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Energy Efficiency in the Arab World

Designing indicators on energy efficiency progress evaluation

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Abstract

The paper aims at developing set of indicators to evaluate energy efficiency progress in the Arab World considering the current realities of the countries. In particular, the paper explores the current situation of energy efficiency in the region, provides in depths description and analysis of the main drivers and barriers, identifies the essential features of good energy efficiency governance and presents a pathway to pursue energy efficiency. Indicators are developed within organizational matrix which comprises of three major categories: (1) market stimulation; (2) policy framework; (3) institutional capacity. Indicators assess the current state of energy efficiency in residential and tertiary sectors, states' efforts in overcoming energy efficiency barriers and their institutional capacity to properly design, deliver, implement and evaluate energy efficiency policies.

Keywords: Energy efficiency, Arab countries, policy evaluation, energy efficiency indicators

Executive Summary

Currently 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. Under such circumstances countries simply cannot afford wasteful consumption of energy. Today, energy efficiency is not a fancy trend anymore driven by green aspirations, but a necessity. It is true that EE represents a 'low hanging fruit' to attain energy savings, but harvesting that fruit requires true commitment and political will. Achieving EE in the residential and tertiary sector is especially challenging task because it requires changing the attitudes and behavior of wide, diverse group of stakeholders. In the Arab countries this task is further complicated by longstanding tradition of subsidizing energy making it look as a cheap and easily available resource. As a result people in this region do not view energy as a scarce declining resource that needs to be saved and used rationally, but rather as a basic good that has to be supplied by the government. Substantial efforts need to be put in this region to transform the society towards energy efficiency without further harming already suffering economy. This requires careful planning, targeted measures, collaborative approach and most importantly true commitment and political will of the leaders to improve EE.

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. Some have vague commitments and some have none at all. There are still number of social, economic and political barriers to energy efficiency that need to be addressed. RCREEE as an independent regional think tank is entrusted to assist its member states with developing sustainable energy policies. The main purpose of the current thesis is to develop set of indicators to evaluate EE progress in the Arab World considering the current realities of the countries. In particular the thesis aimed at understanding the current state of EE in the region, identifying main drivers and barriers and distilling the essential features of good EE governance.

Identified barriers include heavy fossil-fuel subsidies, poor policy framework, weak institutional capacity, lack of information and awareness about benefits of EE, lack of knowledge and expertise, and high capital costs of EE projects. Suggested policies to improve EE in the residential and tertiary sectors include phasing out fossil-fuel subsidies, introducing time-differentiated electricity price structure accompanied with comprehensible utility bill, creating conditions for operation of ESCO business, providing financial incentives to stimulate investments in EE projects and introducing mandatory EE requirements for buildings, household appliances, office equipment and lighting technology. Raising awareness and capacity building activities are indispensable and for better effects should be tailored towards consumer needs to better reduce information gap and improve stakeholders' knowledge and expertise.

Indicators are developed within organizational matrix which comprises of three major categories: (1) market stimulation; (2) policy framework; (3) institutional capacity. The organizational structure of indicators follows the Deming cycle on continuous improvement and reflects elements of IEA energy efficiency governance framework. The first category of indicators assesses the factors that are important to stimulate the market of energy efficiency services, but do not necessarily require compliance and enforcement mechanisms. The second category of indicators relates to the policy measures that have been identified as necessary to stimulate the uptake of energy efficiency measures, but the effectiveness of which depend on the compliance and strong enforcement mechanisms. The third category of indicators assesses the institutional capacity of the states to properly design and deliver effective EE policies.

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Abbreviations

AUE	Arab Union of Electricity
AFED	Arab Forum for Environment and Development
BTI	Bertelsmann Stiftung's Transformation Index
CFL	Compact Fluorescent Lamps
CO_2	Carbon Dioxide
CPI	Corruption Perceptions Index
ESCOs	Energy Service Companies
EE	Energy Efficiency
EU	European Union
FTL	Linear Fluorescent Tube
GHG	greenhouse gas(ses)
GDP	Gross Domestic Product
GEF	Global Environment Facility
GWh	gegawatt-hour
IEA	International Energy Agency
ICER	International Confederation of Energy Regulators
IMF	International Monetary Fund
ISO	International Standardization Organization
km	kilometers
kWh	kilowatt-hour
MENA	Middle East and North Africa
MEPS	Minimum Energy Performance Standards
M&V	Monitoring and Verification
MWh	megawatt-hour
NEEAP	National Energy Efficiency Action Plan
PDCA	Plan-Do-Check-Act
PPP	Purchasing Power Parity
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
SWH	Solar Water Heaters
TOU	Time-of-use
UNDP	United Nations Development Programme
UNEP	United National Environment Programme
WB	World Bank

1 Introduction

1.1 Problem Statement

The Arab world is generally characterized by unsustainable pattern of energy production and consumption. The region almost entirely relies on fossil fuel for meeting its energy demand and heavily subsidizes energy prices. Arab countries are among the most energy-intensive regional economies in the world. With rapid urbanization, population growth and industrialization the trend is towards an even greater rise in energy intensity. (El-Katiri, 2012) It is estimated that countries are expected to grow at an average annual rate of about 5% with increase in demand for electricity by 3.4% annually (ESMAP, 2009) (AFED, 2011)

Such high growth in energy demand resulted in increased air pollution and emission of green house gas concentrations. It is estimated that CO_2 emission growth constituted 88% between the periods of 1990-2004, which is three times higher than world average. (AFED, 2011) The region has high levels of local airborne pollution with particulate matter emissions far above levels in OECD countries. It is estimated that urban air pollution in eight Arab countries: Algeria, Egypt, Iran, Jordan, Lebanon, Morocco, Syria and Tunisia causes 40,440 premature deaths per year. Only in Egypt, the damage costs due to air pollution constituted 2.1% of GDP accounting for 44% of the total costs of environmental degradation in the country. (ESMAP, 2009) Despite the abundance of energy resources in the region around 60 million people lack access to affordable energy services, resulting in severe constraints for economic and social development. The need to mitigate economic, social and environmental challenges of the region in light of rapidly growing demand for energy services and declining fossil-fuel reserves requires Arab countries to shift towards more sustainable energy development. (AFED, 2011)

Needless to say that energy efficiency (EE) is beneficial for overall economy and the environment. "Pursuing efficiency is an approach that, almost by definition, can only be viewed positively." (Luciani, 2012) It is estimated that improving EE in the region by 20 to 50% could generate an additional 1% of GDP. 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 $5.5 billion of new investments. (ESMAP, 2009) Switching 5 million incandescent lights to more energy efficient lighting technology such as compact fluorescent lamps (CFL) in Lebanon would result in savings of about $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% reduction of CO_2 emissions and generate energy savings of 1.67 TWh per year. (Gelil, 2011)

Arab countries recognize the importance of EE and are undertaking steps in this direction. In 2008 thirteen Arab States found an independent regional organization dedicated to promote renewable energy and EE: Regional Center for Renewable Energy and Energy Efficiency (RCREEE). 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) The main purpose of the Guidelines is to promote cost effective improvement of end use electricity in the member states through guiding targets, mechanisms, incentives and institutional framework. According to this Directive member 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 from the date of adoption of the Directive. (Arab Electricity Ministers, 2010)

1.2 Focus Problem

Despite pronouncements by Arab leaders for more sustainable energy development today only few countries in the region have published EE strategies with quantified targets and supporting policy measures. Some have vague commitments and some have none at all. There are still many social, economic and political barriers to EE that need to be addressed. RCREEE as an independent regional think tank is entrusted to assist its member states with developing sustainable energy policies. During the Tunisia workshop on "National Plans for Regional Challenges in the field of Energy" the RCREEE was requested by its member states to monitor the qualitative progress and quantitative impact of national EE action plans. (Kraidy, Arab EE Guideline Monitoring & Evaluation, 2011)

Currently there are only few institutions that work on issues related to energy efficiency at the regional level. The key institutions include RCREEE and two projects funded by the European Union, MED-ENEC project on EE in the construction sector in the Mediterranean, and Euro-Mediterranean Energy Market Integration Project which ended its operations in 2012 (MED-EMIP, 2012). Although these institutions produce on a regular basis various studies and reports on EE in the Arab region currently no analytical tool exists that provides framework for holistic systematic approach to evaluate EE progress in all members of RCREEE. Often studies are limited to covering either one aspect of EE or only particular geographical segment of the region and usually represent one time analysis. In other words, there is no systematic continuous evaluation of EE policies and measures in the region.

1.3 Research Goals & Objectives

The main purpose of the current work is to assist RCREEE in developing an assessment tool to evaluate EE progress in the thirteen member states of RCREEE. In particular the thesis aims at developing indicators to measure EE progress in the Arab States in order to enable RCREEE to:

- ✓ provide holistic systematic assessment of EE progress in the region on a continuous basis
- ✓ effectively communicate such progress
- ✓ benchmark countries to provide additional stimulus to improve their EE efforts
- ✓ identify areas for possible intervention at the regional level to maximize the efforts to improve EE

Research questions:

1. Why there is slow progress towards EE in the region?
2. What EE policies are needed to accelerate this progress?
3. What could be a suitable set of indicators to evaluate and benchmark the EE progress and the effectiveness of policy measures?

1.4 Research Methodology

The current research is primarily based on qualitative methods of research and data analysis. Primary data was gathered through structured and semi-structured interviews with EE experts in the region. Literature review included both the primary sources such as policy documents and secondary sources such as reports and scholarly publications.

1.4.1 Literature review

Literature review was substantial part of my research. I undertook extensive literature review mainly through internet sources, internal library of RCREEE, documents that have been kindly shared by interviewees. There were three main types of literature that I studied: literature describing EE situation in the region, literature on best practices in EE policies and measures around the world and literature on EE indicators and policy evaluation tools. The following subsections outline in more details the studied literature.

Literature on EE situation in the region

The major goal of my thesis was to find out the current situation with EE in the Arab countries. I was particularly focused on researching existing barriers and challenges to EE. Substantial part of that information came from country specific reports undertaken by various international and regional organizations such as RCREEE, World Bank, Med-ENEC Project and others. RCREEE in 2010 undertook country specific studies on all members of League of Arab states on their national regulations and incentives for renewable energy and EE. In 2011 RCREEE together with Plan Bleu undertook country specific studies on energy EE in nine Southern Mediterranean countries. Another important study that was extensively used in my thesis is "Tapping a Hidden Resource: Energy Efficiency in the Middle East and North Africa" conducted by Energy Sector Management Assistance Program in 2009. Last, but not the least Arab Human Development Report on energy subsidies in the Arab world (2012). Other literature on situation in the region included studies and reports on more general energy situation such as "Green Economy in Arab World" conducted by Arab Forum for Environment and Development, Arab Development Challenges Report and others.

The second major source of information was primary data obtained from RCREEE internal library and documents kindly shared by interviewees. These documents include policy documents such as Arab Guidelines on energy efficiency, National Energy Efficiency Action Plans, information on electricity tariff structures, statistical bulletin produced by Arab Union of Electricity on energy balance and electricity sector in the Arab countries and others.

Literature on EE policies and measures

The second type of literature review included information on best practices on EE policies and measures around the world. This information was primarily derived from reports and studies conducted by international organizations such as International Energy Agency (IEA), World Energy Council, International Confederation of Energy Regulators and others. One of the key documents used as the basis for developing my conceptual framework became IEA 2010 study on EE governance describing best practices and identifying key elements in good EE governance. Other documents included studies on specific issues related to EE such as fossil-fuel subsidy reform, energy service companies in developing countries, importance of electricity price structure and others. In developing indicators I also relied on good number of guidelines mostly on the topic of strategic energy planning.

Since the scope of my thesis was limited to developing indicators for commercial and tertiary sectors a lot of literature review included study of best practices in regulating EE in building sector, appliances and lighting with special focus on the Arab region and developing countries in general.

Literature on EE indicators and policy evaluations

The second goal of my thesis was to develop criteria to evaluate policy measures and general progress towards EE in the Arab countries. As such major part of research concentrated on study of existing EE indicators and policy evaluation tools. In this regard two major initiatives were found especially useful: European experience with ODYSEE-MURE project on developing EE indicators using bottom-up approach and international initiative on developing world wide EE indicators by World Energy Council. Both initiatives maintain an on-line database on EE indicators accessible for public use: http://www.odyssee-indicators.org/ and http://wec-indicators.enerdata.eu/. Literature on policy evaluation tools included reports, guidelines and scholarly publications such as "Guidelines for the monitoring, evaluation and design of energy efficiency policies" by AID-EE, "theory-based policy evaluation tools of 20 energy efficiency instruments" by Harmelink and others.

1.4.2 Interviews, presentation & consultations

Most of the interviews were conducted in Cairo, Egypt with local and regional experts on EE. To get different perspectives on the situation and to test my findings from literature review I had eight interviews with Egyptian experts on EE and three with experts working in the field of EE at the regional level. The main purpose of interviews was to find out the current situation and identify main barriers to EE. The list of interviewees is provided in the Appendix A.

On July 10th 2012 I presented the idea, goals, objectives and draft of my conceptual framework on EE progress evaluation to the staff of RCREEE. The presentation lasted 20 min followed by 30 min discussion. The main purpose of the presentation was to present the concept of my framework and get feedback. During the discussion different suggestions were made regarding the nature of future indicators. It was suggested to ensure that indicators are practical, operational, relevant to the region, resource efficient and easy to measure. It was recommended that indicators should be designed in a way to make the best use of existing resources and data of RCREEE to ensure the effective use of resources. Also it was suggested that indicators should measure only the most important aspects of EE progress in order to avoid unnecessary collection of data of small details that do not add much value to the overall results.

To get in depth discussions of indicators on by-weekly basis I had consultations over Skype with senior regional expert on EE from RCREEE Ashraf Kraidy. The consultations on average lasted two hours. Consultations aimed at discussing and refining the proposed indicators in order to ensure that they remain relevant, important and realistic.

1.5 Conceptual Framework

The design of indicators to evaluate EE progress in the Arab world is pursued within an organizational structure that I developed on the basis of synthesis of two different concepts: (1) Deming cycle on continuous improvement; and (2) IEA EE governance framework. The following sections provide brief description of the two concepts and explain why they were chosen as the basis for organizing my indicators.

1.5.1 Deming cycle on continuous improvement

Deming cycle Plan-Do-Check-Act (PDCA) is a famous management model to ensure control and continuous improvement of processes, products and systems. PDCA was originally developed by W. Edwards Deming and further conceptualized by Walter A. Shewhart.

Applying PDCA model in energy management is not a novel idea. PDCA constitutes a basis for newly developed ISO 50001 standard on energy management system. (ISO, 2011) The standard provides requirements for an energy management system to be implemented at a firm or organization in order to achieve continuous improvement in energy performance. (Kristen Parrish, 2012) The main purpose of PDCA in energy management system is to ensure continuous improvement through defining and testing possible EE measures.

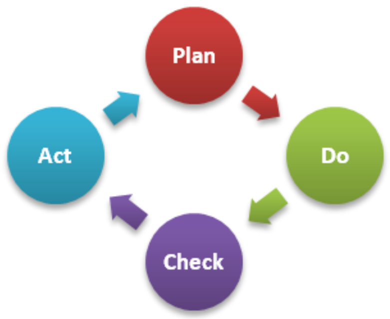

Figure 1: Deming cycle on continuous improvement

PDCA allows adopting holistic approach to dealing with energy issues and requires undertaking decisions based on organization wide energy goals and priorities. (Kristen Parrish, 2012) The cycle is a dynamic model, where completion of one cycle flows into the beginning of the next one. It consists of four major steps: plan, do, check and act.

The first stage involves demonstrating commitment for energy improvement through identifying objectives, setting targets, developing policies and action plans. The second stage is the actual implementation of the policies and action plans. The third stage comprises of monitoring and evaluation to ensure that energy policies and energy performance indicators are measured and objectives and targets are met. Final stage is management review to ensure that energy management system supports the organization's energy goals and objectives. (ISO, 2011)

1.5.2 IEA EE governance framework

In 2010 IEA based on the extensive review of EE policies and measures around the world developed EE governance framework. The framework identifies elements of successful EE governance structure. It is based on review of policies in 110 countries with survey of over 500 EE experts accompanied by extensive literature review of best practices on EE governance. According to this framework good EE governance comprises of three main elements: enabling framework, institutional arrangement and co-ordination mechanisms. (IEA, 2010)

Enabling frameworks consists of EE laws, decrees, strategies, action plans and funding mechanisms. The main purpose of enabling framework is to confer authority, build consensus, attract attention to EE and ensure access to dedicated and adequate funding. Institutional arrangements include the main actors that play important role in EE implementation. They are comprised of six main parts: implementing agencies, resourcing requirements, energy service providers, public-private sector co-operation, stakeholder engagement and international assistance. Co-ordination mechanisms ensure that there is no duplication and overlap between EE policies and measures. They include governmental co-ordination mechanisms, targets and evaluation. (IEA, 2010)

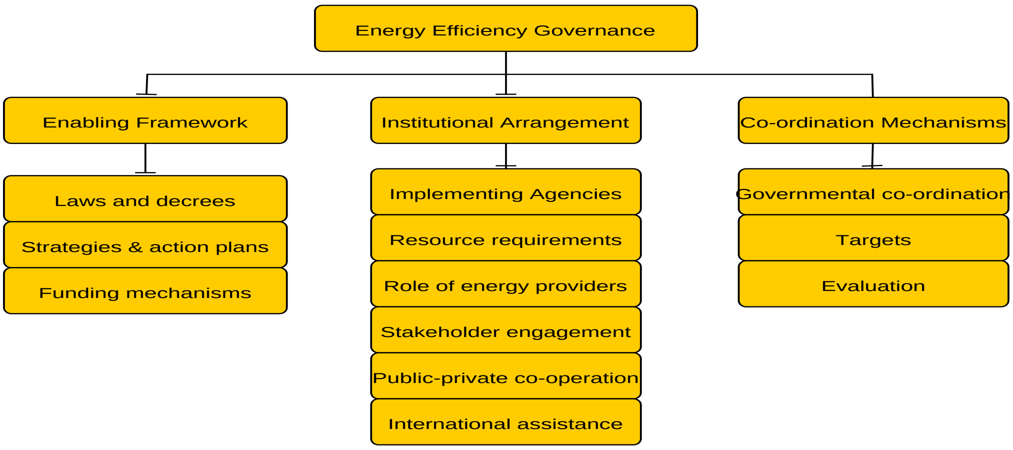

Figure 2 – IEA EE governance framework

Source: (IEA, 2010)

1.6 Scope and Limitations

In order to design indicators capable of evaluating EE progress in a holistic systematic manner thesis aims at exploring all aspects of EE including market barriers, policy drivers and effective EE governance structure. Due to such wide coverage of issues no deep analysis of particular aspects of EE is pursued.

The scope of research is limited to developing indicators on EE progress in the residential and tertiary sectors. Residential sector includes private households, excluding institutional living quarters. Common electricity usage in residential sector includes space heating, space cooling, water heating, air conditioning, lighting, refrigeration, cooking and using different household electric appliances. Tertiary sector includes segment of the economy that provides services to consumers including commercial and public services. Electricity consumption in tertiary sector comprises of space heating, space cooling, air conditioning, lighting, and running different office equipment. As such the research is focused on developing EE indicators for building sector, lighting, household appliances and office equipment. For purposes of the thesis writing the research is limited only to study of efficiency in electricity consumption.

Geographical scope of the thesis is limited to study of EE in thirteen founding states of RCREEE: Jordan, Bahrain, Tunisia, Algeria, Sudan, Syria, Iraq, Palestine, Lebanon, Libya, Egypt, Morocco and Yemen.

1.7 Thesis Outline

The thesis is composed of five chapters. The first chapter is introduction which provides description of the problem statement, research objectives and goals, outlines the methodology and briefly presents two conceptual frameworks that have been utilized in this work. The second chapter explores the current situation of EE in the region and identifies main barriers and drives to EE in the region through literature analysis and interviews. In particular, the chapter provides background information on energy consumption pattern of the region, provides in depths description and analysis of the main drivers and barriers to EE progress such as fossil-fuel subsidy reform, electricity price structure, energy audits and energy service companies, EE policies, financial incentives and awareness raising. The third chapter presents a pathway to pursue EE based on two conceptual frameworks: Deming cycle on continuous improvement and IEA EE governance framework. The chapter outlines essential elements of good EE governance and justifies their importance and relevance in ensuring EE progress. Based on the literature review and interviews on EE barriers, drivers and effective EE governance structure the fourth chapter presents indicators on EE progress evaluation. The chapter provides description of indicators and elaborates on rationale for their choice. The last chapter – conclusion summarizes the main findings of research and reflects upon methodology and limitations of the thesis.

2 Energy Efficiency Drivers & Barriers

2.1 Region Overview

The thirteen Arab countries which are under focus in this thesis represent only part of the whole Arab World. Nevertheless the region covers geographical area of 86, 45,878 km^2 with total population of 301 million people. The largest country by population is Egypt with about 82.5 million people and smallest country is Bahrain with only 1.3 million people. In the recent years the region has been the epicenter of political and social turmoil. Only in the last two years almost all the countries in the region experienced serious revolutionary wave of protests and demonstrations. As a result of political and civil uprisings rulers have been forced from power in Tunisia, Egypt, Libya and Yemen and armed conflict is still ongoing in Syria. Major protests have broken out in Bahrain, Algeria, Iraq, Jordan, Morocco and Sudan. (CIA)

At the same time the region remains politically, socially and economically diverse. As illustrated in the figure below the three countries with highest GDP are Libya, Bahrain and Lebanon and three countries with lowest GDP are Yemen, Sudan and Palestine. Some countries are more service oriented economies (with contribution to GDP of more than 50%) such as Morocco, Jordan, Lebanon, Tunisia and Syria; whereas other countries have stronger industrial presence (with contribution to GDP of more than 50%): Algeria, Bahrain and Iraq. The biggest export commodities of the region include crude oil, petroleum, natural gas, petroleum products. Other major export commodities include cotton, textiles, clothing, chemicals and chemical products. (CIA)

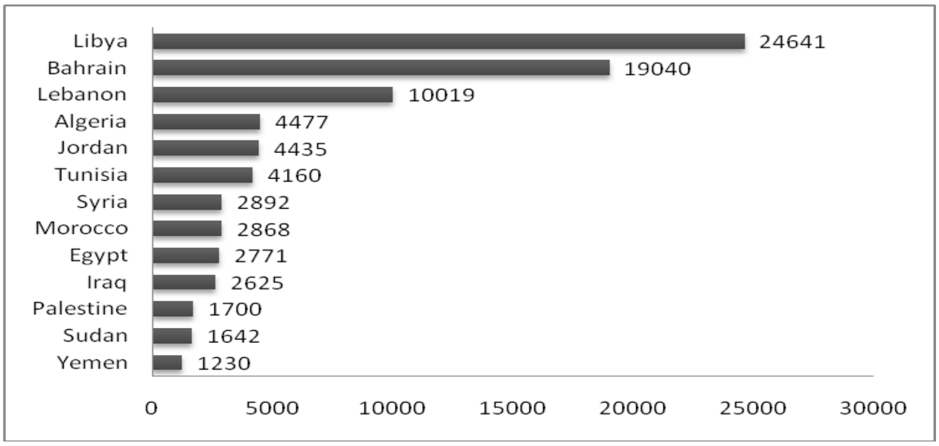

Figure 3: GDP per capita (2010)

Source: (IMF, 2010)

2.1.1 General energy intensity of the region

As illustrated below Egypt as the country with the biggest population constitutes the largest electricity consumer. In 2009 the total electricity consumption of Egypt constituted 11, 8903 GWh. In all countries, except for Morocco and Tunisia residential sector represents the largest electricity consumer group followed by industries and tertiary sector. Residential sector is responsible for consuming 47% of electricity; industry 32% and tertiary 17%. Industry in Yemen is almost absent. In some countries such as Egypt, Jordan, Libya, Morocco, Tunisia and Sudan agricultural sector is important and represents in total 4% of electricity consumption.

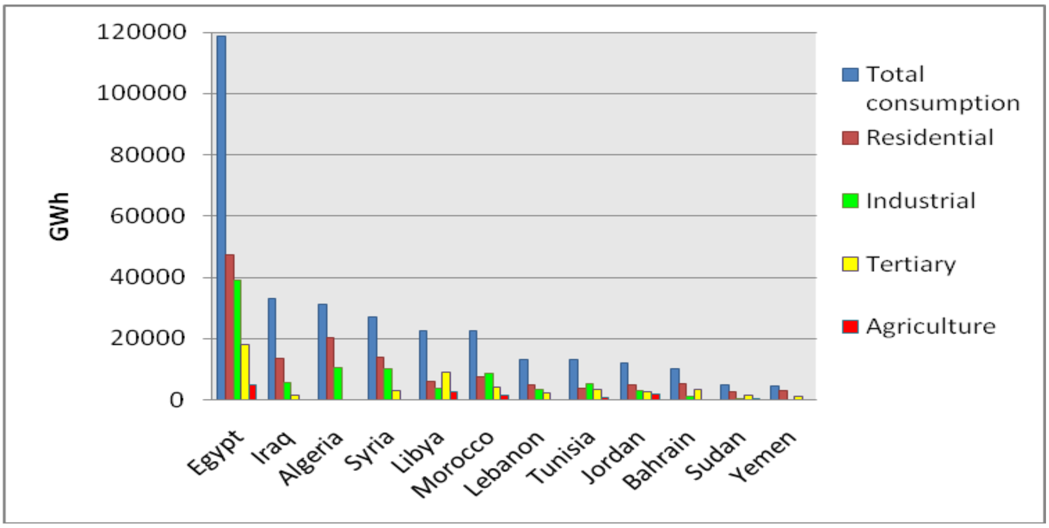

Figure 4: Total electricity consumption in the region

Source: (IEA, 2009)

In general the total amount of electricity consumption correlates with the size of country population. The largest countries: Egypt, Algeria and Iraq constitute the largest electricity consumers. The only exceptions are Sudan and Yemen. Sudan is the third largest and Yemen is the sixth largest countries by population in the region, but their total electricity consumptions are very low which is mainly due to low level of electrification rate. According to Index Mundi only 39.5% of Sudan's population has access to electricity and in Yemen only 39.6% of population. (Index Mundi, 2012) Electricity in the region is mostly produced from fossil fuel (55% from gas and 38% from oil). Renewable energy is underdeveloped and accounts only for 10% of total electricity generation. (Arab Union of Electricity, 2011)

Economy's energy intensity can be measured in different ways. The figure below illustrates primary and final energy intensity of the countries. Primary energy intensity is measured as the ratio of total energy consumption to its GDP and final energy intensity represents the amount of energy consumed by end users, expluding the use of petroleum products and natural gas over GDP. These indicators, although not perfect, are the most typical ways of measuring energy intensity at the macro level. They measure the amount of energy necessary to generate one unit of GDP. By expressing at Purchasing Power Parity GDP is adjusted to reflect the differences in the cost of living in different countries. (ENERDATA, 2012) Using these indicators Syria, Libya, Jordan and Egypt at the macro level are more energy intensive compared to Europe, which means that these countries are less productive and require more amount of energy to produce one unit of GDP. The flaw of these indicators though that they are based on the assumption that more or less the same economic activities contribute to composition of GDP in all countries, which is not necessarily true. One country's GDP might be composed of economic activities that are less energy intensive by nature such as services, or comodities that require less energy input such as textile; whereas other countries might have industries that are more energy intensive by nature such as chemical production. (ENERDATA, 2012)

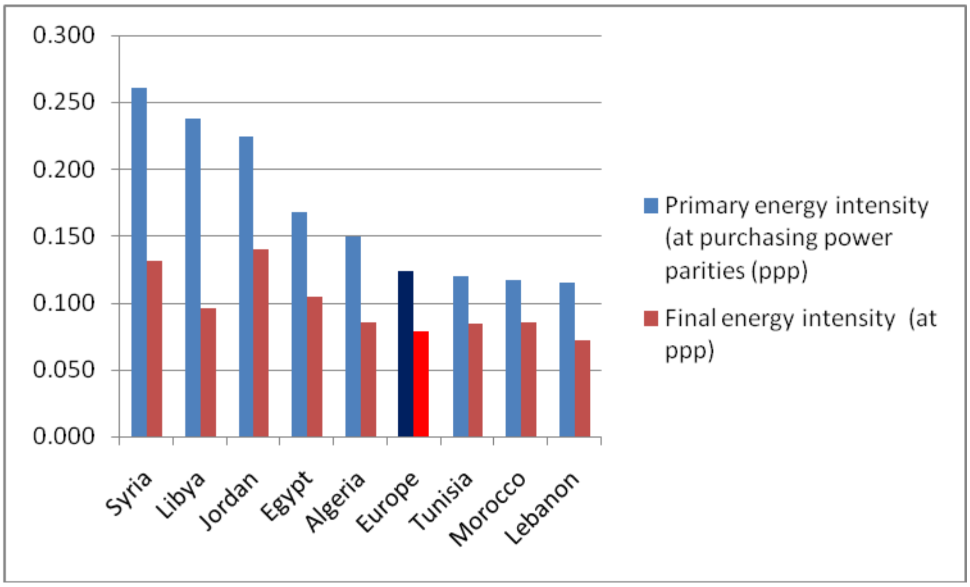

Figure 5: Energy intensity at PPP (koe/$2005p)

Source: (ENERDATA, 2012)

2.1.2 Energy consumption in residential & tertiary sectors

As illustrated in the figure below in all countries the demand for electricity consumption in the residential sector has been steadily growing over the last ten years and it is projected to continue to grow. (ESMAP, 2009) This trend holds true also for other Arab countries, not represented in the chart and for tertiary sector as well.

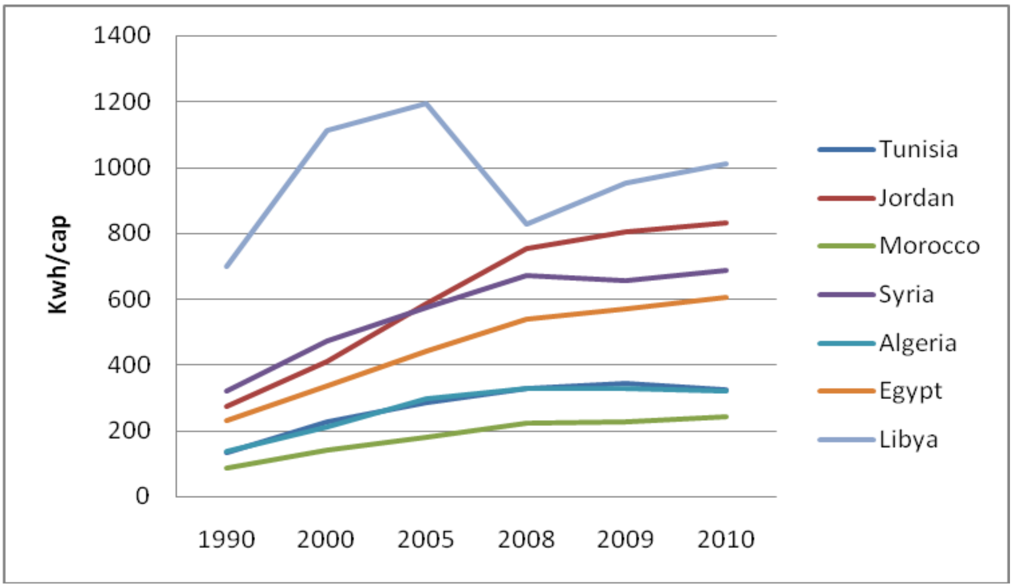

Figure 6: Electricity Household Consumption per capita

Source: (ENERDATA, 2012)

The building sector represents the largest energy consuming sector with a share of around 29% in the total final energy consumption. In the region the highest consumption per m^2 is observed in Libya (275 kWh/y/m^2) and the lowest in Egypt (60 kWh/y/m^2). (Mourtada, 2010) As has been stated earlier the main driving forces for increased energy consumption in building sector are rapid urbanization, population and economic growth. It is estimated that in the period between 1971-2004 more than 60% of increase in greenhouse gas emissions (GHG) from residential sector occurred in developing countries with 42% in Asia and 19% in MENA. (UNDP, 2010) The trend of urban building stock increase in developing countries is estimated to further double by 2030. (Feng Liu, 2010) EE factors in buildings depend on energy uses which differ according to geography, climate conditions, building type and location. (Mourtada, 2010) In developing countries cooking and water heating often dominate followed by lighting, small appliances and refrigerators. In the Arab countries due to hot climate conditions the demand for space cooling has been steadily increasing. (UNDP, 2010)

Subdividing energy consumption by various energy end-uses in buildings is difficult because often air-conditioners, appliances, lighting, pumps and heating installations draw electricity from the same metering. (IEA, 2008) Thus specific data on energy consumption of appliances and equipment is often unavailable, especially in developing countries. Nevertheless it is estimated that the use of electricity by appliances in IEA countries grew by 53% over the period 1990-2006, driving the overall increase in household energy demand. In most developing countries lighting is the most important use of electricity in the residential sector. Evening lighting contributes significantly to the peak load. (Dilip R. Limaye, 2009)

Over the last decade many initiatives have been undertaken in developing countries to promote EE lighting technology. Compared to other EE measures greater diffusion of EE lighting technology has received particularly active support by various donor organizations such as World Bank, International Finance Corporation, Asian Development Bank, United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), Global Environment Facility (GEF) and others. Besides addressing environmental issues the primary objectives of these programmes has been addressing the peak power shortages and improving reliability of supply. (Dilip R. Limaye, 2009) Most of these initiatives included bulk replacement of incandescent light bulbs with CFLs. Despite all these initiatives and increase in use of efficient lighting technology, to date the use of incandescent light bulbs continues to dominate in the residential sector in most of the developing countries. (Dilip R. Limaye, 2009) It is estimated that the penetration of CFLs in most of the developing countries remains relatively small – no more than 10-15%. (Dilip R. Limaye, 2009)

At the same time research indicates that building sector has the largest global potential in mitigating GHG emissions mainly through cost-effective EE measures. (Feng Liu, 2010) Based on survey of 80 studies UNDP concluded that there is global potential to reduce approximately 29% of GHG emissions by 2020 in the residential and tertiary sectors. (UNDP, 2010)

The major bulk of energy consumption in the building typically occurs during its operational phase and less during construction and demolition phases. (Mourtada, 2010) It is estimated that 75% of energy savings occur for new buildings through designing and operating buildings as complete systems. (UNDP, 2010) Energy loads for space cooling, heating and lighting can be best addressed through building design, choice of location, orientation, structure, and layout as well as choice of building materials and equipment. (Feng Liu, 2010) Also the marginal cost for improving EE in new buildings is the lowest at construction time. Thus, literature recommends that actions should first be concentrated at design and construction phases. (UNDP, 2010) (Feng Liu, 2010) In the Arab region particularly integrating EE solutions in the new buildings represents great opportunitity for saving energy consumption due to rapid speed of construction of new buildings. (UNDP, 2011)

It is further estimated that appliances represent big potential for EE that can be achieved in relatively short period of time. (IEA, 2010) According to IEA calculations global energy savings potential in lighting and appliances constitute approximately 3.7 Gt CO2 emissions per year.(IEA, 2010) Greater diffusion of energy efficient lighting technology can significantly contribute to energy savings and reduce peak loads. (Dilip R. Limaye, 2009) Energy efficient technology such as linear fluorescent tube lights (FTLs), compact fluorescent lamps (CFL), light-emitting-diode (LED)-based systems provide energy savings of more than 80% compared to conventional incandescent light bulbs for the equivalent lighting output and last five-ten times longer. (Dilip R. Limaye, 2009) It is estimated that the average payback on investment for a CFL is about one year. (Gelil, 2011)

2.2 Energy Subsidy Reform

Adequate energy pricing is essential part of EE policy. In order to induce rational and economic use of electricity by consumers, prices should reflect the full cost of energy supply, including externalities (World Energy Council, 2008). It has been empirically proven that large price distortions that result from energy subsidies constitute key reason for low EE. Likewise the higher energy prices force more rapid rate of EE improvements. (Ellis, 2010(b)) Phase-out of fossil-fuel subsidies is an important issue not only for Arab region, but for the whole world due to their harmful environmental and fiscal effects. According to some conservative calculations environmental impacts of fossil-fuel subsidies removal include overall world reduction of CO_2 emissions by 13% and reduction of GHS emissions by 10% by 2050. (Ellis, 2010(b)) Many countries recognize the negative impact of fossil-fuel subsidies and have already publicly announced commitments to phase-out them. According to a recent study conducted by Benjamin K. Sovacool on importance of comprehensiveness in renewable electricity and energy-efficiency policy 131 out of 181 interviewed energy experts around the world identified fossil-fuel subsidy removal as the most important policy instrument to foster EE. (Sovacool, 2009) Fossil-fuel subsidy reform is especially important topic for the Arab region since Arab countries are among the most energy intensive economies in the world with highest subsidies.

Energy subsidies constitute major reason for lack of EE progress in the Arab world. The region has strong tradition in maintaining relatively low prices for fossil fuel and subsidies make on average more than 20% of governments' expenditures. (ESMAP, 2009) In Egypt, energy subsidies in 2010 constituted 21% of budget and 73% of total subsidies. (Castel, 2012) Arab countries are among the largest fossil fuel subsidizers in the world and at the same time are among those who have undertaken the least reform efforts to tackle the issue. (Ragab, 2010) All countries in the region subsidize fossil fuel products, and most subsidize electricity. (ESMAP, 2009) Compared to OECD electricity prices, electricity prices in these countries do not cover the long-run marginal cost of supply. (ESMAP, 2009)

Subsidies take different forms depending on number of factors such as oil-producing or oil-importing countries, the organization of the energy sector, the ownership structure of energy assets, the distribution network of gas and petroleum products and others. (El-Katiri, 2012) Typical subsidies include explicit or implicit cash transfers by the government to either producers or the consumer, cross financing between different energy user groups, pricing fuels below international prices but above production costs, or pricing fuels below the market price and compensating the importing companies or the refineries. (ESMAP, 2009) (El-Katiri, 2012) Electricity subsidies are more complicated as they are subsidized at different levels:

through subsidizing the oil or gas prices to power companies and/or through pricing structure charged to various types of consumers with or without compensation of the utilities. (ESMAP, 2009)

2.2.1 Impact of subsidies

Many studies have been undertaken to assess the impact of energy subsidies on national economy. General consensus exists that despite social and economic goals that fossil-fuel subsidies pursue they have net negative effect, both on individual countries and on a global scale. (Ellis, 2010(b)) The biggest negative impact of fossil-fuel subsidies is price distortion which in turn creates inefficiencies that lead to serious environmental, economic and social impacts. Fossil-fuel subsidies encourage inefficient allocation of scarce resources, wasteful consumption of energy; discourage more resource efficient production improvements; result in smuggling of petroleum products due to price disparities among neighboring countries and cause other negative economic impacts. (El-Katiri, 2012) Fossil-fuel subsidies constitute heavy burden on budget. Among Arab countries, seven are already experiencing a significant budget deficit: Egypt, Syria, Yemen, Jordan, Lebanon and Tunisia. The continued increase in oil prices is further exacerbating the situation. (ESMAP, 2009) In Egypt, fossil-fuel subsidies increased from 40 billion of Egyptian Pounds (LE) in 2005/2006 to 68 billion in the 2009/2010. These estimates represent only the financial subsidies and do not represent the real economic cost of subsidies, which is estimated to be as high as 140 billion of LE equivalent to 11.9% of GDP. (Castel, 2012)

Fossil-fuel subsidies are regressive in nature because the rich tends to benefit proportionally more than poor because they consume more subsidized energy. (ESMAP, 2009) Fossil-fuel subsidies constitute "a misguided form of subsidy: It is estimated that the non-poor benefit from 90% of energy subsidies(World Bank, 2002) and paradoxically the poor, in effect, subsidise the non-poor by being deprived of essential services." (G.J.M. Phylipsen, 2010, p. 74) In Egypt, it has been estimated that 93% of gasoline subsidies in 2004 benefited the richest 20% of the country's citizens because they own most of the vehicles. (Burke, 2008) Similarly the rich received 65% of natural gas subsidies because the gas network exists only in the wealthiest urban neighborhoods. (ESMAP, 2009) Kerosene was found to be an exception to this pattern because kerosene is the fuel of poor households. (ESMAP, 2009) In Yemen, 40% of subsidized diesel benefited the richest 10% of households, while the poorest 20% received only 2% of subsidies. (ESMAP, 2009)

The problem is further reiterated by corruption and poor governance, resulting in mismanagement of subsidies and "leakage to the nonpoor populace". Edward Burke, 2008) According to Al-Ahram Weekly newspaper Egypt is currently suffering from recurring gasoline, diesel and butane gas cylinder shortages. Government believes that such shortages mainly occur because of black market and smuggling. (Al-Ahram Weekly, 2011) Fuel subsidies can also divert substantial resources from 'pro-poor' social protection programs such as healthcare and education. (El-Katiri, 2012) It was estimated that in Yemen "the petroleum subsidy, which benefits only 23 percent of the poor, costs the government 10 times as much as specific and targeted poverty reduction programs…" (ESMAP, 2009) Environmental impacts include increased GHG emissions, resource depletion, environmental degradation, exacerbation of local pollution and others. Fossil-fuel subsidies also undermine the development of renewable energy. (El-Katiri, 2012) Literature suggests that even marginal shifts of subsidies from fossil-fuel to renewable energy could accelerate development of renewables. (UNEP, 2008)

2.2.2 Measuring subsidies

Estimating exact amount of subsidies is a challenging task due to big range of subsidies, different modes of implementation, poor data quality, limited data availability, and lack of transparency. "Direct financial transfers are generally the easiest to quantify, as they are usually included in government budgets. In addition, some market transfers to consumers through lowered prices and tax credits are also straightforward to estimate." (Ellis, 2010(b)) Different studies use different approaches to quantify the amount of subsidies. Due to its simplicity of calculation the most common approach used is so called 'price-gap approach' which compares domestic retail prices for fuel products against a certain benchmark or reference price. (El-Katiri, 2012) However, even this method is not the best one due to existence of major disagreements among various stakeholders of what constitutes the proper reference price as benchmark price may involve taxes and other charges, which may represent significant component of retail fuel prices. (El-Katiri, 2012) (ESMAP, 2009)

Various studies have been done to estimate the amount of subsidies for individual countries, but to this day no uniform method exists to measure subsidies and provide fair comparison among the countries. "Because of differences in definitions, methodologies and the transparency of fiscal systems, it is difficult to compare regional or individual country studies measuring the magnitude and impact of energy subsidies." (UNEP, 2008) The closest methodology that would allow some comparison among the countries is may be the one developed by IEA which provides indication of fossil-fuel subsidy rate as a proportion of the full cost of supply. IEA calculates subsidies using price-gap approach. However, existing IEA on-line database on fossil-fuel subsidization rate does not provide information on all Arab countries, which makes it difficult to compare the countries (IEA, 2012) Snapshot of IEA on-line database on fossil-fuel subsidies is provided in Appendix B.

Given the lack of data on subsidy rate in all Arab countries and difficulties in measuring subsidies according to one common methodology a proxy is proposed to estimate approximate amount of subsidies in the region. It is suggested to estimate the amount of subsidies by calculating the difference between Palestinian and the focal country's retail electricity prices. The method is similar to price-gap approach, where Palestinian prices for electricity are chosen as reference prices. In the region, only Palestine does not subsidize electricity due to complete dependence on imported energy from Israel. Cost of electricity in this country fluctuates as it follows the international prices for fuel. Energy prices in Palestine are close to international prices; therefore electricity prices are very high compared to prices in neighboring countries. On average, the electricity bills amount to about 10% of the family income. (RCREEE, 2010)

Like other methods, this method has its own limitations. First, it is based on assumptions that the cost of electricity production is more or less similar in the region and more or less similar fuel types are used in generation, which is not necessarily true. In Sudan, for example 58% of electricity is hydro based and in Egypt 12.8% is produced from renewables, but on average in the region 87.42% of electricity is produced from fossil-fuels. (Arab Union of Electricity, 2011) Another limitation of the method includes unreliability of future Palestinian electricity prices: Palestinian authorities plan to decrease electricity prices in the future by 2%-22% for commercial users, by 22%-36% for industrial users and by 27%-37% for agricultural users. (Portland Trust, 2011) However, despite these limitations the method so far is the only one that can provide more or less adequate estimation of subsidy rates of electricity in the Arab countries with minimum input of resources until better data is collected. The following table represents the amount of fossil-fuel subsidy rates based on the proposed method of calculation.

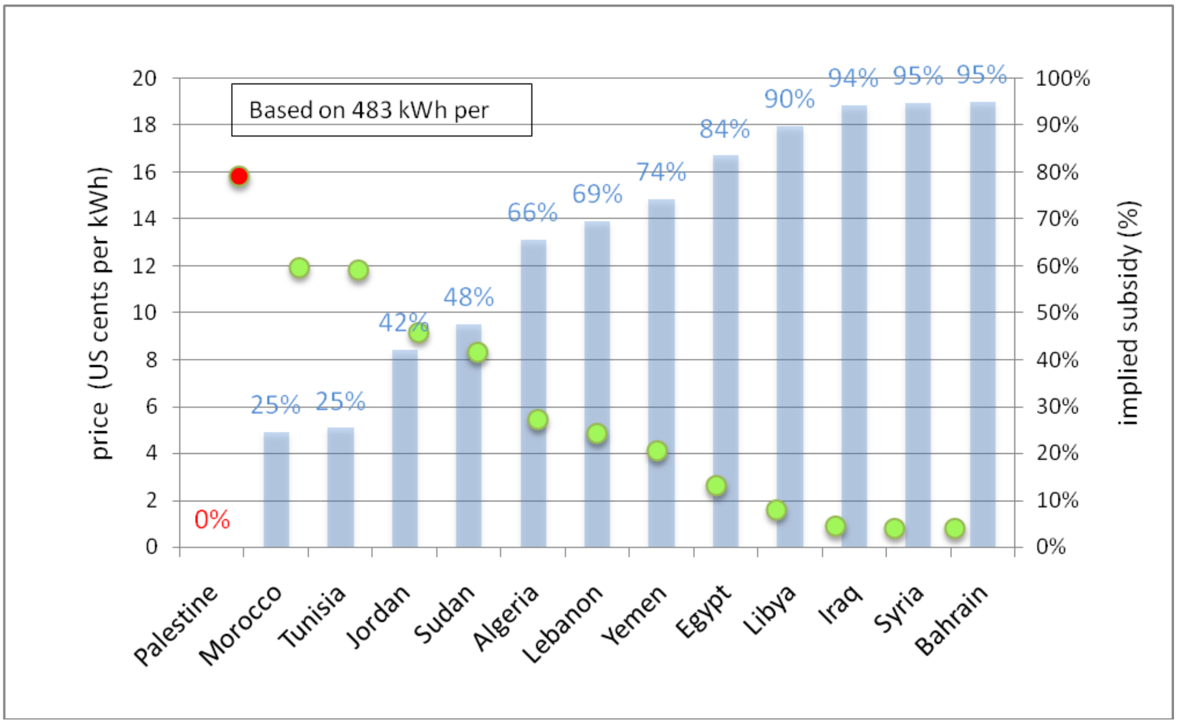

Figure 7: Residential electricity prices and subsidies benchmarked to Palestine

Source: (Arab Union of Electricity, 2011), chart created by Brit Samborsky

According to these calculations countries with largest subsidies are Bahrain, Syria, Iraq and Libya where electricity prices in the residential sector are subsidized by 90% and more. The countries with the lowest subsidies are Morocco and Tunisia. In these countries subsidies constitute less than 30%.

2.2.3 Efforts to reform

Despite clearly known negative impacts of fossil-fuel subsidies on national economy and welfare system, reform of subsidies remains a highly challenging task in the Arab countries. Policy makers often fear public resistance and the impact of energy price increase on the social wellbeing. In the light of the recent and on-going political uprisings decision makers are especially reluctant in undertaking unpopular decisions. In addition, lack of transparency about the size of subsidies, their social and economic impacts and difficulties in identifying main beneficiaries further complicate the initiation of the energy pricing reform.

But, such reforms today are necessary in addressing not only pressing energy needs of countries, but also in moving towards more sustainable energy development path in general. Based on the analysis of the six key global studies on fossil-fuel subsidy reforms Ellis concludes that there are significant environmental and economic benefits from eliminating subsidies. (Ellis, 2010(b)) Advantages of removal of fossil-fuel subsidies include effecting consumer behavior towards more rational use and valuation of energy resources, untangling funds to be spent on other government programs, reducing national deficit, encouraging renewable energy development, reducing CO_2 emissions and local pollution. (Sovacool, 2009)

Many governments in the region understand the importance of subsidy reform, however not everyone is ready to phase-out subsidies due to difficulty, unpopularity and sensitivity of the issue. Only few of the governments have publicly announced plans to phase-out fossil-fuel subsidies. On October 2011 Egypt's trade and industry minister announced that government would start the phase-out with energy-intensive industries, such as steel and cement. (Blair, 2011)

2.2.4 Effective protection to poor

It is widely recognized that energy subsidy reform has to be accompanied by effective social protection to poor in order to enable its success and mitigate the negative impacts of subsidy removal on the vulnerable part of population. (ESMAP, 2009) Fossil-fuel subsidy removal will inevitably have some negative impact on households' welfare, competitiveness of industries and firms, possible reduction of economic activities, increase in the consumer price index and others. Ability and willingness of policymakers to address wisely the economic and social costs of subsidy removal is therefore the key element to making the reform of energy prices politically feasible (El-Katiri, 2012). "Measuring the impacts of subsidy reform is a critical step in determining under what conditions the net effect of subsidy removal is positive and what supporting measures need to be undertaken to ensure that negative effects are minimized." (Ellis, 2010(b))

Organizations such as World Bank have undertaken various country specific studies estimating social and economic impacts of subsidy removal, often with the aid of complex economic models. Study conducted by Energy Sector Management Assistance Program on energy efficiency in the MENA outlines basic principles for designing and implementing successful social safety nets to accompany energy-price reforms. According to this study, these principles include: (1) properly identifying target group for compensation; (2) estimating the cost of subsidies; (3) mobilizing the funding; (4) selecting the form of compensation; (5) conducting wide information and communication campaign; and (6) selecting the right transfer mechanism. (ESMAP, 2009)

Properly identifying the target group for compensation involves two basic steps: first, identifying those who would be the most affected by subsidy removal and then assessing the extent of their vulnerability. In other words estimating how much those vulnerable groups would be affected by fossil-fuel subsidy removal or energy price increases. Usually such assessments are carried out with the help of economic models run under different scenarios. (ESMAP, 2009) Estimating the cost of subsidy involves both identifying the amount to be compensated to the poor and administrative costs necessary to run the social protection program. It is estimated that well-run social protection programs costs 5-10% of benefits. (ESMAP, 2009)

Depending on the policy of the state different forms of compensation measures can be chosen, including direct cash transfers to the households, indirect transfers through vouchers, salary or pension increases; and conditional transfers, which oblige the beneficiaries to take certain actions in order to be eligible for compensation e.g. sending kids to school. (ESMAP, 2009) Selecting the right transfer mechanism is closely linked to the form of compensation measure. Different mechanism can be used including postal checks, bank checks, vouchers, smart cards as long as their implementation is reasonably simple to administer. (ESMAP, 2009) Major part of introducing and implementing the protective mechanism to poor is effective communication and information campaign. It is important to clearly communicate both the merits and the content of measures. (Sovacool, 2009) Considering the importance of proper social protection program in undertaking fossil-fuel subsidy reforms, it is important to measure the effectiveness of states' efforts in mitigating the negative impacts of subsidy removal.

2.3 Price Structure

Much of the literature suggests that EE can be effectively achieved through sending right price signals to consumers, without necessarily raising the electricity prices. Using effective electricity rate structures together with maintaining flexibility in the price setting process can help to sharpen the price signal, achieve the changes in consumer behavior and reduce wasteful energy consumption by providing clearer and more timely energy use and price information. (ESMAP, 2009) (Prindle, 2009) Experience shows that differentiated pricing structure according to time, location and quality of supply is a strong mechanism to incentivize consumers to use energy more rationally and reduce peak loads. (ESMAP, 2009) Reflecting time of use in the price structure can show consumers the differences in electricity production and consumption according to either the time of day, week, or month. (Sovacool, 2009) Depending on the extent of metering and policy considerations different time-differentiated price structures can be used including time-of-use rates, real time pricing, critical peak pricing and others. (Prindle, 2009) (Steven Braithwait, 2007) The following sections describe the effect of time-differentiated price structure on EE and importance of clarity and comprehensibility of electricity bill.

2.3.1 Time-differentiated price structure

Time-of-use (TOU) pricing is the most commonly used form of time-differentiated price structure.[1] It encourages the consumers to be more energy efficient by allowing the utility to charge different prices during the peak load and off peak periods. Time-of-use pricing signals to consumers that energy usage is more expensive depending when it is used, thereby inducing them to shift energy consumption from peak periods to off peak periods. (Prindle, 2009) Time-of-use has two important economic impacts: (1) by reducing the peak load one reduces the need to generate or supply the higher capacity necessary to meet peak load; and (2) additional capacity can be designed to serve the system's base load instead of peak load. (ESMAP, 2009)

Historically, retail electricity prices were and are still in many countries set based on average prices, summarized in monthly bills, so consumers never know or see the differences in prices during the peak and off peak hours, consequently consuming electricity irrationally. (Sovacool, 2009) "[C]harging a flat rate for electricity regardless of when it was used seems like "charging a flat price per pound for all items in a grocery department store. What would happen if everything that came out of the cow-steak, hamburger, suet, bones, and hide-were priced average cost per pound?" The result is that everyone would always eat steak!" (Sovacool, 2009 quoting Alfred Kahn) In addition traditional retail prices focus mostly on recovering utilities' historical embedded costs rather than reflecting forward-looking market costs. (Steven Braithwait, 2007)

According to the US National Action Plan for Energy Efficiency (2009)time-of-use electricity rates provide high incentive for customers for peak demand savings, medium incentives for overall energy savings and low financial risks for utility "because rates are more closely liniked to utility costs, and so the risk of failing to recover costs is reduced". (Prindle, 2009) Research conducted in the Niagra Mohawk Power Corporation service area in the USA indicates that

[1] Out of 503 price offerings by utilities in the US, 315 were time-of-use rates (Prindle, 2009)

in areas where the utility offered time-of-use tariffs for large customers with peak demand needs, more than 30% of industrial customers responded by giving up discretionally electricity consumption and 15% changed their consumption from peak periods to off-peak periods; 45% installed demand reduction enabling technologies on site; and peak load for the utility was reduced by 15%. (Sovacool, 2009) "Time-differentiated or de-averaged rates would not necessarily mean instant minute-by-minute prices, but would at least reflect meaningful differences between peak and off-peak consumption." (Sovacool, 2009)

Most of the Arab countries do not use any time-differentiated price structure for residential and tertiary sectors. However, a lot of them apply inclining block rate electricity price structures for residential and tertiary sectors and some type of TOU electricity price structure for high voltage customers. (Arab Union of Electricity, 2012) Inclining block rate electricity pricing refers to a pricing method where consumers pay according to their consumption per billing period i.e. the higher the consumption, the higher the rates per kWh. The pricing structure is divided in blocks; each block having a higher rate per kWh than the previous one. The argument in favor states that it can generate savings that are more worth than with a flat rate. The argument against this pricing structure states that poor people with inefficient houses and who cannot decrease their consumption under a certain threshold have their rates increase unfairly. (Eskom, 2010)

2.3.2 Clarity & comprehensibility of utility bill

Important aspect of changing consumer behavior towards EE that is highlighted by many scholars and was stressed during almost every interview is effective communication and consumer awareness. Time-differentiated and other EE stimulating electricity price structures will succeed in inducing the right responses to energy prices only if the consumer understands the system. Therefore, clarity and comprehensibility of electricity bills are of utmost importance in enabling the right consumer response. Likewise lack of transparency and unclarity of price and rate information can substantially limit the customers' abilities to understand the bill and make the right price-response decisions. (Prindle, 2009) "Customers need to get usage and cost information that allows them to connect their energy use decisions with the resulting cost impacts." (Prindle, 2009)

According to a recent survey conducted in Nordic countries about consumer preferences relating to utility billing, customers indicated five things that were important to know when receiving utility bills: (1) the amount of electricity consumption in the form that it would make it easy to relate and check their consumption behavior; (2) the cost of each unit of electricity and understand how their consumption relates to what they have to pay; (3) ability to compare the current price with the prices offered by alternative supplier in the market; (4) information about ratio of taxes and VAT; and (5) information about how much to pay and when. (Lewis, 2011) Other studies conducted in the US indicate that three forms of information would be the most valuable and effective in inducing energy efficient behavior: "energy use histories, such as month-to-month comparisons of current year consumption with past years, adjusted for weather and price fluctuations; comparisons to the usage of other customers in the same neighborhood or with similar-sized residences; and calculations of change in energy use before and after investment in a new appliance or home improvement." (Sovacool, 2009)

It has been empirically proven that just providing information about energy consumption can positively affect the consumers' behavior. "One study provided residents with daily electricity prices for a month and found a 10.5% reduction in electricity use (Kempton and Layne, 1994). Another analysis of residential electricity use from 1973 to 1980 found that "feedback" in the form of information detailing daily and weekly electricity prices reduced consumption between 6% and 20% (Winkler and Winnett, 1982). […] A random sample of 414 Delaware residents, matched with utility company records, also found that merely telling consumers that peak consumption was more expensive reduced electricity use all year round (Byrne et al., 1985)."(Sovacool, 2009)

In the Arab countries given the current situation where no time-differentiated price structures are applied in the residential sector, consumers only need to understand the concept of inclining block rate electricity pricing. Utility bills should clearly signal consumers that the more they consume the higher price per unit of electricity they pay. However, when time-differentiated price structure will be introduced, it will be important for utility bills to clearly signal the consumers that using electricity during peak hours is more expensive than using it during off peak hours. The literatures stresses the importance of clarity of utility bill when introducing time-of-use price structure because of so called 'endowment effect,' where customers are attached to their energy consumption routines and habits and may be reluctant to change them or demand high compensation to do so. (Michael G. Pollitt, 2011) In other words, consumers need to receive information about clarity of consumption feedback and cost-comparative information in order to change behavior towards EE.

2.4 Energy Audits & ESCOs

2.4.1 Energy Audits

Energy audit is a basic and effective tool in pursuing comprehensive EE program at the level of buildings/facilities owners or operators. It allows identifying various EE improvements that can be made in a specific facility ranging from no or low cost quick improvements to more complex solutions involving changing or upgrading technology. Typically energy audit consists of verification, monitoring and analysis of the energy consumption, followed by report with recommendations and depending on the scope of the audit the report can contain detailed recommendations with cost-benefit analysis and specific action plan. (ICER, 2010) Energy audits on their own do not necessarily lead to reduction of energy consumption, but they are critical in pursuing EE improvements.

Energy audits are important in understanding the efficiency of the current state of energy use and identifying potentials for improvements. It is a strong tool not only to justify the EE measures, but also to raise awareness of those who are involved in energy management process. (World Energy Council, 2008) Energy audits can be either voluntary or mandatory. There is no definite agreement in the literature whether the mandatory nature of energy audits will necessarily produce better results as the real success in achieving EE improvements depends not on the mandatory nature of audits, but on successful implementation of audit recommendations. (World Energy Council, 2008)

2.4.2 ESCOs

Traditionally Energy Service Companies or ESCOs are companies that provide energy-efficiency improvement services in exchange for a fee that is directly linked to the amount of energy saved or project's performance. (World Energy Council, 2008) As such, ESCOs guarantee that the energy savings will be sufficient to cover the costs of the project over certain period of time and they do not get remuneration in case of failure to generate energy savings. Pay-back periods depend on the projects and can vary from one year to five or ten years. (Ellis, 2010(a)) In many developing countries the concept of ESCO is understood to mean the companies that provide EE improvement services in exhange for remuneration that is not necessarily linked to the project's performance. Usually in such cases ESCOs do not take performance risks, arrange financing or undertake monitoring and verification. (Ellis, 2010(a))

Usually ESCOs undertake full responsibility over all steps of the project from its design to implementation. Thus typical ESCO services include identification, development and design of EE projects; installation and maintenance of EE equipment; and measurement, monitoring and verification of the project's energy savings. (World Energy Council, 2008) Financing of the project can be undertaken either by ESCO's internal funds, by the customer or by a third party, usually by financial institution in the form of special credit line either to ESCO or the client. (World Energy Council, 2008)

ESCOs are important players in advancing EE as they have specialized necessary expertise and knowledge in implementing cost effective energy efficient solutions. Making EE improvements at the low cost is basically ESCO's core business. Thus they can play special role in accelerating progress towards EE, especially in energy intensive economies like Arab states. Depending on who is performing ESCO services ESCOs can be divided into vendor-based and consultancy-based. Vendor-based ESCOs are usually energy technology suppliers with connection to energy-efficiency equipment manufacturers. Consultancy based ESCOs are firms that have general expertise in cleaner production, engineering and EE solutions. (Ellis, 2010(a))

2.4.3 Current situation

Although some countries in the region have undertaken efforts to promote the start and development of ESCOs, in general there is no strong ESCO presence in the market. Research conducted on this issue by RCREEE lists weak capitalization of small companies as the main challenge to bigger market penetration. (RCREEE, 2010) Like in other developing countries most ESCOs in the region were established and still exist mostly due to financial support from international donor institutions such as World Bank. The following table illustrates the approximate number of ESCOs in the countries.

Table 1 ESCOs in the Arab world

ALG	EGY	JOR	LEB	LIB	MOR	PAL	SYR	TUN	YEM	BAH	IRQ	SUD
0	10	1	15	0	0	0	0[2]	10	n/a	n/a	n/a	0

Source: (RCREEE, 2010)

As can be observed from the table, most of the countries do not have any ESCO industry, only three countries: Egypt, Lebanon and Tunisia have some ESCO presence. In these countries ESCOs' activities are mostly limited to energy auditing, except for Tunisia, where ESCOs seem to have implemented EE projects. In Egypt, around ten ESCOs were established with the help of donor projects and special financing scheme has been developed, even national association for ESCO has been formed called the Egyptian Energy Service

[2] The Energy Conservation Law provides for mandatory energy efficiency measures for state-owned industry with prescribed penalties. There are no private ESCOs in the country.

Business Association, but the results seem to be disappointing. Most ESCOs are small and remain under-resourced. (RCREEE, 2010)

There are numerous challenges that ESCOs face in the Arab region. Due to uniqueness and complexity of the business model ESCOs require not only special legal and financing conditions to operate in, but also high degree of awareness and trust among government bodies, financial institutions and the clients. The section will concentrate only on key factors identified through literature review and interviews that are necessary to enable successful sustainable growth of ESCOs in the Arab world.

2.4.4 Enabling factors

The main precondition for energy audits and successful operation of ESCOs in the market is sufficient demand for EE improvement services. It is the need to reduce energy consumption for reasons of either lowering the costs or pursuing environmental benefits that drives the customers to undertake EE improvements. Various factors can generate demand for EE improvement services, including high energy prices, minimum energy performance standards, EE obligations, mandatory energy audits and other policies that stimulate or mandate EE. (World Energy Council, 2008) (Shaalan, 2012) Lack of sufficient demand for EE creates significant disincentives to undertake EE investments as priority is usually given to other, more critical cost-cutting measures. (World Energy Council, 2008) It has been noted that often in developing countries with government subsidies companies that undertake EE measures are usually those that are so inefficient that energy inputs represent 50 to 60% of their cost, and thus saving a 10% makes a difference for them. (Ellis, 2010(a)) Likewise, it has been noticed that in countries where price subsidies have been lowered, demand for ESCOs' services had increased. (Ellis, 2010(a)) Lack of sufficient demand for EE has been noted as one of the major barriers to upscale of energy audits and development of ESCOs in the Arab region. (Shaalan, 2012) Low energy prices and lack of government policies stimulating demand for EE services constitute serious challenges for ESCOs in undertaking their business in a healthy sustainable manner without the need for external support.

Lack of access to adequate financing of energy efficient projects has been identified as a major barrier to ESCOs' successful operation in developing countries. Due to novelty and complexity of ESCO business domestic banks find them too risky and are reluctant to finance. Due to lack of knowledge about ESCO business model high initial costs and uncertainty about the credit-worthiness of ESCOs and their clients is what particularly hesitates domestic banks. As a result ESCOs in developing countries have to spend considerable amount of efforts on securing the funding for EE projects. (World Energy Council, 2008) In those developing countries where ESCOs exist, the projects are usually either entirely or co-financed by international donor institutions such as EBRD, the World Bank, the GEF, UNDP and others. (Ellis, 2010(a))

Many experts recognize the need for financing support schemes and funding mechanism to be especially important in kick starting ESCO business. Funding support is important in overcoming the high initial capital costs, risks associated with start up, in building human capacity of ESCOs. (Ellis, 2010(a)) Financial support is necessary to help ESCOs to mature as a self-sustaining business. In light of heavily subsidized energy prices financial support is especially essential in keeping ESCOs operational. Therefore sufficiency of financial support, at least at the early stages, is an important indicator in measuring the progress in promoting ESCOs in the country.

As mentioned earlier energy audits are successful only if the recommendations made as a result of audit are implemented. Thus, it is recommended to focus on undertaking measures aimed at strengthening the compliance with the audit recommendations either through financial incentives for EE improvements or reward schemes. Financial incentives can include subsidies, tax bonuses, soft-loans, grants, credits and other measures that reduce either the payback periods or the cost of EE investments. (World Energy Council, 2008)

It is obvious that identifying EE improvements through energy audits requires certain level of knowledge and expertise in the areas of cleaner production, industrial processes, buildings and other EE related areas. To ensure the quality of energy audit the auditors are usually certified by third party quality control institutions or at least supervised by certified energy managers. However, many developing countries, especially in the early phases of introducing energy audits lack qualified energy auditors and energy managers. (World Energy Council, 2008) Therefore, capacity of energy auditors is an important factor in assessing the quality of audits.

EE knowledge and expertise is even more important for successful operation of ESCOs as it constitutes their core business. In addition to possessing sufficient technical skills ESCOs must have some contracting, financing and project management skills. People working at ESCOs need to have capacity to identify possible projects, design and implement them, which requires multi-disciplinary skills. This expertise cannot just be created by funding institutions, they need to be developed. (Ellis, 2010(a)) For these reasons, it is important to measure the capacity of ESCOs in undertaking EE projects.

As mentioned earlier, ESCOs require special legal conditions to operate in. Without proper legal or institutional framework ESCOs can face difficulties in start-ups as it is not clear whether they should be treated as equipment sales business, financing business or service businesses. (World Energy Council, 2008)(Ellis, 2010(a)) Supporting legal framework is necessary not only to create favorable conditions such as special tax regimes, but also to provide protection to ESCOs and their clients by ensuring security and enfoceability of ESCO contracts. (Ellis, 2010(a)) It is important to note that creating supporting legal framework includes first of all removing institutional, legislative or market barriers to sucessful operation of ESCOs

Lack of awareness is a general problem in advancing EE measures, but it is especially significant barrier for operation of ESCOs. ESCOs often face significant difficulties in convincing potential clients and financial institutions of the operationality of the ESCO model and projects. (Ellis, Energy Service Companies (ESCOs), 2010(a)) Based on interviews with practitioners and representatives of industry groups in Egypt it was revealed that there seems to be limited confidence in ESCO services due to lack of successful projects. Such situation corresponds to situation in other developing countries such as India, where ESCO had poor track records and failed EE projects, which resulted in mistrust to ESCO industry. (Ellis, 2010(a))

Literature and experts repeatedly stress that government support to ESCOs through raising awareness and capacity building programs are critical for their success, particularly in the start-up stages. (Ellis, 2010(a)) Raising awareness and capacity building efforts through information dissemination, public campaigns, trainings, workshops, manuals for stakeholders are necessary in mitigating the barriers for ESCOs. (World Energy Council, 2008) Experience shows that demonstration projects are effective means in building trust, improving perceiption of financial institutions and raising awareness about ESCOs, EE technologies and EE in general. They are also important in increasing capacity of ESCOs and creating a market for them. (World Energy Council, 2008)(Ellis, 2010(a))

2.5 EE Policy Measures

Policy measures are necessary to foster and enable the uptake of EE improvements and induce positive changes in consumer behavior. (UNDP, 2010) Experience shows that removing barriers to EE is not sufficient, proactive instruments are necessary to enhance consumers' willingness to adopt energy efficient technologies and practices. (UNDP, 2010) There are three types of policy instruments: regulatory, financial or market-based and information-based. Regulatory measures use command and control approach and prescribe mandatory requirements for EE. Financial or market-based instruments use market-based approaches to stimulate energy efficient behavior. Information-based instruments provide information to consumers on energy consumption of building or equipment. Each policy instrument has its own advantages and disadvantages and results often depend on many factors, including design of the instrument, suitability of the instrument to the context, implementation and enforcement factors. Literature states that there is no one best instruments for all situations; similar instruments can have different results in different countries. However, based on the experience some policy instruments prove to work more effectively than others. (UNDP, 2010)

2.5.1 EE standards for buildings

There are two main approaches to improving energy performance in building sector: (1) reducing building's energy demand; and (2) integrating renewable sources of energy in the building system. (UNDP, 2010) In improving energy performance of buildings special attention should be paid on activities that have the highest energy consumption. In developing countries demand for energy is dominated by food refrigeration, space cooling and lighting. (Gelil, 2011) Energy performance of building depends not only on the performance of individual critical elements such as building and thermal envelopes, windows but also on how they perform as an integrated system. Therefore building design is important in integrating all EE influencing factors such as construction materials, building lay-out and others. (Gelil, 2011) Special attention should be paid to building and thermal envelopes as they are the main determinants of the amount of energy needed for cooling, heating and ventilation purposes. (Gelil, 2011)

The literature repeatedly stresses that EE standards for buildings are the most cost-effective measures in improving EE performance of buildings, especially in countries with high construction activities. (Feng Liu, 2010) (UNDP, 2010) (IEA, 2008) Mandatory EE standards, if enforced properly, can constitute strong driving force for the construction industry to start developing and producing more energy efficient buildings and integrating energy efficient solutions. Similarly standards can have strong leverage on entire supply chain to start producing more energy efficient construction materials. (Feng Liu, 2010) Also such standards can help capture the largest EE potential in building at the lowest cost since they are targeted at the design and construction phases. (IEA, 2008) EE standards generally prescribe the requirements for energy performance of the building shell such as thermal insulation requirements, rates of glazing per orientation, solar protection and others and may even include requirements for integrating renewable energies. They can also contain requirements for efficient systems of heating, ventilation, cooling, production of running hot water and lighting. (Antipolis, 2011) Although little research has been done assessing the impact of EE standards, it is argued that such standards effectively reduce energy consumption in building as they address efficiency of critical parts of the building, including building envelope, heating, cooling and ventilation systems, and other building related energy end-uses such as lighting. (IEA, 2008) (Steven Braithwait, 2007)

EE standards can be prescriptive or performance based. There is no definite agreement in the literature on what standards would be better suitable for developing country with weak compliance and enforcement mechanisms. Performance based standards are generally regarded better than prescriptive ones as they look at the building as a whole system and allow achieving EE at the lower cost due to greater flexibility given for designers and architects. But at the same time they can be more difficult to design as they require higher level of expertise, which is often lacking in developing countries. They also require more detailed data on the energy consumption patterns of existing building stock in order to develop realistic suitable energy consumption requirements. Monitoring the compliance with MEPS seems to be also complicated again to due to requirement of higher level of expertise of building inspectors. (UNDP, 2010) Literature suggests that due to relative easiness in enforcement, prescriptive EE codes might be better suited for countries with limited experience with EE or situations where there is low qualification and skills of the building sector. (UNDP, 2010) EE standards can be set in different ways, either be integrated in general building codes or be separate standards for EE. (IEA, 2008) As long as their implementation and enforcement is ensured literature does not indicate either of the forms as a preferable one. (IEA, 2008)

According to UNDP study the key elements of successful EE standards for buildings include stakeholder participation for development of EE prescription such as architects, builders, developers, contractors. Wide stakeholder participation can allow developing more realistic and practical energy prescriptions and thus enable greater compliance rate with requirements. Demonstration projects are also important in illustrating the adequacy and cost-effectiveness of standards. (UNDP, 2010)

Compared to new buildings integrating EE solutions in existing buildings is a challenging and expensive task. Many building owners are reluctant to implement EE solutions in existing buildings due to associated high costs and disturbances caused for building users. It is best to implement EE solutions for existing buildings when they are going through refurbishments because energy savings can be best obtained when other construction activities take place. Thus refurbishments present a major opportunity to tap EE potential of the building at relatively low cost. (UNDP, 2010) During refurbishments energy improvements can be made either at small or no additional costs. Literature strongly suggests that EE requirements during refurbishment are important and should be included in building codes. (IEA, 2008)

In the region situation with EE codes varies just like with other energy policy instruments. Regarding the development of mandatory thermal regulations for new buildings Tunisia seems to be the most advanced country. It has had thermal regulations for new building since 2008, implementation of which still remains to be voluntary though. Few demonstration projects have been built in accordance with these regulations for raising awareness and capacity building purposes. (Antipolis, 2011) In Morocco with the support of GEF project and the ADEME of France thermal energy regulations for residential, commercial building and hospital sectors are currently under development. (Antipolis, 2011) (Gelil, 2011) In Lebanon again with the support of GEF and ADEME Lebanese building code provides for financial incentives for voluntary thermal insulation of buildings. (L.C.E.C., 2012) Egypt introduced two energy efficiency codes for residential buildings in 2006 and for commercial buildings in 2009. (Feng Liu, 2010) However, both regulations remain voluntary and largely unimplemented. (Antipolis, 2011) In Jordan EE code was developed in 2009, but the status of its adoption remains unclear. Based on the Jordanian code Palestinian energy building code was developed and adapted. (Gelil, 2011) In Syria thermal insulation regulations for buildings were developed in 2008, but remain unimplemented. The following table illustrates the current status of existing EE standards for buildings in the region.

Table 2: Current status of Energy Efficiency Standards for Buildings

EE building code	ALG	EGY	JOR	LEB	MOR	PAL	SYR	TUN	BAH
Mandatory	x P		x P			x	x	x B	x
Voluntary		x B							
Planned				x B	x				

Source: (Gelil, 2011) (Antipolis, 2011) (Visser, 2012)

x - Energy efficiency code/ building thermal insulation code/ thermal energy regulations
P – Prescriptive; PB- performance based; B- both

One of the approaches to reducing energy consumption in building is integrating local sources of renewable energy. Use of renewable energy can be either passive or active. In passive systems renewable energy is used to reduce the energy demand of building. In active systems renewable energy is used to produce heat or electricity that otherwise would come from non-renewable sources. Such systems include solar water heaters (SWH), use of PV panels to produce electricity and others. With increasing energy demand in buildings integrating renewable energy is becoming important part of energy performance of the buildings and more advanced standards include these sources. (IEA, 2008)

Information on diffusion of solar water heaters in the region is limited. According to RCREEE studies on EE indicators Palestine has the highest rate of diffusion of solar water heaters per 1000 inhabitants (368.4 m_2 /1000 hab) mainly due to high energy prices. (gtz, 2009) In general diffusion of solar water heaters in residential sector is much higher than in tertiary sector. As illustrated in the figure below the presence of solar water heaters in tertiary sector is almost invisible. The main barriers to diffusion of solar water heaters in the region include high upfront costs of equipment compared to consumer's purchasing powers, lack of financial incentives, inadequate quality control infrastructure which lead to entry of low quality products in the market subsequently resulting in negative experience. (gtz, 2009) The following figure illustrates the rate of solar water heater diffusion in the region.

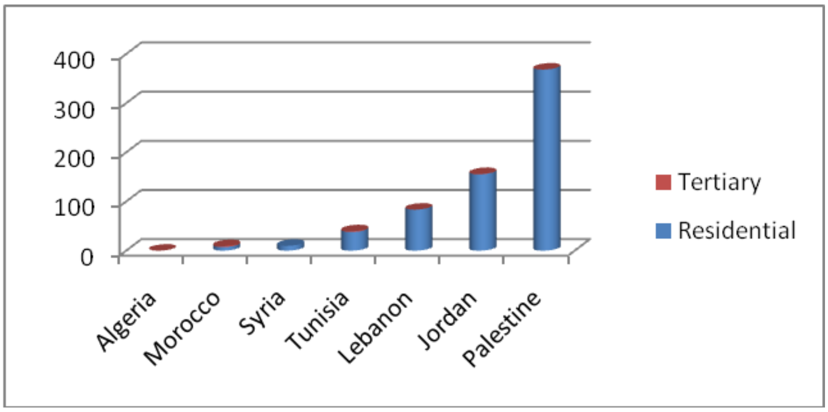

Figure 8: Rate of Solar Water Heater Diffusion

Source: (RCREEE, 2010)

In the literature Tunisia is often cited as a model for successful diffusion of SWHs. In 2005 Tunisia developed and launched innovative program for SWH diffusion called PROSOL, which resulted in immediate success with record figure of 7,400 SWHs installed in less than a year. PROSOL consists of innovative financing scheme targeted towards overcoming high initial investment costs of SWHs and actively involves all stakeholders including state electricity utility, commercial banks, equipment suppliers and SWHs installers. Accompanying measures include quality control system, awareness raising campaigns and capacity building programmes. (gtz, 2009)

2.5.2 MEPS for appliances & equipment

To reduce energy consumption of household appliances and office equipment many countries have introduced Minimum Energy Performance Standards (MEPS) for household appliances and office equipment often followed by labeling programmes. MEPS define EE performance threshold for appliances and equipment, thereby preventing the entry of cheap inefficient products into the market. (World Energy Council, 2008) MEPS are particularly important for products for which EE performance constitutes the least important feature for consumers such as TV sets.

Labeling programmes are aimed at providing consumers with information on energy consumption of appliance or equipment, thereby allowing them to compare and make the right choices. The main purpose of labeling is to stimulate technological innovation and introduction of more efficient products. (World Energy Council, 2008) Most countries focused first on refrigerators and air conditioners since these appliances account for the largest household electricity consumption. Today, MEPS exist for greater number of appliances, including washing machines, TV sets, dryers, dishwashers, water heaters and others. (World Energy Council, 2008)

Experience shows that MEPS together with labeling programs are effective in reducing energy consumption of appliances and equipment. The EU labeling scheme increased refrigeration efficiency by 25% from 1992 to 1999. Research also indicates that increased use of more efficient appliances did not result in price increase for the consumers. (World Energy Council, 2008) IEA in its report "25 energy efficiency policy recommendations" recommends governments to priorities MEPS and labeling programmes for appliances and equipment that are likely to result in the largest energy, economic and environmental benefits. (IEA, 2011)

2.5.3 Phase-out policy of inefficient lighting

Recognizing the high inefficiency of incandescent lighting technology today many countries in the world have either phased-out these products from the market or in the process of doing so. Cuba was one of the first countries to successfully complete the phase-out of incandescent light bulbs in 2007. It banned the sale of incandescent lamps and implemented a program of direct substitution of such lamps with CFLs. (Dilip R. Limaye, 2009)

In the Arab world, many countries have launched various initiatives to phase-out incandescent lamps, but these initiatives vary in scale and stages of development. (Gelil, 2011) Countries have formulated and implemented various policies and measures to support the deployment of CFLs with mandatory and voluntary components. (Gelil, 2011) Measures aimed at reducing the cost of CFLs have been the most preferred approach in the region to phasing-out incandescent lamps. Such approach has been prevalent mostly due to heavily subsidized electricity prices and relatively high costs of CFLs. (Gelil, 2011) Most of such measures include bulk distribution of CFLs at considerably low price. Although many countries have initiated various activities to facilitate greater deployment of CFLs none of them have banned the sale of incandescent lamps. Only four countries, Egypt, Lebanon, Algeria and Tunisia have announced plans to ban incandescent lamps by certain date. Egypt and Algeria plan to phase out incandescent lamps by 2020, whereas Lebanon and Tunisia have earlier dates: 2012 and 2013. (Gelil, 2011) (Ministry of Energy and Mines, 2011)

Both literature and interviews indicate lack of high quality CFL bulbs in the market as one of the biggest challenges to large-scale implementation of CFLs in the Arab world. Poor quality CFLs in the market significantly taint the image of what is essentially a very good lighting source, resulting in great disappointment and distrust among customers, and negatively affecting efforts to promote efficient lighting technologies. (Dilip R. Limaye, 2009) According to a study conducted in 2010 approximately one third of the CFLs produced in Asia are of questionable quality. Research suggests that developing and harmonizing minimum efficiency and quality standards through appropriate testing and certification mechanisms is a key to eliminating low quality products from the market and creating trust among consumers. (Gelil, 2011) (Dilip R. Limaye, 2009) Assuring quality and efficiency of CFLs includes defining product technical specifications such as lamp wattage, lumen output, rated lifetime, color rendering index, lumen maintenance over time, power factor, mercury content, safety, certification and warranty. All these specifications are necessary to ensure not only energy performance of CFLs, but also their life-span and safety. (Dilip R. Limaye, 2009)

2.6 Financial Incentives

Lack of adequate financing of EE projects constitutes one of the biggest challenges to EE in general. Reasons for inadequacy of financing are numerous, including lack of capital to cover high upfront costs of EE investments, lack of awareness on the financial benefits of the investments, fear of hidden costs, uncertainty regarding the precise nature of energy savings, high transaction costs, difficulties in separating operating and capital budgets and others. For developing countries, lack of experience with project financing creates an additional hurdle for obtaining financing for EE projects. (UNDP, 2010) In the Arab region the problem of lack of adequate financing is further exacerbated by heavily subsidized energy prices, making EE investments less profitable, especially in the residential sector. Variety and complex of measures are needed to overcome these problems.

Financial incentives are one of the ways of addressing the challenge of lack of adequate financing of EE projects. Especially in building sector despite life cycle cost benefits constructing more energy efficient buildings is usually more costly than conventional buildings. For low income households it can be hard tradeoff between having a housing versus having an energy efficient housing. (Feng Liu, 2010) Financial incentives are useful not only in overcoming high capital costs of EE projects, but also attracting more consumer attention, raising awareness about benefits of EE and demonstrating government's commitment to EE improvements. (UNDP, 2010) Many countries use financial instruments to enhance the compliance with mandatory or voluntary prescriptions on EE. (UNDP, 2010)

Financial instruments are designed to encourage EE investments either through reducing the costs associated with investments or decreasing the costs associated with energy use. (ICER, 2010) Literature differentiates two types of financial instruments: economic incentives and fiscal measures. (World Energy Council, 2008) Economic incentives include grants, various subsidy schemes and soft loans. The main purpose of these incentives is to help to overcome the initial high upfront costs of EE investments by reducing the price of EE equipment or labor (World Energy Council, 2008) Grants and subsidies are usually given directly to the party implementing EE projects. (ICER, 2010) Subsidies for audits are aimed at facilitating and promoting EE improvements by making it inexpensive to identify possible EE measures, but also to provide technical and financial information on achieving EE. (ICER, 2010) Subsidies can be expressed either as a fixed amount or a percentage of the audit costs. (World Energy Council, 2008)

Unlike subsidies fiscal measures encourage EE investments not through reducing the upfront payment, but through reducing the overall costs of EE investments. The main purpose of fiscal measures is to reduce the tax amount that consumers have to pay in undertaking EE improvements. Such measures include tax credits, tax deductions, tax reductions, tax exemptions and others. (World Energy Council, 2008) Historically many countries have preferred to use fiscal measures over subsidies due to cost-effectiveness of the measure. Fiscal measures allow reaching large number of beneficiaries using existing taxation system, thus avoiding incurring high administrative costs. (UNDP, 2010)

Today use of market-based instruments is a wide-spread measure. Many countries have developed various subsidy schemes to encourage energy efficient investments. For developing countries, where the cost difference between conventional and energy efficient equipment may represent higher proportion of consumer's disposable income, financial instruments aimed at reducing the initial upfront costs are regarded generally as more preferable than those instruments that spread out over the lifetime of the investment. (UNDP, 2010)

To limit the number 'free-riders' and ensure the effectiveness of incentive schemes literature suggests specifying and limiting the number of possible beneficiaries and eligible technologies. (UNDP, 2010) However, at the same time it is important to maintain the simplicity of the procedure for getting financial assistance. Experience shows that often consumers who were the targeted audience of financial schemes did not take advantage of these instruments because the procedure was too burdensome and bureaucratic or consumers were simply unaware of existence of such instruments. Maintaining easy access to financing schemes is equally important as the actual existence of financial schemes in encouraging investments in EE. To operate properly it is important to have efficient and cost-effective arrangements for assessing the technical and administrative aspects of financing mechanisms and making sure that targeted audience is adequately informed of the existence of incentives. (UNDP, 2010) (World Energy Council, 2008)

2.7 Raising Awareness

Both literature and interviews indicate that lack of awareness as one of the biggest challenges to EE improvement in the Arab world. Even where EE constitutes low cost opportunity to save money and resources the uptake of EE measures is very slow due to lack of consumer awareness about energy consumption, benefits of EE and their implementing measures. (Dilip R. Limaye, 2009) According to UNDP report surveys regularly demonstrate that "energy users underestimate the benefits of energy-saving technologies and overestimate their costs." (UNDP, 2010) Information about EE solutions is often incomplete, unavailable, expensive or difficult to obtain.

The problem of lack of information and awareness about EE and its benefits persists not only among consumers, but also among policymakers and even professionals. Often professionals are not always aware about available EE technologies and solutions. When they are aware, they are reluctant to try them either due to fear that it will not work or due to lack of capacity to correctly apply them. (Feng Liu, 2010) It is estimated that payback period for deployment of energy efficient lighting technology is less than 2 years for most Arab countries and for household appliances is about 2 years, except for three countries where electricity sector is heavily subsidized, namely Algeria, Egypt and Syria. Research indicates that the biggest barrier for wide diffusion of these technologies is lack of awareness and information on the benefits of these measures. (Mourtada, 2010)

Reducing information gap and raising awareness is another important factor for EE improvement. Awareness raising activities are necessary to educate consumers about importance of EE and resource conservation in general. Consumer information and knowledge about benefits of EE can have significant positive effect on consumer behavior and enhance the uptake of EE measures. (UNDP, 2010)

Raising awareness activities can vary in nature, scale and scope. Literature recommends pursuing both building general level of awareness of public on energy conservation, and also providing information on more specific consumer questions and concerns. Although general activities on raising awareness such as public campaigns, leaflets and information brochures are important, sometimes they can fail to reach the majority of relevant consumers, especially when the campaign ends. To enable positive changes in consumer behavior, it is important to provide them with more individual coaching such as energy conservation tips and action plans. Consumers need to be able to know what EE technology is more suitable for them, what product, what technical specifications, where to find the product or company to perform the service, what financial help they can get and other relevant information. (UNDP, 2010) Experience shows that setting up local EE information centers is effective way of providing and disseminating such information. Such centers can be useful in providing tips on energy conservation measures, up-to date information on EE technology, technical advice, useful contacts of installers, manufacturers, and relevant authorities and information on available funding. It is observed that countries with such centers have higher rate of implementation of EE measures. (UNDP, 2010)

Raising awareness has been objective of many policies around the world. Countries have undertaken various measures ranging from public campaigns, leaflets, and information brochures, social advertisements to individual audits, EE information centers and demonstration projects. (UNDP, 2010) All these activities are important, but the message that is stressed in literature is that they have to be carried out on a regular basis. (UNDP, 2010) Not many studies exist estimating the actual impact of raising awareness activities on energy conservation; but results that are available indicate that such measures are generally less effective that regulatory instruments. (UNDP, 2010)

3 Pathway to Pursue Energy Efficiency

Effective legislative framework constitutes an important factor in fostering and enabling EE. According to IEA report on EE governance key elements of effective legislative framework include clear government's intent and commitment for EE improvement; high level and long-term focus; specific, quantitative and time-bound EE objectives; justification for the need of government intervention; assigned agency for planning, designing and implementing EE measures; dedicated funding and resources to achieve the stated goals and objective; and effective oversight of policies and measures such as monitoring and reporting. (IEA, 2010) (IEA, 2009) For better diffusion of EE measures it is also recommended that EE laws and polices constitute part of broader economic, social and environmental policies. (IEA, 2009)

3.1 Energy Planning

Strategic energy planning is a critical step in pursuing effective EE strategy. Energy planning involves various activities including estimating potential for EE, identifying barriers to cost-effective energy efficient investments, setting long-term and intermediate national indicative savings targets, prioritizing measures, setting EE goals and objectives, formulating policies and developing specific action plans. (National Action Plan for Energy Efficiency, 2007) 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. It also allows pursuing more cost effective solutions through identifying, comparing and prioritizing various energy-efficient measures according to their EE potential and cost-effectiveness. (IEA, 2009) Strategic planning is useful in focusing attention on the important issues, identifying necessary tasks and resources and allocating implementing and monitoring responsibilities. (IEA, 2007)

3.1.1 Measuring energy consumption

Solid data on energy end-uses constitutes a basis for proper energy planning. Literature strongly recommends making all possible efforts to collect data on energy end-use before formulating EE policies. (UNDP, 2010) Reliable, timely and detailed data on energy end-uses allows proper estimation of EE potential, which in turn allows better framing of EE policies and programs. (IEA, 2011) Data collection is also necessary for understanding the current state of energy consumption, defining baseline and setting proper priority EE targets. The more detailed and timely data on energy end-use the better energy prognosis and planning can be achieved. (UNDP, 2010)

Data collection is especially important in developing indicator on evaluation of energy savings at the macro and sector levels. There are two approaches in evaluating energy savings: top-down approach and bottom-up approach. Top-down approach refers to the method of energy savings evaluation where "amount of energy savings or energy efficiency progress are calculated using national or aggregated sectoral levels of energy saving as the starting point." (Bruno Lapillonne, 2009) Contrary to top-down approach "bottom-up evaluation starts from data at the level of a single energy efficiency improvement (EEI) measures, mechanism, programme, or energy service […], and then aggregates results from all EEI measures […] to assess its total energy savings in a specific field." (Evaluate Energy Savings EU)

Bottom-up approach provides better basis for formulating more dedicated, effective and measurable EE strategies and policies, but at the same time it can represent more difficult and costly procedure in calculating energy savings. (Phylipsen, 2010) (Evaluate Energy Savings EU) The top-down approach can be easier to apply, but it is more difficult to define the actual energy consumption pattern and identify precise energy savings. (Evaluate Energy Savings EU) The top-down approach is helpful in understanding indications, or approximations of energy intensity or EE at the higher level, which is important for formulating broader energy-related policies and development-related issues, such as access to electricity, supply constraints, import dependency and others. This is particularly relevant to developing countries, where most of the data on energy consumption is limited to energy indicators rather than energy end-use indicators. (Phylipsen, 2010) Literature recommends in formulating strategies and policies to giver prior consideration to the question of how the effect of the policies are going to be monitored in order to identify appropriate indicators for a given policy. (Phylipsen, 2010)

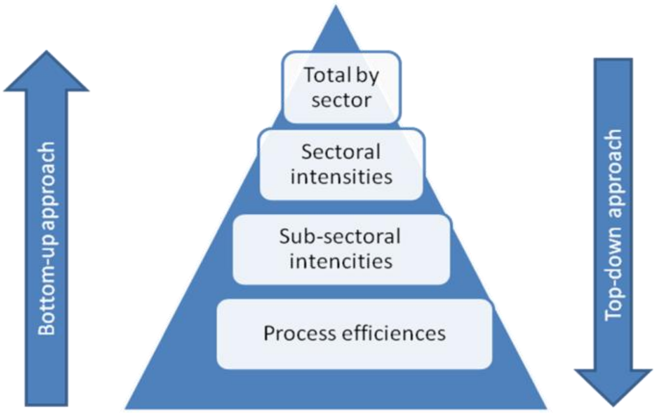

Figure 9: Energy Savings Evaluation Pyramid

Source: (Phylipsen, 2010)

Based on the European practical experience of calculating energy savings using both approaches, literature recommends using top-down calculation method for electric appliances, solar water heaters and vehicles because there is well-defined statistical indicator of the average specific annual energy consumption per unit of appliance or per vehicle, and for solar water heaters. (Evaluate Energy Savings EU) Bottom-up approach is best suitable for all other end-use sectors, end-uses and EE improvement measures, particularly in the case of buildings. (Evaluate Energy Savings EU)

Data collection is expensive procedure and availability of such data often constitutes a major challenge in developing countries. (Phylipsen, 2010) Due to lack of detailed data on energy end-use usually data availability in many developing countries is limited to energy indicators rather than energy end-use indicators. However even in the absence of full range of data on energy end-uses general orientations for formulating policies can still be inferred from information such as growth rates of major economic sectors, population growths, energy intensity and others. It is argued that such information can be actually more important for rapidly changing countries than information on current energy end-uses. (UNDP, 2010)

Detailed data availability on energy end-uses constitutes a great challenge in the Arab world. According to recent study undertaken by RCREEE on EE indicators in the region only Tunisia has an extensive data on energy end-uses at the macro and sector levels. In all other countries the project encountered substantial difficulties in gathering good quality data. A lot of data was found to be either absent or difficult to locate, incomplete, unreliable, low quality, inconsistent and difficult to interpret and analyze. The major problems encountered during the data collection included difficulties in obtaining access to data due to secrecy of information; limited or inexistent database of national statistical bodies; difficulties in identifying responsible entity for data collection. In some countries such as Yemen and Palestine data collection process was significantly hindered by unstable political situation. The study noted that obtaining sector specific data was especially difficult.

Table 3: Summary of challenges in data collection

Difficulties in collecting data	Country
Data discrepancy and inconsistency (various national organizations provide different data)	Jordan, Yemen
Difficulties in obtaining data due to secrecy of information e.g. data on fuel subsidies	Jordan, Yemen
Difficulties in identifying responsible entity for gathering data	Jordan, Yemen
Absence of data or inability to physically locate the data, especially sector specific data	Jordan, Lebanon, Libya, Morocco, Palestine, Syria, Tunisia, Yemen
Lack or weak government statistical system (limited database)	Libya, Morocco, Palestine, Syria, Yemen
Incomplete, unreliable low quality data	Libya, Palestine, Syria
Unstable political situation that created substantial difficulties in data collection process	Yemen, Palestine

Source: (RCREEE, 2010)

The figure below illustrates the data availability on energy end-uses in the region.

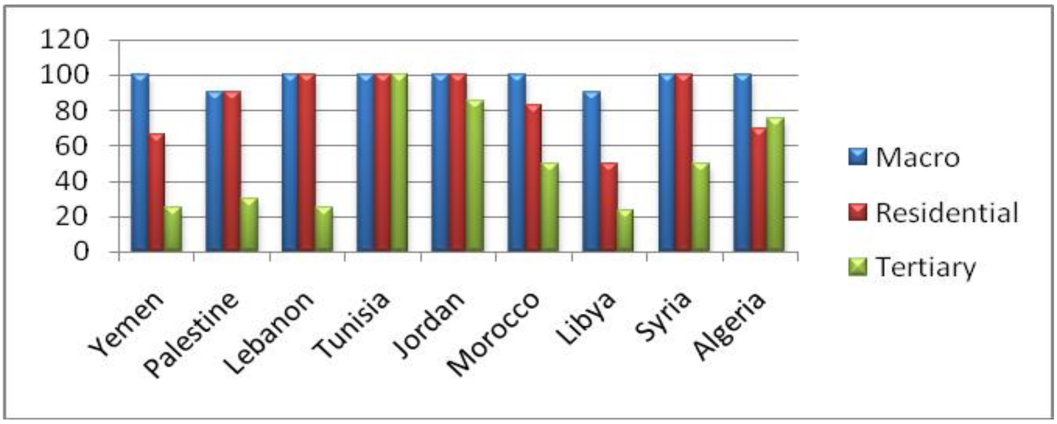

Figure 10: Data availability

Source: (RCREEE, 2010)

3.1.2 Estimating EE potential

Estimating EE potential is another basic step in implementing effective EE program. The major purpose of estimating EE potential is to identify areas where the biggest EE improvements can be made at the lowest economic costs. Estimating EE potential is especially helpful in proper target setting, both at the macro and sector specific levels. Estimating EE potential can include estimating technical, economic and program potentials. Technical potential refers to the amount of energy savings occurred as a result of penetration of all EE measures that are technically feasible from engineering perspective. Economic potential is usually referred to technical potential of only those measures that are economically feasible. Program potential takes into account practical limitations on achieving energy savings. (Belzer, 2009) Thus, estimating EE potential allows comparing impacts of various measures and identifying those that are technically feasible, economically beneficial and practically implementable. Often EE potential is estimated with the help of complex economic modeling tools.

In the Arab region the en.lighten initiative estimated the potential electricity savings, CO_2 emission reduction and the resulting economic benefits from phasing out incandescent light bulbs. (Gelil, 2011) According to this study it is estimated that the total energy savings for the whole region would constitute 20 Twht/year resulting in reduction of 571 Mt/year CO_2 emissions, which represents 7.8% of energy savings for the region. Potential energy savings for individual countries depend on their pattern of energy consumption, fuel mix of electricity generation and energy efficiency. Algeria is estimated to have the highest energy savings potential (14%) and Egypt - the lowest (4.2%) from phasing out inefficient lighting technology. (Gelil, 2011) The following table provides more detailed information on the potential of energy savings in the region.

Table 4: Estimated Energy Efficiency Potential

Estimated Savings	**ALG**	**EGY**	**JOR**	**LEB**	**LIB**	**MOR**	**PAL**	**SYR**	**TUN**	**YEM**	**IRQ**	**SUD**
Energy Savings (Twh/year)	4.2	4.7	0.9	0.7	1.2	1.8	0.2	2.2	0.9	0.5	2.4	0.3
% energy Savings	14	4.2	7.8	7.4	6.6	8.3	4.5	8.3	6.9	11.4	6.7	7.7
Total CO2 emissions (Mt/year)	86	169	19.2	11.4	43.2	40.8	2.3	53.8	22.4	20.6	91.5	10.9
annual financial savings (mill USD/year)	335	331	104	65	36	263	17	44	45	55	120	28
Payback period	1	1.1	0.7	0.9	2.7	0.7	0.8	4	2.7	0.7	1.6	2.1

Source: (Gelil, 2011)

3.2 Target Setting

Extensive review of EE policies around the world conducted by IEA and World Energy Council identified clearly defined EE objectives with specific timelines as one of the attributes of successful EE strategy. (IEA, 2010) According to World Energy Council report proper regulatory framework with official clear quantitative targets on EE improvements followed by monitoring and evaluation mechanisms can provide a long lasting context for EE policies and avoid one time actions. (World Energy Council, 2008) EE targets are useful in motivating implementing agencies to be more pro-active and measuring the progress of EE initiatives. Targets also provide basis for long-term EE programmes and provide justification for obtaining funding. (IEA, 2010) "Adopting a target is a statement of the importance of EE policy in relation to other government priorities; as such, it helps mobilize stakeholders, build political consensus and increase awareness." (IEA, 2010) At the same time one ought to be careful in constructing targets to avoid misleading or false impressions of government's activities. To be useful in measuring progress, it is recommended that targets are supported by strong analytic basis, high-quality data and transparent measurement procedure. (IEA, 2010)

Targets can vary according to their stringency, type and scope. Stringency refers to binding or indicative and non-binding or voluntary targets. Literature recommends setting binding targets only if they are matched by political, resource and stakeholder commitment. (Joanne Wade, 2011) Type of targets refers to the way they are expressed and measured. The most common way of expressing targets is in the form of volumetric defined EE improvements either as a rate of energy savings or specific volume of savings. (World Energy Council, 2008) Other forms of target expressions include improvement in energy intensity, expression of elasticity against another index, or as specific transactions e.g. number of CFLs installed. (IEA, 2010) Scope can include geographical, economy-wide, sectoral and subsectoral scope. (Joanne Wade, 2011)

Targets can be expressed in different ways as long as they remain *SMART*: specific, measurable, acceptable, realistic and time-bound. Targets need to be based on solid evidence of energy savings potential, moderated by real-world expectations of what can be realistically be achieved from technical, economic and programme perspectives, as well as upon progress that can be credibly and transparently demonstrated. (Joanne Wade, 2011) Literature indicates that targets that are set too low may become meaningless, but unrealistically high targets can severely undermine stakeholders' faith in them. (Joanne Wade, 2011) According to IEA guidelines on target setting it is suggested that targets have medium-term relevance and balance stringency with achievability to ensure that targets do not loose political value and practical utility by being set too far in the future. Experience shows that long-term targets have practical and political value if they are accompanied by interim targets. Targets should also be straightforward to monitor in order to enable governments to actually measure EE progress without the need for extensive and complex procedures. Although measurability of targets is not an easy task, it depends on target type, the degree of aggregation (top-down approach vs. bottom-up), institutional capacity and quality and availability of data. (Joanne Wade, 2011) Finally targets should be clearly communicated and documented in order to ensure their wide recognition by stakeholders. (IEA, 2010)

While it is wise to have macro level targets, literature suggests that sector specific targets are more effective as they are capable of producing overall EE savings at the lower costs due to differences in improvement potentials in each sector. For example in Mexico aggressive targets were set for appliances (52% reduction in energy use) and transport (26% reduction in energy use), but less stringent requirements for buildings and industry. Sectoral approach recognizes the difference in potential for energy improvements and their associated costs, thus allows pursuing more effective EE strategy. However such target setting needs to be accompanied by strong analysis and wide consultations with experts and stakeholders. (IEA, 2010)

Situation with target setting in the Arab world varies greatly. Literature provides inconsistent information on national indicative EE targets, creating confusion and uncertainty. For example RCREEE report states that Morocco has set a target of 15% of energy savings by 2030 (RCREEE, 2010), whereas Arab Forum for Environment and Development Green Economy report states that Morocco set 12% of savings by 2020 (AFED, 2011). Similar inconsistency is observed in the case of Egypt – RCREEE states that Egypt has target of 20% savings by 2020 (RCREEE, 2010), whereas AFED states that Egypt has set targets of 10% savings by 2020. (AFED, 2011) During consultations RCREEE EE expert Ashraf Kraidy stated that only indicative EE targets stated in NEEAPs should be seriously considered; other targets constitute mere political statements not necessarily backed up with specific programs and resources. (Kraidy, 2012) Among thirteen members of League of Arab States only four countries adopted official NEEAPs: Lebanon, Tunisia, Egypt and Palestine. Syria, Sudan and Jordan have prepared a draft of NEEAP, but have not officially approved them yet and Algeria, Yemen, Bahrain and Libya showed interests in developing one. (Kraidy, 2012) The major problem with EE targets in the Arab countries is their ambiguity and uncertainty. Indicative EE targets in the region are not easy to comprehend.

3.3 Dedicated EE Agency

Designated EE agency constitutes "the heart of any system of energy efficiency governance", the structure and design of which ought to be carefully considered. (IEA, 2010) Experience shows that EE agency is instrumental in effective fostering EE policies. (World Energy Council, 2008) (Dilip R. Limaye, 2009) EE agency should be a body with a strong technical skills authorized to implement and oversee EE policies. Such agencies should be able to conduct multiple tasks, including carrying out economic and policy analysis, planning, administration, management, engineering, logistics and programme evaluation. (IEA, 2010)

Such agencies can be organized in various forms such as specialized departments within a larger ministry, or stand alone agencies or independent statutory authorities or even in the form of public-private partnerships. The literature does not identify particular organizational form as a preferable one. Each organizational form has its own advantages and disadvantages and it should be chosen considering the local context. (IEA, 2010) What has been identified as an important element of EE agencies is: (1) their ability to work collaboratively; (2) ability to enhance private sector and energy provider participation: (3) credibility with stakeholders; and (4) adequate technical and administrative resources. (IEA, 2010) These core competences are necessary in order to properly design, implement and evaluate programmes and measures, to contract and engage range of stakeholders and finally to ensure effective coordination between various levels of authorities. (World Energy Council, 2008) According to IEA study factors affecting organizational success include strong leadership, professionalism, strong technical expertise, good external contacts and coordination with stakeholders, financial independence, control and inspection functions. (IEA, 2010)

Particularly important function of EE agency is coordination of all government activities in the field of EE. Since EE measures can be undertaken in various sectors by various governmental and semi-governmental structures coordination of all initiative is essential in order to avoid duplication, scattered and uncoordinated actions. (World Energy Council, 2008) It is argued that effective coordination has direct impact on the quality and effectiveness of EE policy outcomes. (IEA, 2010) In countries where EE projects are mostly financed by donor organizations, such agencies can act as a national counterpart with whom donors can negotiate the implementation of financial packages or developing new funding schemes. (World Energy Council, 2008)

In the region only few countries have functioning EE agencies. Some countries such as Egypt and Libya have no dedicated agencies at all. In other countries such as Lebanon EE agency is still supported by donor organization. Morocco is in the stage of introducing dedicated EE agency. Algerian and Palestinian agencies are weak with limited and incoherent responsibilities. Only Tunisia, Jordan and Syria have more or less functioning EE agencies. (RCREEE, 2010)

3.4 Compliance & Enforcement

Literature repeatedly states that effectiveness of policy instruments depends on their compliance and enforcement. Mandatory standards can be efficient only if they are effectively enforced. Compliance with mandatory prescriptions in building sector remains a challenge in many countries, resulting in much smaller energy savings and emission reductions. (Feng Liu, 2010) Experience shows that countries that have well done with compliance are often those that had wide stake holder participation in the development of EE standards for buildings. (Feng Liu, 2010)

In order to ensure strong compliance with mandatory standards literature recommends dedicating sufficient resources to support enforcement, training and educating stakeholders to meet the standards, 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.

3.4.1 Product test standards & measurement protocols

Product test standards and measurement protocols are the quality assurance procedures. The main purpose of such standards and protocols is to check and verify the product's efficiency and quality in order to assure customers that products comply with prescribed quality and energy performance standards "in a consistent manner, using accurate instrumentation applied by qualified staff in controlled conditions". (Gelil, 2011) Such standards are helpful in protecting market from penetration of low quality products. They are also helpful in establishing equal ground for suppliers by subjecting them to the same market entry conditions. Without such standards non-compliant products can substantially compromise the effectiveness of quality and energy performance standards and labeling programs. (Gelil, 2011) Literature recommends aligning national product test standards and measurement protocols with the development and use of international test standards and measurement protocols in order to have better performance comparisons and benchmarking for energy efficient appliances and equipment and to reduce industry compliance costs. (IEA, 2011)

Maintaining product test standards and measurement protocols requires having specialized testing laboratories and facilities capable of performing unbiased reliable energy tests. Such tests can be performed either by government or non-government entities. However, government needs to establish a procedure for monitoring compliance against the label or standard. The procedure needs to specify the procedure for selecting and testing an appliance or equipment, the number of products to be tested, who will pay for the test and other important practicalities. (Gelil, 2011)

3.4.2 Capacity building

Designing, constructing and renovating buildings according to energy-efficient standards requires upgrading skills, knowledge and expertise of professionals in the building sector, including architects, designers, builders, contractors, installers and others. Ability of stakeholders to comply with designed EE measures constitutes one of the important components of successful market transformation. Research recommends accompanying policy measures with relevant training activities about new designs, construction materials, and equipment in order to enhance the capacity of target group and increase the rate of compliance. (UNDP, 2010) Capacity building initiatives can be of various nature and scale, including integrating EE issues in the school curricular to local targeted training programs. (UNDP, 2010)

Research indicates that it can be more difficult to implement performance based EE standards for building in countries with little experience in EE because such standards require higher level of technical understanding, expertise and knowledge of the building as a system, thus more efforts are required in educating professionals in the construction industry. (UNDP, 2010) Important actors in implementing energy efficient building codes are those responsible for ensuring the compliance and enforcement such as reviewers of site plan and building designs, construction and equipment inspectors and others. It is thus equally important to concentrate on building capacity of these people, be they government employees or third parties. (Feng Liu, 2010)

Lack of readily available construction materials and energy efficient equipment is often an issue that slows down the progress of implementation of EE building codes. In some countries capacity building of construction industry presents additional challenges due to low level of education of manual labourers. Public buildings are great avenues for not only implementing innovative EE solutions, but also for enhancing the capacity of stakeholders and influencing building sector in general. (UNDP, 2010) It is recommended that international donor institutions should be involved in building demonstration projects during the first years after adoption of energy efficient building codes to help to increase the supply of energy efficient equipment and assure the quality. (Feng Liu, 2010)

3.4.3 Global initiatives measuring enforcement

Many developing countries have introduced EE standards for buildings, but most of them lack enforcement practices, substantially undermining the effectiveness of policy measures and precluding the proper tapping of EE potential. (Feng Liu, 2010) Reasons for weak enforcement mechanisms in developing countries are numerous, including corruption, weak institutional capacity, under-funding, lack of technical capacity to carry out proper inspection and supervision of construction projects and others. (Feng Liu, 2010) Developing indicators to measure the compliance record and effectiveness of enforcement mechanism of a country is a thesis on its own. As an indicator to measure the effectiveness of enforcement mechanism it is suggested to use the results of existing initiatives on this issue. Two global initiatives were found to be suitable for assessment of effectiveness of countries' enforcement system: the Bertelsmann Stiftung's Transformation Index (BTI) and Corruption Perceptions Index by Transparency International.

The Bertelsmann Stiftung's Transformation Index (BTI) measures countries' transition to democracy and market economy. BTI publishes on bi-annual basis results of their assessment for 128 countries. Countries are assessed according to 17 criteria by country experts guided by a standardized codebook. These assessment then reviewed by second country experts and then each of the 49 individual scores are subjected to regional and inter-regional calibration processes to ensure robustness of the results. The BTI aggregates the results into two indices: the Status Index and the Management Index. The Status Index has two analytical dimensions assessing the country's state of political and economic transformation towards rule of law and market economy, whereas the Management Index assesses the quality of governance. More detailed description of BTI methodology is available on their website http://www.bti-project.org/index/methodology/. (Transformation Index BTI, 2012)

Corruption Perceptions Index (CPI) developed by Transparency International, the global coalition against corruption measures the perception of corruption in the public sector which includes public officials, civil servants and politicians. Corruption is interpreted as an abuse of entrusted power for private gain. It is based on the results of the questionnaires on bribery of public officials, kickback in public procurement, embezzlement of public funds, and efforts to fight against corruption. Information is drawn from 17 data sources from 13 institutions and claims to be of the highest quality. CPI is well known and widely trusted index. It has been existed since 1995. More detailed information on CPI can be found at http://www.transparency.org/research/cpi/overview. (Transparency International, 2012)

The figure below illustrates the results of BTI and CPI assessments of the Arab countries:

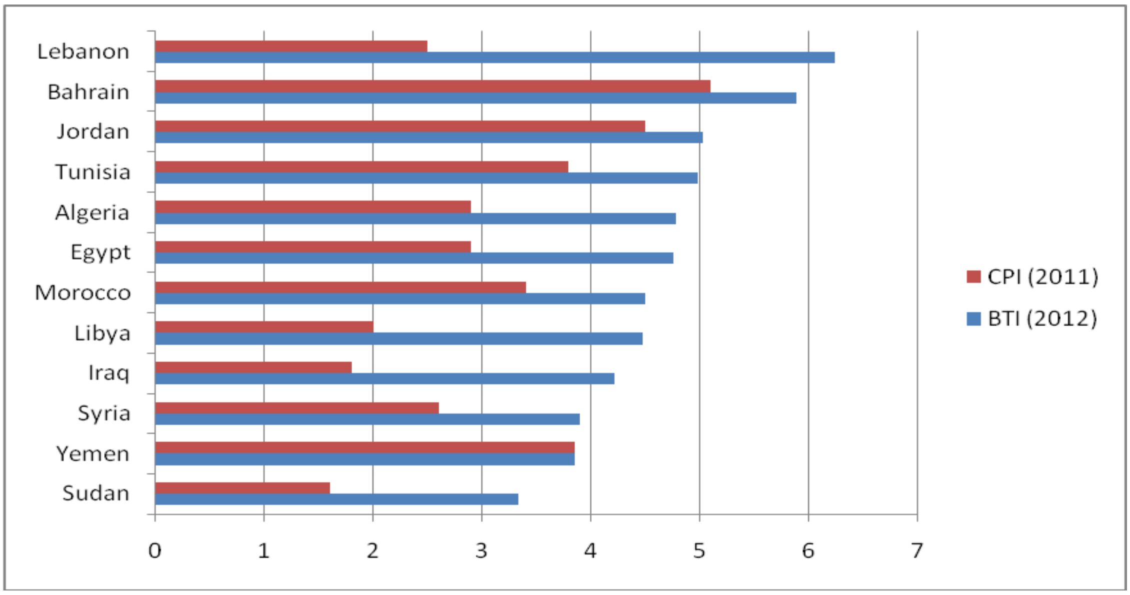

Figure 11: Bertelsmann Stiftung's Transformation Index and Corruption Perceptions Index

Source: (Transformation Index BTI, 2012) (Transparency International, 2012)

3.5 Monitoring & Evaluation

Literatures repeatedly states that to be effective policy instruments need to be regularly revised and become gradually more stringent in accordance with technology and market changes. (Rene Vossenaar, 2010) (UNDP, 2010) Minimum energy performance standards force technological innovation and drive the market price down. When producers are faced with new standards they adapt the appliances and equipment to meet them, if standards do not become stricter there are no incentives for producers to go beyond what is required. Literature particularly recommends regular revision of standards for programmes where labels play secondary role to encourage continuous technological innovation and ensure steady improvement in EE. (World Energy Council, 2008) It is also recommended that standards are revised in accordance with proven international practices. (IEA, 2011)

Policy monitoring and evaluation is typically aimed at quantifying to the extent possible the accomplishments of the policy objectives. Objectives formulated at the stage of policy formulation usually determine the objectives of policy evaluation. Basic categories of policy evaluation objectives include measuring the accomplishment of environmental and energy resource objectives such as the amount of CO2 emission reductions, reduction of energy imports, amount of energy saved, promoting general economic development and transforming the market. (AID-EE, 2006) Programmes on greater deployment of energy efficient lighting technologies are typically focused on energy savings (MWh) and peak load (MW) reduction impacts. (Dilip R. Limaye, 2009)

To facilitate better monitoring and evaluation of EE measures Efficiency Valuation Organization developed the International Performance Measurement and Verification Protocol. (EVO, 2012) This Protocol describes common practices in measuring, computing and reporting energy savings achieved by EE measures. The protocol provides M&V techniques that can be used by facility owner or EE project investor or public authority implementing EE project as a basis for preparing savings reports. (EVO, 2012)

Measurement and Verification (M&V) is the procedure for measuring and determining the actual energy savings occurred as a result of implementation of the EE measure. Energy savings cannot be directly measured, since they represent an unused energy, therefore savings are usually estimated by comparing the energy use before and after implementation of the measure. (EVO, 2012) M&V is necessary in order to evaluate the effectiveness of the policy measure and make appropriate adjustments. Important elements of M&V constitute data gathering, development of relevant computation method and acceptable estimates, computations with measured data and reporting. Accurate determination of energy savings provides valuable feedback on the effectiveness of EE measure, thus allows adjusting the policy measures to better tackle the EE. Good M&V report enhances the credibility of energy management projects, increasing the confidence of donors and investors and encouraging further investment in EE projects. M&V also allows accounting for related emission reductions, which further adds value to efficiency projects and highlights the public benefit provided by good energy management. (EVO, 2012)

Regular revision of standards and regulation is a common practice, in most European countries over the last 30 years thermal building codes have been reinforced three to four times. The new EU building directive includes a provision that energy building codes must be revised every 5 years. (UNDP, 2010)

There is no one standard for M&V for all EE projects. Each project needs to have its own specific M&V plan that addresses the unique features of EE project. To facilitate more effective evaluation program literature recommends designing pre- and post-installation surveys in order to develop basic information needed to calculate the direct program impacts. (Dilip R. Limaye, 2009) Literature also stresses that monitoring can be an endless procedure, therefore it is suggested to have proper balance between what needs to be monitored and what is practically doable. Ideally these choices should be made during the design of the policy measure.(AID-EE, 2006)

4 Designing Indicators

Based on the above analysis of the literature and interviews on EE barriers, enabling factors and good governance practices I developed indicators to measure EE progress in the Arab World. Indicators are developed within organizational structure illustrated in table 6 which comprises of three major categories: (1) market stimulation; (2) policy framework; (3) institutional capacity. The organizational structure of indicators follows the Deming cycle on continuous improvement and reflects elements of IEA EE governance framework. The first category of indicators assesses the factors that are important to stimulate the market of EE services, but do not necessarily require compliance and enforcement mechanisms. These factors include introducing time-differentiated price structure, reforming energy subsidies, removing barriers to greater penetration of EE technology and equipment and creating conditions for Energy Audits and ESCOs.

The second category of indicators relates to the policy measures that have been identified as necessary to stimulate the uptake of EE measures, but the effectiveness of which depend on the compliance and strong enforcement mechanisms. The third category of indicators assesses the institutional capacity of the states to properly design and deliver effective EE policies. As illustrated in the table 6 categories and factors have been designed with the assumption to be relevant and applicable to all sectors of economy including macro, residential and tertiary, industry, transport and utility. However, due to limitation of the current thesis to developing indicators only within residential and tertiary sectors it remains to be seen whether proposed organizational matrix would be suitable to other sectors.

Table 5: Energy Efficiency Progress Evaluation Organizational Matrix

Category	**Factors**	**Macro/ General**	**Residential & Tertiary**			**Industry**			**Transport**			**Utility**		
			Buildings	Appliances	Lighting	Cement	Steel	…				Generatio	Transmiss	Distributi
Market Stimulation	Energy Subsidy Reform													
	Price Structure													
	Energy Audit & ESCOs													
	EE technology & equipment													
Policy Framework	Energy Planning													
	Target Setting													
	Policy Measure													
Institutional Capacity	EE Agency													
	Compliance & Enforcement													
	Monitoring & Evaluation													
	Raising Awareness													

4.1 Indicators: Market Stimulation

Market Stimulation category consists of three factors: (1) energy subsidy reform; (2) price structure; (3) energy audits & ESCOs. These factors are measured by ten quantitative and qualitative indicators.

Heavy subsidies for fossil-fuel and electricity have been identified as major obstacle to energy efficiency in the region, thus it is an important factor to be measured. Energy subsidy reform is measured by three indicators: the amount of subsidy, public commitment to phase out energy subsidies and by efficiency of ensuring protection to poor. The amount of subsidies is currently calculated as the percentage of Palestinian retail electricity prices since only Palestine in the region has the highest electricity prices and pursues the no-subsidy policy. This method is suitable to estimate the amount of subsidies in the residential and tertiary sector, but is not perfectly suitable to measure the overall fossil-fuel subsidy amount for the whole economy. Different, more elaborated approach needs to be pursued in measuring subsidies.

The second indicator measures the countries' intent to phase-out fossil-fuel subsidies. Considering the importance of energy subsidy reform for EE and given the current situation of almost no efforts to reform, it is important to recognize and give credits to those governments who publicly announce intentions to phase-out fossil-fuel subsidies. The third indicator measures one, but important aspect of political feasibility and viability of energy subsidy reform by looking at the ability of policymakers to wisely address the economic and social costs of subsidy removal on vulnerable parts of population. This indicator is qualitative and requires the regional expert assessment of the effectiveness of ensuring protection to poor.

The second factor, electricity price structure is not an obstacle to EE like fossil-fuel subsidies, but rather an unexplored opportunity to stimulate energy efficient behavior and reduce peak loads. As has been stated earlier accurate electricity pricing, which includes pricing electricity higher during the peak hours is a strong mechanism to encourage rational use of energy. However, it only works if the consumers actually understand that they are being charged more during the peak hours, therefore measuring the comprehensibility and clarity of utility bill is indispensable. Given the current situation in the region where countries apply only inclining block rate price structure and no country applies time-differentiated price structure the assessment of comprehensibility of utility is thus limited only to assessing the consumers' understanding of the concept of inclining block rate price structure. Although, it is important to note that effectiveness of TOU electricity pricing and inclining block rate pricing is somewhat conditional on removal of energy subsidies.

The last factor is maturity of Energy Audit and ESCO business. Energy efficiency *per se* does not depend on energy audits and ESCOs. Country might make substantial progress towards EE without any ESCO presence. However, strong healthy presence of ESCOs in the market gives an indication of the amount of relatively larger scale EE projects pursued in the country since ESCOs are driven by the demand for EE services. Experience, although limited, seems to indicate strong correlation between presence of ESCOs and current state of EE in the country. So the purpose of measuring Energy Audits and ESCOs is not to see how much countries have done to promote this business, but rather to see how much demand there exists for EE services and estimate the approximate amount of EE projects undertaken in the country. Energy Audits and ESCOs are measured by six indicators: number of ESCOs, number of projects implemented, maturity of ESCO business assessed through expert survey to see whether the current presence of ESCOs and amount of implemented projects is sufficient in light of country's size and potential. The criteria to assess the maturity of ESCO business include assessing the capacity of Energy Auditors and ESCOs, sufficiency of financing energy efficiency projects.

The literature also suggests that funding by international institutions should be viewed only as a short-term solution. It is argued that to have sustainable ESCO business the local banking sector must be sufficiently mature and should play role in financing ESCO projects. The World Bank in particular has been criticized for not undertaking initiatives to promote the interest of domestic commercial banks in lending to ESCOs. It was argued that many ESCO projects supported by the World Bank in developing countries were only undertaken because of availability of the World Bank funding. (Ellis, 2010(a)) In lieu of these facts, to measure the sustainability of initiatives in promoting ESCOs it is necessary to measure the participation of local financial institutions in financing ESCO projects. The following table illustrates indicators, their type and indicates the sources of data:

Table 6 Energy Efficiency Progress Indicators: Market Stimulation

Factor	Indicator	Scale	Type	Data source
Price Structure	Time-differentiated price structure	Yes/No	qualitative	Country electricity tariff structure
	Clarity & comprehensibility of electricity bill	a) Comprehensive b) Somewhat comprehensive c) Incomprehensive	qualitative	Expert/customer survey
Subsidy Reform	Subsidy amount	% of Palestinian retail price for electricity	quantitative	Country electricity tariff structure
	Announced plans to phase out subsidies (2011-2012)	Yes/No	qualitative	Mass media
	Effectiveness of protection to poor	a) Effective b) Somewhat effective c) Ineffective or non-existent	qualitative	Expert survey
Energy Audits & ESCOs	Maturity of ESCO business	a) Sufficiently mature b) Immature c) Non-existent or nearly non-existent	qualitative	Expert survey
	Supporting legal framework	a) comprehensive b) parts of framework in place c) no legal framework	qualitative	Expert/stakeholder survey
	Share of financing ESCO projects by local financial institutions	(%)	quantitative	To be defined
	Number of energy audits conducted (2011-2012)		quantitative	To be defined
	Rate of implementation of energy audit recommendations	(%)	quantitative	To be defined

4.2 Indicators: Policy Framework

Policy Framework category consists of five factors: (1) measuring energy consumption; (2) estimating EE potential; (3) EE indicative targets; (4) EE regulations; and (5) financial instruments. The first three factors do not have direct impact on EE, but play an important role in formulating proper EE policies and better tapping EE potential.

Energy planning consists of measuring energy consumption and estimating EE potential. Measuring energy consumption for purposes of indicators is important for three reasons: first, it is essential for proper setting of targets and framing policies; second, it allows assessing the current state of EE in the countries; and third, it can encourage states to improve their data collection system. As discussed earlier, measuring energy consumption involves systematic detailed data collection on energy end uses. In measuring the current state of energy consumption I rely on existing EE indicators that have been developed by Enerdata maintained in World Energy Council database. As has been stated earlier, due to lack of data availability on energy end-uses in the Arab countries most data is limited to energy indicators rather than energy end-use indicators. However, with time it is suggested to include more detailed energy end-use indicators to measure more accurately energy consumption levels. The table 8 illustrates in more details the indicators on energy consumption.

The precise number of indicators measuring the countries' efforts to estimate EE potential depends on the extent and depth of estimation, but should provide at least the following information: estimated energy savings (Twh/year), estimated % of energy savings, estimated CO_2 emissions savings (Mt/year), estimated annual financial savings (mill USD/year). As stated earlier it is more preferable to have more detailed estimation of EE potential including estimation for the whole economy, for specific sectors, for subsectors (buildings, appliances and lighting) and for specific EE measures.

Based on the literature analysis in previous chapters clearly stated quantitative time bound indicative EE targets are important for setting a long lasting context for EE polices and avoiding one time actions. As has been stated earlier in the Arab countries targets that are expressed in NEEAPs should be considered as other targets might constitute mere political statements not necessarily supported by adequate resources and programmes. To assess whether the targets are specific, measurable, realistic and time bound the country's NEEAPs should clearly specify the target, target type, target date, chosen indicator to measure the target and interim targets. Similar to other indicators sector specific targets are more preferable as they typically reflect the differences in EE potential.

Regulations include mandatory measures prescribing specific energy performance and information-based instruments that provide information on the energy performance of household appliances and office equipment. Through literature analysis certain regulations were identified as essential in fostering EE in the residential and tertiary sectors. These regulations include mandatory EE standards for buildings, minimum energy performance standards and appropriate labeling programmes for household appliances and office equipment, and phasing out inefficient lighting technology. Indicators assess not only the actual presence of these regulations, but also the number of buildings built or retrofitted according to the standards and rate of solar water heater diffusion.

As discussed earlier financial incentives are important in promoting the uptake of EE projects especially in countries where high capital costs of EE investments constitutes a barrier. Depending on the purpose and the design financial incentives can take different forms including subsidies, soft loans, fiscal measures and others. The form of the financial incentive is of secondary importance. What is important is whether incentives are conducive to encouraging EE projects. Therefore, indicators measure not the existence of soft loans, subsidies and tax measures, but rather their adequacy and sufficiency to promote EE projects. The following table lists all the indicators in the Policy Framework category.

Table 7: Energy Efficiency Progress Indicators: Policy Framework

Factor	Indicator	Scale	Type	Data source
Energy Consumption	Ratio final/primary intensity	(%)	quantitative	World Energy Council Database
	Primary energy intensity (at purchasing power parities (ppp)	koe/$05p	quantitative	
	Final energy intensity (at ppp)	koe/$05p	quantitative	
	Ratio final/primary intensity	%	quantitative	
	Average electricity consumption of households per capita	kWh/cap	quantitative	
	Average electricity consumption of electrified households	kWh/dw	quantitative	
	CO2 emissions from fuel combustion of residential sector per household	tCO2/dw	quantitative	
	Energy intensity of service sector (to value added) (at ppp)	koe/$05p	quantitative	
	Electricity intensity of service sector (to value added) (at ppp)	kWh/k$05p	quantitative	
	Unit electricity consumption of services per employee	kWh/emp	quantitative	
Energy Planning	Estimated energy savings (Twh/year)	Yes/No	quantitative	Country reports, country specific reports by organizations
	Estimated CO2 emissions savings (Mt/year)	Yes/No	quantitative	
	Estimated % of energy savings	Yes/No	quantitative	
	Estimated annual financial savings (mill USD/year)	Yes/No	quantitative	
	Quantitative time bound EE indicative targets (macro, sector specific, subsector specific)	Yes/No	qualitative	NEEAPs
	Quantitative time bound EE interim indicative targets (macro, sector specific, subsector specific)	Yes/No	qualitative	NEEAPs
EE Regulations	Mandatory EE standards for buildings	Adopted Planned None	qualitative	Database of national laws
	EE standards for existing buildings	Adopted Planned None	qualitative	Database of national laws
	Mandatory minimum energy performance standards for household appliances (list appliances)	Yes/No	qualitative	Database of national laws
	Mandatory minimum energy performance standards for office equipment (list equipment)	Yes/No	qualitative	
	Labeling programme for appliances (list appliances)	Yes/No	qualitative	Database of national laws
	Labeling programme for office equipment (list equipment)	Yes/No	qualitative	
	Announced plans to phase out inefficient lamps	Yes/No	qualitative	Mass media/policy documents
	Number of information centers on EE	No of infor center/mill inhabitants	quantitative	To be determined
Financia l	List of financial incentives (subsidies, soft loans, fiscal measures)	Yes/No	qualitative	Financial institutions, donor
	Number of recipients of financial assistance	% of targeted audience	quantitative	

	Number of projects received financial assistance (2011-2012)	No of projects/one thousand of inhab	qualitative	organizations

4.3 Indicators: Institutional Capacity

Institutional Capacity category assesses the capacity of the states to formulate and successfully implement EE policies. Strong institutional capacity is critical in ensuring the effectiveness of the EE policies and programmes. It consists of three factors: (1) EE agency; (2) compliance and enforcement; and (3) monitoring and evaluation.

As discussed earlier EE Agency should be a dedicated body with a strong capability not only to design, formulate, implement, evaluate EE policies and programmes, but also capable of coordinating activities among various stakeholders and government institutions to ensure more efficient use of existing human, capital and technical resources in achieving EE objectives. This factor is measured by three indicators. The first one measures the actual existence of dedicated body responsible for developing and implementing EE policies and programmes. The second indicator is qualitative and measures the human, financial and technical capacity of the agency through expert survey. The third indicator measures the output of such agency.

Critical aspect of institutional capacity is the ability to ensure strong compliance with EE policies and programmes. Ensuring strong compliance and enforcement is a difficult task and requires complex activities including activities aimed at encouraging the compliance rate (capacity building programmes, demonstration projects, financial incentives and others), clearly prescribed enforcement procedure, adequate financial and human resources of the enforcement agency and others. Similarly, measuring compliance and enforcement is an uneasy task due to too many economic and political influencing factors. Nevertheless I developed several indicators measuring the compliance and enforcement mechanisms. Most of the indicators measure the level of compliance with EE regulations for buildings by asking the % of new building stock built according to the EE standards. The two indicators are global composite indices measuring the perceived level of corruption in the public sector (CPI) and the country's state of political and economic transformation towards rule of law and market economy (BTI).

The last factor within Institutional Capacity category is policy monitoring and evaluation. The main purpose of policy monitoring and evaluation is to quantify to the extent possible the accomplishment of the objectives of EE policies and programmes. As discussed earlier monitoring and evaluation is necessary not only for accounting for related emission reduction and energy savings, but also for reasons of adjusting policy measures to better tap the EE potential, to enhance the credibility of EE projects, increase the confidence of donors and investors. Monitoring and evaluation ensures that continuity of EE process. Indicators mainly assess the outcome of the EE policies.

Table 8: Energy Efficiency Indicators: Institutional Capacity

Factor	Indicator	Scale	Type	Data source
Energy Efficiency Agency	EE Agency	Yes/No	qualitative	NEEAPs
	Financial, human & technical capacity of the agency	a) Sufficient b) Somewhat sufficient c) Insufficient	qualitative	Expert survey
	Number of EE projects/programmes initiated, completed in 2011-2012		quantitative	National EE Agency reports
Compliance & Enforcement	Product test standards and procedures for household appliances (list appliances)	Yes/No	qualitative	To be defined
	Rate of compliance with energy efficiency standards for buildings	% of new building stock built according to the standard	quantitative	To be defined
	Rate of compliance with energy efficiency standards for existing buildings	% of existing building stock retrofitted according to EE standards	quantitative	To be defined
	Name of the agency responsible for ensuring the compliance	Yes/No	qualitative	
	Number of demonstration projects	No of buildings/one million inhab	quantitative	To be defined
	BTI Status Index		qualitative	BTI website
	Corruption Perceptions Index		qualitative	Transparency International
Monitoring & Evaluation	Rate of solar water heater diffusion		quantitative	To be defined
	Number of CFL distributed, installed, replaced (2011-2012)		quantitative	NEEAP reports
	% of energy savings achieved towards the target	%	quantitative	NEEAP reports
	Baseline energy consumption for buildings	Yes/No	qualitative	Expert survey
	Amount of energy saved	kWh saved	qualitative	To be defined

5 Conclusion

Currently 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. Under such circumstances countries simply cannot afford wasteful consumption of energy. Today, energy efficiency is not a fancy trend anymore driven by green aspirations, but a necessity. It is true that EE represents a 'low hanging fruit' to attain energy savings, but harvesting that fruit requires true commitment and political will. Achieving EE in the residential and tertiary sector is especially challenging task because it requires changing the attitudes and behavior of wide, diverse group of stakeholders. In the Arab countries this task is further complicated by longstanding tradition of subsidizing energy making it look as a cheap and easily available resource. As a result people in this region do not view energy as a scarce declining resource that needs to be saved and used rationally, but rather as a basic good that has to be supplied by the government. Substantial efforts need to be put in this region to transform the society towards energy efficiency without further harming already suffering economy. This requires careful planning, targeted measures, collaborative approach and most importantly true commitment and political will of the leaders to improve EE.

The main task of the present paper was to develop set of indicators to evaluate EE progress considering the current realities of the Arab world. In particular the thesis aimed at understanding the current state of EE in the region, identifying main drivers and barriers and distilling the essential features of good EE governance. Through literature analysis and interviews I found that current state of EE greatly varies in the region and depends on many different factors including the size of the country, the state of economic growth, composition of economic sectors, dependency on imported energy and others. Identified barriers include heavy fossil-fuel subsidies, poor policy framework, weak institutional capacity, lack of information and awareness about benefits of EE, lack of knowledge and expertise, and high capital costs of EE projects.

Suggested policies to improve EE in the residential and tertiary sectors include phasing out fossil-fuel subsidies, introducing time-differentiated electricity price structure accompanied with comprehensible utility bill, creating conditions for operation of ESCO business, providing financial incentives to stimulate investments in EE projects and introducing mandatory EE requirements for buildings, household appliances, office equipment and lighting technology. Raising awareness and capacity building activities are indispensable and for better effects should be tailored towards specific consumer needs. Creating EE information centers has been found especially effective methods in reducing information gap and improving stakeholders' knowledge and expertise. All these policy measures are not novel; they have been applied in many countries in different context and have been identified as effective tools in promoting EE by various experts.

Although all listed drivers and barriers are important and deserve adequate attention from policymakers, however heavily subsidized energy prices deserve special attention. Unlike other barriers fossil-fuel subsidies constitute an 'active' obstacle to EE, the presence of which will always undermine and impede the effectiveness of efforts to improve EE. Low energy prices are more likely to keep EE improvement efforts more costly due to necessity of addressing greater resistance of public. When energy prices are low the 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. A good example to illustrate this is the case of Palestine. Despite the absence of strong policies, Palestine has the highest rate of SWH diffusion in the region and the lowest level of primary energy consumption per habitat mostly due to high energy prices.

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

In my thesis I attempted to develop set of indicators enabling evaluation of EE progress in a holistic systematic manner. As such indicators assess the current state of EE in residential and tertiary sectors, states' efforts in overcoming EE barriers and their institutional capacity to properly design, deliver, implement and evaluate EE policies. The main challenge in achieving this task was addressing the wide spectrum of countries. Thirteen countries that were focus of my work despite many similarities have different economic, political and social realities. Having developed these indicators it is still not clear whether the task is achieved. Collecting and imputing the real data is required to verify whether the developed indicators adequately depict the EE progress in the Arab countries. To ensure and verify the reliability, practicality and robustness of developed indicators the next step in this process should include collecting data and testing these indicators on individual countries. Since thesis was limited to residential and tertiary sector the developed set of indicators are not sufficient to portray the full picture of EE progress in the countries. Developing similar indicators for other sectors of economy is required to ensure the complete and full assessment of EE progress in the country.

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Appendix A: List of Interviewees

No	Name	Position
1	Florentine Visser	MED-ENEC Key Expert, Low Energy Building and Urban Planning
2	Ali Abo Sena	Deputy Director Senior Chemicals Management Expert, Egypt National Cleaner Production Center
3	Mohamed Mahmoud	Senior Energy Efficiency Specialist, Egypt National Cleaner Production Center
4	Wafaa Ismail Abdalla	Energy Sector Head, Federation of Egyptian Industries
5	Mohab Hallouda	Senior Energy Specialist, The World Bank
6	Ibrahim Yassin	Project Manager, Improving Energy Efficiency for Lighting & Appliances Project, GEF UNDP
7	Ashraf Kraidy	Senior Energy Efficiency Expert, RCREEE
8	Amel Bida	Senior Energy Efficiency Expert, RCREEE
9	Mohamed Sobki	Director of Energy Research Center, Faculty of Engineering, Cairo University
10	Reem Hanna	Egyptian Joint German Committee on Renewable Energy and Energy Efficiency
11	Ihab Shaalan	Energy Efficiency Consultant, UN-Habitat Housing and Building Research Center

Appendix B: Snapshot of IEA database on fossil-fuel subsidies