizing cost-effective investments that result in energy savings for building owners or leaseholders.

Increasingly, companies and government agencies in Arab countries see improving energy efficiency as a critical tactic for cutting costs and greenhouse gas (GHG) emissions. The costs of heating and cooling in inefficiently designed and constructed buildings are putting an increasing financial burden on occupants, particularly in those countries - Jordan and Morocco - where fuel and electricity subsidies are gradually being removed. Even in high-income Arab countries with significant energy subsidies for end-users, supply is unable to meet soaring demand for electricity. End-use energy efficiency in buildings offers a cost effective strategy to reduce electricity consumption compared with, for instance, expansion of supply capacity. In fact, end-use energy efficiency improvements are the surest, cleanest, and least expensive option to meet increased demand.

In Arab countries, buildings account for an average of 35 percent of all final energy consumption, and contribute 35-45 percent of all CO_2 emissions. Most of these impacts occur in the occupancy phase of the building lifetime. Moreover, the building sector is one of the fastest growing sectors in the Arab region. It is projected that a total of US$ 4.3 trillion will be spent on construction in the Middle East and North Africa (MENA) region over the next decade. The bulk of this construction will be directed towards new residential, commercial, and public buildings such as hospitals and schools. Therefore, a common challenge will be the sector's significant use of resources and emissions of CO2. These projections give proof that prudently managing energy consumption in buildings matters significantly.

Global studies have demonstrated that most commercial buildings could cut energy use by 30 percent or more through investments in improved efficiency. Despite the opportunities, few companies in Arab countries have fully invested in cost-effective energy efficiency improvements. A number of barriers prevent these companies from identifying or approving smart efficiency investments. One of the most often cited barriers is the lack of knowledge by companies and end-users about the opportunities that exist and how to take advantage of them.



This handbook offers a roadmap that can be used by office or facilities managers in Arab countries to identify, assess, and prioritize energy investment opportunities that will lower their energy use and hence reduce their carbon footprint. The handbook's primary focus is on the largest consumers of electricity in an office building including heating, ventilation, and air conditioning (HVAC), lighting, water heating, and office equipment such as computers, copiers, and printers. The handbook takes a generalized approach to improving energy efficiency in office buildings, and therefore, users may have to tailor some contents to the specific conditions of their location. In addition to addressing efficiency in electric power use, the handbook contains a chapter to address reducing fuel use by company-owned or company-leased vehicles.

Arab Forum for Environment and Development (AFED)

www.afedonline.org/eeh/eeh-ar.html

TABLE 3 **DEDICATED ENERGY EFFICIENCY AGENCIES IN ARAB COUNTRIES**

Algeria	National Agency for the Promotion and Rationalization of Use of Energy (APRUE)
Morocco	National Agency for the Development of Renewable Energy and Energy Efficiency (ADEREE)
Tunisia	National Agency for Energy Management (ANME)
Lebanon	Lebanese Center for Energy Conservation (LCEC)
Palestine	Palestinian Energy and Natural Resources Authority (PEA)
Syria	National Energy Research Centre (NERC)

Source: RCREEE internal library (2013)

strong regulatory framework, Palestine has the highest rate of solar water heater diffusion rate in the region, where almost 70 percent of households are equipped with solar water heaters; in addition, it has the lowest level of primary energy consumption per dwelling, mostly due to high energy prices. Morocco has relatively low primary energy intensity and one of the best energy efficiency performances of the industrial sector. For example, specific consumption of cement industry in Morocco in 2009 was one of the lowest in the region (88 kgoe/tonne) compared to cement industries in Tunisia (87 kgoe/tonne), Algeria (151 kgoe/tonne) and Yemen (109 kgoe/tonne) (Missaoui et al, 2012).

c. Strengthening compliance and enforcement

The effectiveness of policy instruments depends on their compliance and enforcement. Strengthening compliance and enforcement requires dedicating sufficient resources to support enforcement, training and educating stakeholders to meet the standards, developing fair and transparent enforcement mechanisms (Feng Liu, 2010).

d. Monitoring and Evaluation System

Monitoring, verification, and evaluation of energy savings are necessary in order to evaluate the effectiveness of the policy measure and make appropriate adjustments. Accurate determination of energy savings provides valuable feedback on the effectiveness of energy efficiency measure, enhances the credibility of energy management projects, consequently increasing the confidence of donors and investors and encouraging further investment in EE projects.

e. Strong Institutional Framework

To ensure the planning, design and implementation of these policies, strong institutional capacity is required. Experience from the region shows that those countries with stronger EE regulatory framework and better EE performance are the same ones with dedicated EE agencies. Table 5 lists the countries that currently have dedicated agencies.

Energy efficiency is a multi-decade continuous process that requires taking actions on a systematic, regular basis at all levels by a wide spectrum of stakeholders. To ensure continual attainment of efficiency goals, careful planning is required with robust monitoring and evaluation procedures, accompanied by dedicated resources and strong institutional capacity. Framing more targeted EE policy measures requires measuring energy consumption on a systematic regular basis, estimating EE potential, and ensuring wide stakeholder participation in the formulation of policies.

REFERENCES

Alyousef, Y. & Abu-ebid, M. (2012). Energy Efficiency Initiatives for Saudi Arabia on Supply and Demand Sides. In Z. Morvaj (Ed.), *Energy Efficiency – A Bridge to Low Carbon Economy* (pp. 279-308). Rijeka, Croatia: InTech.

AUE. (2012a). *Statistical Bulletin 2011, 20th issue*. Arab Union of Electricity.
AUE. (2012b). *Electricity Tariff in the Arab Countries*. Arab Union of Electricity.

Blair, D. Z. (2011, October 27). *Egypt to decide soon on energy subsidy phase-out.* Retrieved July 30, 2012, from Reuters: http://www.reuters.com/article/2011/10/27/us-mideast-summit-egypt-trade-idUSTRE79Q5AM20111027

Castel, V. (2012). *Reforming Energy Subsidies in Egypt*. African Development Bank.

Dilip R. Limaye, A. S. (2009). *Large-Scale Residential Energy Efficiency Programs Based on Compact Fluorescent Lamps (CFLs). Approaches, Design Issues, and Lessons Learned.* The World Bank Energy Sector Management Assistance Program.

EIA. (2013). U.S. EIA International Energy Statistics. Retrieved March 13, 2013 from http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=2&pid=2&aid=2&cid=r5,r6,&syid=2000&eyid=2010&unit=BKWH

IEA. (2010). *Energy Efficiency Governance*. International Energy Agency.

El-Katiri, B. F. (2012). *Energy Subsidies in the Arab World.* United Nations Development Programme.

ENERDATA. (2012). *Energy Efficiency Indicators.* Retrieved September 10, 2012, from World Energy Council: http://wec-indicators.enerdata.eu/#/primary-energy-intensity.html

ESMAP. (2009). *Tapping a Hidden Resource Energy Efficiency in the Middle East and North Africa, Energy Sector Management Assistance Program.* World Bank Group.

Feng Liu, A. S. (2010). *Mainstreaming Building Energy Efficiency Codes in Developing Countries. Global experiences and lessons from early adopters.* The World Bank.

Gelil, I. A. (2011). *Regional Report on Efficient Lighting in the Middle East and North Africa.* UNEP GEF.

Hormann, M., Kuntze, J., and Dib, J. (2012). *Delivering on the energy efficiency promise in the Middle East.* Oliver Wyman Inco.

IEA. (2010). *Energy Efficiency Governance.* International Energy Agency.

Lahbabi, A. (2013). *Scaling up Energy Efficiency in Morocco,* Energy Efficiency Policies for SEMED/Arab Region, Amman, Jordan 15-16 April, 2013.

Lehr, U., Monnig, A., Missaoui, R., & Marrouki, S. (2012). *Promotion of renewable energies and energy efficiency in Tunisia.* Tunis: GIZ.

MEDENER. (n.d.). *Energy Efficiency in the Southern and Eastern Mediterranean Countries, Overview of policies and good practices,* MEDENER.

Missaoui, R., Ben Hassine, H., Mourtada, A. (2012). Energy efficiency indicators in the Southern and Eastern Mediterranean countries. Regional Report.

OAPEC. (2005). *Annual Statistical Report 2005*. Organization of Arab Petroleum Exporting Countries.

OAPEC. (2007). *Annual Statistical Report 2007.* Organization of Arab Petroleum Exporting Countries.

OAPEC. (2012). *Annual Statistical Report 2012.* Organization of Arab Petroleum Exporting Countries.

Trilnick, I. (2012, March 23). *Electricity rates to rise 9percent in April.* Haaretz. Retrieved August 16, 2012, from http://www.haaretz.com/business/electricity-rates-to-rise-9-in-april-1.420289

UNDP. (2010). *Promoting Energy Efficiency in Buildings: lessons learned from international experience.* United Nations Development Programme.

United Nations. (2013). United Nations Statistics Division. Retrieved May 21, 2013 from http://unstats.un.org/unsd/default.htm

World Bank. (2013). World Development Indicators. Retrieved March 15, 2013 from http://databank.worldbank.org/data/views/variableselection/selectvariables.aspx?source=world-development-indicators#s_g

NOTES

1. Israel faces the same energy security issues as some Arab countries, being a net importer and relying on supply chains at risk of disruption (Trilnick, 2012). If Israel were to be included in the figures, it would have ranked second highest for residential price, at 14 US cents per kWh, and fifth highest for industrial price, 9 cents per kWh (IEA, 2012b).

2. These countries are RCREEE member states including Algeria, Morocco, Tunisia, Libya, Egypt, Syria, Lebanon, Jordan and Yemen.