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Final report

Financing of Urban Energy Efficiency and Small-scale Renewable Energy Investments in the Southern and Eastern Mediterranean Region

European Investment Bank

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Glossary

ADEREE	Agency for Development of Renewable Energy and Energy Efficiency
AFD	Agence Française du Développement
ANME	National Agency for Energy Management
APRUE	National Agency for the Promotion and Management of Energy Efficiency
CBL	Central Bank of Lebanon
CDER	Centre for Development of Renewable Energy
CFL	Compact Fluorescent Lamp
COP	Coefficient of Performance
EdL	Electricité du Liban
EER	Energy Efficiency Ratio
EIB	European Investment Bank
ERR	Economic Internal Rate of Return
ESC	Energy Supreme Council
ESCO	Energy Service Company
EU	European Union
FNME	National Fund for Energy Management (Algeria)
FOGEER	Guarantee Fund for Renewable Energy and Energy Efficiency
FRR	Financial Internal Rate of Return
GEF	Global Environment Facility
GHG	Greenhouse Gas
HPS	High Pressure Sodium
IAEREE	Algerian Institute for Renewable Energy and Energy Efficiency
IEA	International Energy Agency
IRR	Internal Rate of Return
JREEF	Jordanian Renewable Energy and Energy Efficiency Fund
LAS	League of Arab States
LCEC	Lebanese Centre for Energy Conservation
LHV	Lower Heating Value
LPG	Liquefied Petroleum Gas
MEE	Ministry of Electricity and Energy (Egypt)
MEM	Ministry of Energy and Mines (Algeria)
MEMEE	Ministry of Energy, Mines, Water and Environment (Morocco)
MEMR	Ministry of Energy and Mineral Resources (Jordan)
MEW	Ministry of Energy and Water Resources (Israel)
MEW	Ministry of Energy and Water Resources (Lebanon)
MIT	Ministry of Industry and Technology (Tunisia)

MNI	Ministry of National Infrastructures (Israel)
MoE	Ministry of Energy (Syria)
MPCs	Mediterranean Partner Countries
MSP	Mediterranean Solar Plan
NEEAP	National Energy Efficiency Action Plan (Lebanon)
NEEAP	National Energy Efficiency Action Plan (West Bank/Gaza)
NEEREA	National Energy Efficiency and Renewable Energy Account (Lebanon)
NEES	National Energy Efficiency Strategy (Egypt)
NERC	National Energy Research Centre
NG	Natural Gas
NPV	Net Present Value
OME	Mediterranean Energy Observatory
PEA	Palestine Energy Authority
PEC	Palestinian Energy and Environment Research Centre
PNAP	National Plan for Priority Actions
PNME	National Programme of Energy Management
PV	Photovoltaic
SSEECP	Supply-side Efficiency and Energy Conservation and Planning Project
SWH	Solar Water Heater
TSP	Tunisian Solar Plan
UfM	Union for the Mediterranean
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
VAT	Value Added Tax

DISCLAIMER

The views and opinions expressed in this publication, as well as the assumptions made for the underpinning analysis, are those of the authors and do not necessarily reflect the official policy or position of the European Investment Bank.

SUMMARY

RATIONALE AND OBJECTIVES

This study has been developed as an EIB initiative to analyse the possibility of developing the urban EE&RE potential in the Southern and Eastern Mediterranean region similarly to the current actions the Bank is developing in the EU with the ELENA facility. This study was used as background information to analyse possible projects in this area.

Improving energy efficiency (EE) and developing small-scale renewable energy (RE) projects in the urban environment of the Mediterranean Partner Countries[1] [2] (MPCs) can contribute to facing increasing energy demand and to reducing pollution, in particular Greenhouse Gas (GHG) emissions, in the region. Such investments could also lead to increased economic competitiveness and local employment opportunities. Ultimately such investments would support the objectives of the Mediterranean Solar Plan[3] (MSP), which is a priority initiative of the Union for the Mediterranean (UfM).

This study, prepared by a consultant under the supervision of the European Investment Bank (EIB) staff, analyses the EE and small-scale RE projects in the urban environment, as identified in the national plans of the MPCs as of 2011-12. Accordingly, this study covers energy efficiency and small-scale RE technologies in the residential and tertiary sectors, and does not cover in the industry, transportation or rural sectors. The analysis presented in this report aims at assessing:

- The energy savings (RE production[4]) and the required investment costs resulting from the total or partial implementation of the identified projects in the relevant national plans;
- A simplified estimate of the economic and financial profitability of these projects;
- The main barriers to the implementation of these projects.

[1] Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Syria, Tunisia, West Bank/Gaza.

[2] Following EU sanctions in November 2011, the EIB has suspended all loan disbursements and technical assistance contracts for projects with the Syrian state. Due to the current political situation in Syria, a significant part of the data collection which was undertaken over 2011 was deemed not relevant by the authors. The detailed data and results for Syria are therefore not presented in the same way as for the other countries covered by the study. Only a few key data were kept, and used in the remainder of the study for regional aggregation and comparison purposes.

[3] The MSP is a flagship initiative of the UfM with the main objective to deploy 20 GW of additional RE generation capacities by 2020 and improve EE in the Mediterranean region (UfM Secretariat, 2012).

[4] Energy production relates to small-scale RE technologies only. In this study, energy production and energy savings are aggregated in line with how EE and small-scale RE technologies are aggregated by MPCs in their national plans. This also conceptually aligns with the often-used classification of sustainable energy technologies into two groups: supply-side technologies (e.g. large scale renewable power production) versus demand-side technologies (e.g. energy efficiency in residential sector). This study focuses on the latter group of technologies rather than the earlier group, which was more the focus of the previous EIB 2010 study.

Overall approach

A bottom-up approach was used starting with the projects identified in the national energy plans to build a regional overview, including identifying the potential profitable EE and small-scale RE investments in the MPC region. It was performed on the basis of a desk review according to the following steps:

- Overview of energy consumption situation and trends on the basis of the latest International Energy Agency (IEA) energy forecasts;
- Simplified assessment of the Institutional, regulatory and policy frameworks related to EE and small-scale RE in the urban environment of the MPCs;
- Identification of energy savings targets, as well as EE and small-scale RE projects proposed by the MPCs' national plans;
- Assessment of the energy saved (or produced) and of the investment costs needed in the implementation of these projects over 2011-2020;
- Simplified assessment of the economic and financial profitability of the main EE and small-scale RE investments in the national plans;
- Economic implications of full 2011-2020 deployment scenarios of these investments;
- Identification of the barriers to the development of EE and small-scale RE projects and analysis of possible mitigation measures to be adopted in the MPCs.

Context: overview of energy consumption trends and of existing policy frameworks

Energy consumption has been rapidly increasing in the MPC region. The expected increases in population (from 208 million in 2011 to 240 million in 2020) and urbanisation (from 56% in 2011 to 60% of total population in 2020) would lead to an expansion of new dwellings and cities in the region (United Nations, 2010 and Plan Bleu, 2011). This would result in an increase of the final energy consumption (from 135 Mtoe in 2011 to 165 Mtoe by 2020), particularly in the urban environment, if no additional energy efficiency measures were adopted.

Governments of the MPCs have acknowledged the importance of energy efficiency as a strategic goal to be adopted within their national energy plans, but energy efficiency policies and programmes have not yet been a policy priority in most of them (Ben Jannet Allal, 2011). Almost all the MPCs have passed energy efficiency laws or draft laws. The associated national policies and supporting frameworks, however, vary among the MPCs and some have already adopted comprehensive strategies and action plans. National policies in other MPCs are still taking shape and are currently being revised and updated in line with the League of Arab State (LAS) guidelines[5]. Despite this, only three dedicated energy efficiency agencies are established in the region (Algeria, Morocco and Tunisia) and the remaining MPCs have established energy efficiency units and research centres.

[5] The council of electricity ministers in the League of Arab States (LAS) prepared the "Arab guideline to improve electricity efficiency and its rationalisation at the end-user" in November 2010. Arab states were encouraged to prepare National Energy Efficiency Action Plans (NEEAP) adopting the Arab guideline on the national level.

This context calls for MPCs to advance in implementing EE and small-scale RE projects and to develop their potential in this field. Despite the largely recognised energy efficiency potential in the Mediterranean region, concrete implementation of EE and small-scale RE projects on the ground has remained limited. This is in part due, as this study illustrates, to the fact that energy is generally subsidised in the region (World Bank, 2009).

NATIONAL ENERGY SAVINGS TARGETS AND POTENTIAL PROJECTS

Most of the MPCs have set energy savings targets in their national plans or policy papers. However, these targets are not often detailed in terms of baseline, timeframe and methodology adopted. Based on these targets (and using information available at the time of publication), energy savings could reach 12 Mtoe[6] for the region as a whole by 2020; or 7% of the total final energy consumption of 2020. Significant differences exist among countries in terms of their energy savings targets[7] with Jordan, Morocco and Tunisia committed to the highest targets in terms of energy savings in final energy consumption by 2020. These countries are also those in the region where energy subsidies[8] are most limited in comparison to the situation in the remaining MPCs. This situation could change in the short term given that new energy savings targets may be announced in some countries of the region, along with a revision of their national energy policy plans.

The EE and small-scale RE projects in the urban environment of the MPCs as identified in their national plans account for a small share of the energy savings expected by 2020 (only 4% of the total envisaged 2020 targets). In addition to expanding investments in the urban environment, the rest should correspond to further improvements of energy efficiency in the industrial, transportation and rural energy sectors[9]. A total of 55 EE and small-scale RE projects were identified in the urban environment of the MPC region to be implemented over 2011-2020[10]. Among the identified projects, 40 were classified as investment projects and 15 as other measures (technical assistance, norms, etc.). The investment projects would result in annual energy savings (production) of 440 ktoe/per year, out of which 8% would correspond to energy production from small-scale RE.

[6] Energy savings targets of the individual MPCs were homogenised by assuming linear distribution of the identified savings over 2011-2020.

[7] Estimated energy savings targets by 2020 ranged between 1%-2% of the total final energy consumption in Algeria and Syria up to 16%-20% in Tunisia and Jordan.

[8] MPCs with low or no energy subsidies are Israel, Jordan, Lebanon, Morocco, Tunisia and West Bank/Gaza. MPCs with high energy subsidies are Algeria, Egypt and Syria.

[9] Given that the national plans looked at for the study listed projects with an implementation horizon up to 2016 only, it is possible that further projects in the urban sector are planned covering implementation between 2016 and 2020. This would be on the top of EE and small-scale RE improvements in other sectors, most notably the industrial, transportation and rural sectors.

[10] No projects were identified beyond 2016; thus it would be expected that the identified projects alone do not generate enough savings to fulfil the regional 2020 targets.

The estimated investment cost of the identified projects in the urban environment in the national plans amounts to EUR 730 million with the majority of these investments (approximately 80%) in the building sector (residential and tertiary) and related mainly to the efficient building envelope (20%) in new and existing buildings, solar water and space heating (21%), efficient lighting (21%) and photovoltaic (PV) applications (11%). For the resulting energy savings (i.e. 440 ktoe/year), efficient lighting (55%), efficient building envelope (31%) and solar thermal water heating (7%) projects would result in the majority of the achieved savings. Only few measures relate to electric appliances (refrigerators, washing machines, and air-conditioners) although such measures, if properly targeted by the MPCs, would present a large energy savings potential, based on international experience (e.g. in the EU and US). It is very likely, however, that the MPCs have only identified a part of the EE and small-scale RE potential, especially in some sectors such as transportation and industry, which were not the focus of the study, and whose potential appears relatively untapped.

Algeria, Morocco and Tunisia account for the highest share of envisaged investments in the region (approximately 95% of total investment cost). Very few investments were identified in Egypt and Jordan despite their relatively high energy savings targets. This may reflect that some of the EE and small RE measures considered do not require substantial investments. No specific investment projects were identified in Israel, Syria and West Bank/Gaza plans. There might be, however, other planned measures and projects in these countries that have not been identified in the consulted documents and policy papers.

ECONOMIC AND FINANCIAL ANALYSIS

a. APPROACH TO ECONOMIC AND FINANCIAL ANALYSIS

The projects analysed to assess their economic and financial profitability correspond to a representative set of key technologies and measures considered in the national plans, covering energy efficiency (building envelope, lighting, street lighting and electric appliances) and small-scale RE (rooftop photovoltaic and solar water heaters). The main assumptions considered in the analysis (investment cost, energy saved or produced, etc.) for each of the technologies are presented in Appendix 1.

The economic analysis takes into account the economic benefits from the energy saved or produced without energy subsidies or taxes and including some external environmental benefits. The financial analysis, on the other hand, is based on actual energy prices in the different MPCs. A simplified model has been used to assess the economic and financial profitability (internal rate of return, payback period, net present value, etc.) for the selected technologies. Two possible types of investments were considered: (a) investments related to existing buildings or existing energy equipment and electric appliances; (b) investments related to new buildings or new equipment and appliances. Assumptions related to both economic and financial analysis are presented in Appendices 1 and 2, in particular, retail prices of different energy sources (electricity, liquefied petroleum gas, natural gas, kerosene and diesel) and electricity production costs. A 10% discount rate has been considered for the financial and economic profitability analysis to account for the risks involved in the development of EE and small-scale RE projects in the MPC region.

b. RESULTS OF ECONOMIC AND FINANCIAL ANALYSIS

The results of the economic and financial analysis undertaken show that many of the EE and small-scale RE investments would be economically profitable by 2020. This is with the exception of retrofitting the building envelope in existing residential and tertiary buildings, and replacing existing washing machines or air-conditioners by new more efficient ones before they reach the end of their life.

- Solar water heating for residential use and efficient lighting investments (residential, tertiary and street lighting) appear financially justified in most of the MPCs.
- Thermal insulation of buildings would be financially justified in new built only and mainly in MPCs with low (or no) energy subsidies[11]. Thermal insulation of existing buildings is generally not economically justified in the MPCs at this stage.
- Thanks to the recent significant drop[12] in the cost of PV modules, investing in roof-top PV would be economically justified[13] in many of the MPCs in the next few years.
- As energy prices are generally highly subsidized in many MPCs (mainly in the oil/gas exporters), some of the economically justified investments are not financially viable (e.g. the replacement of existing energy efficient refrigerators and the installation of roof-top PV panels).
- Overall, adopting energy efficiency standards and technologies in new buildings appears to be justified. Rehabilitating existing buildings or replacing some of its existing appliances before reaching the end of their life is often difficult to justify financially and economically. Therefore, new buildings seem, in principle, an attractive option to implement EE and small-scale RE programmes, as new construction in MPCs is expanding fast (it may account for up to 20% of the regional building stock by 2020).

The analysis for electric appliances was more difficult, with results showing larger variations in terms of financial profitability. This is mainly due to the large variation of equipment prices in the market for a given appliance (related e.g. to the various available brands for the same appliance). Very little specific data exist in the literature on investment costs for electric appliances in the MPCs. Assumptions were based on data from the European countries[14].

- Overall the replacement of older refrigerators by energy efficient ones (class A and above) seems to be economically justified in all MPCs. Financially, the purchase of the most efficient model of refrigerators (A++) instead of one with a modest performance (B), despite not being financially profitable at present, should become so in the short term in MPCs with low energy subsidies, as the market for more efficient appliances develops.

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[11] This is the case for Israel, Jordan and Lebanon. Thermal insulation investments for new buildings appear economically justified in most of the MPCs with low (or no) energy subsidies.

[12] The total investment cost of PV installations dropped from EUR 3/W_p in 2010 (EIB, 2010) to less than EUR 2/W_p in 2012 (Bazilian et al., 2012).

[13] It has been assumed that PV prices will keep decreasing at an annual rate of 5% (authors' assumption based on Commission of the European Communities (2009)).

[14] In Europe, prices for A++ refrigerators ranged from EUR 370 to EUR 600 and for refrigerators with B energy performance from EUR 160 to EUR 330 depending on the brand. Similar variation range exists for washing machines where prices for A+ washing machines ranged from EUR 336 to EUR 540 and for washing machines with B energy performance from EUR 199 to EUR 490.

- Efficient washing machines or air-conditioners should become economically justified towards the end of the decade for most residential users but would be profitable for energy intensive users (e.g. hotels, hospitals, commercial centres, etc.) even sooner.
- In addition, the development of the market for more efficient appliances (supported via energy performance labelling and other measures) should reduce the difference between more and less efficient appliances and thus facilitate the adoption of more efficient appliances.

DEPLOYMENT SCENARIOS

a. ASSUMPTIONS FOR SCENARIOS

A mix of EE and small-scale RE technologies, in line with the MPCs' national plans, has been used to establish three scenarios (Table 1) and assess how much of the MPCs' 2020 targets in these areas could be achieved. These scenarios have been developed to show the implications of developing the existing national plans (at the time of the study). They do not intend to be forecasts of future developments of the urban EE&RE projects, as there is no evidence that these plans will be developed (or the objectives reached) by the countries concerned.

- Penetration of a given technology has been limited to its estimated technical potential (using a percentage of the 2020 building stock, in line with other relevant international studies) (see Appendix 3).
- For each of the scenarios, the maximum achieved energy savings (RE production) and investment cost implications have been estimated.
- In a full deployment scenario, the required subsidies to ensure a reasonable economic profitability for investments otherwise not financially profitable have also been estimated.
- The economic cost of energy saved (produced) has been used to rank the technologies in an increasing order (i.e. EUR/kWh) and to identify accordingly the most cost-effective technologies.

Table 1: Overview of the developed scenarios

Scenario	Criteria for technology inclusion	Description / meaning
Scenario#1 - financially profitable deployment	Technologies are deployed progressively from the year they become financially profitable (FRR > 10%).	This scenario could be theoretically deployed without financial incentives (based on end-use energy prices).
Scenario#2 - economically profitable deployment	Technologies are deployed progressively from the year they become economically profitable (ERR > 10%).	This scenario assumes that the governments cover the differences between the financial and economic prices of energy.
Scenario#3 – full deployment	All investments considered in the national plans are deployed, even if they are neither financially nor economically profitable before 2020.	As for the previous scenario, the governments will need to cover the additional costs. In addition, subsidies will be needed to ensure a reasonable economic profitability for all these investments.

b. Results of scenarios

i. Energy savings (renewable energy production) in the MPCs by 2020

Based on the national targets, a significant share of the energy savings by 2020 could be achieved by focusing on a few economically profitable technologies in the residential and tertiary sectors (Figure 1). In fact, if all the technologies considered in the national plans were fully deployed (scenario#3), the resulting energy savings (RE production) would almost meet the national targets by 2020 (i.e. 12 Mtoe for the whole MPC region). In addition, it is likely that far more energy savings and RE production could be achieved with economically profitable EE and small-scale RE investments by further developing the potential, even above the current targets (e.g. with other technologies not yet mentioned in the national plans), in these sectors.

The implementation of the economically profitable technologies (scenario#2) could lead to a yearly energy saved or produced of 10.1 Mtoe by 2020, or close to 85% of the regional target. The deployment of the financially profitable technologies of scenario#1 only would lead to approximately 5.5 Mtoe of yearly energy saved or produced by 2020, or 46% of the regional 2020 energy savings target. Scenario#3, where all the technologies are deployed, could save or generate 11.3 Mtoe or 94% of the regional energy savings target by 2020. However, a significant part of the investments considered in the last scenario do not appear economically justified and thus should not be developed (see the following sections).

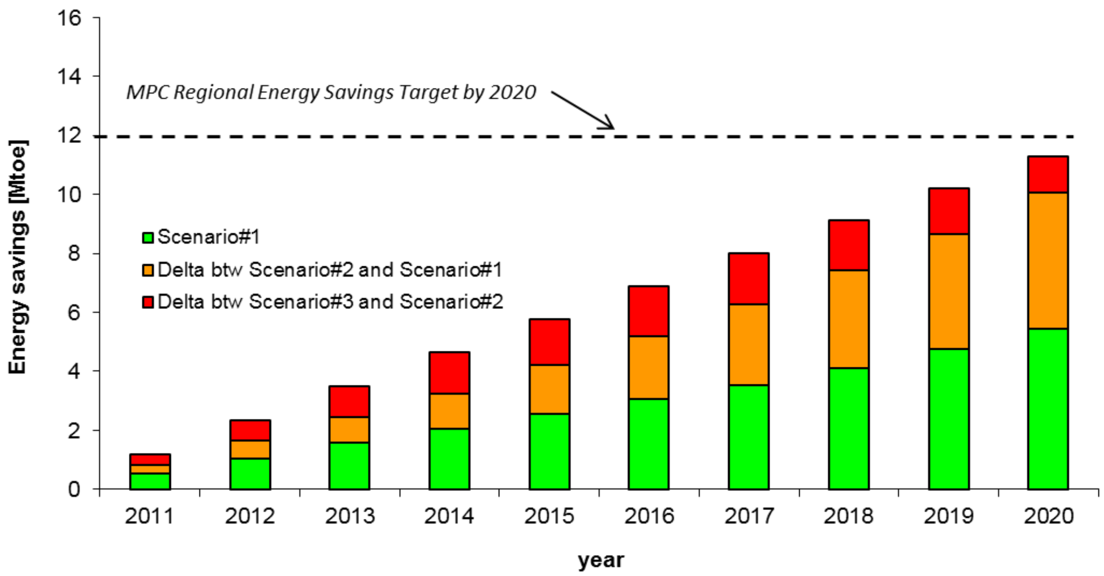


Figure 1: Evolution of energy savings resulting from the developed scenarios over 2011-2020

In the three scenarios, the largest share of total energy savings (RE production) corresponds to efficient lighting (up to 68% under scenario#1), roof-top PV (up to 21% under scenario#2) and electric appliances (up to 22% under scenario#3). Most of these savings (RE production) would be in Algeria and Egypt; the two countries with the largest building stocks among the MPCs.

ii. INVESTMENT COSTS FOR EE AND SMALL-SCALE RE IN THE MPCS

Significant investment needs would be required in the MPCs in order to implement the EE and small-scale RE technologies considered in the national plans and to reach their 2020 targets (Figure 2). Deploying all technologies (scenario#3), including those not economically profitable, would require EUR 91 billion by 2020 (in 2011 prices). The achieving of the large majority (approximately 85%) of the 2020 target via investments in economically viable technologies (scenario#2) would require EUR 30 billion.

In all scenarios, the largest share of investments corresponds to efficient building envelope (up to 64% under scenario#3), electric appliances (up to 40% under scenario#2) and efficient lighting (up to 36% under scenario#1). In addition Egypt and Algeria account for most of the investment needs (up to 60%).

The results of the scenarios also show that non-profitable technologies (scenario#3) are much more investment-intensive than the profitable ones (scenario#1 and #2). In fact, an increase of 10% in energy savings (RE production) under scenario#3 as compared to scenario#2 would require a three-fold increase in investment costs. This shows that refocusing some of the national plans in the MPCs to more profitable investments seems justified.

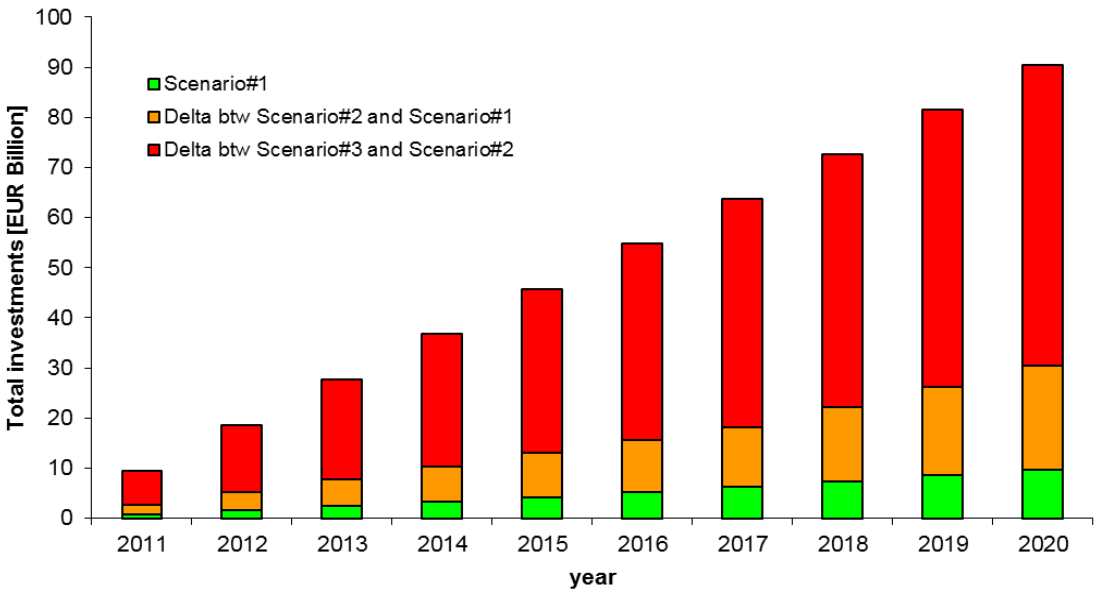


Figure 2: Evolution of investment costs resulting from the developed scenarios over 2011-2020

The full deployment scenario#3 (including the non-profitable technologies (such as efficient building envelope in existing buildings, air-conditioners and washing machines)) would require an additional EUR 29 billion in subsidies[15] (estimated in net present value terms at 10% discount rate), so as to ensure a reasonable economic profitability for all considered investments. Among the investments envisaged in national plans, those needing subsidies mostly appear to be efficient building envelope (82% of the subsidies). In line with its large existing and new building stock, Egypt would be the country needing the largest share of subsidies (45%).

Again, this seems to indicate that economic considerations may not have played a role in the development of the analysed national plans. In addition, some profitable investments may exist that have not been included in the plans, considering that many studies show that the EE potential in these countries is large.

iii. COST OF ENERGY SAVED

The deployment of profitable technologies can be represented by ranking them according to their economic Cost of Energy Saved[16] (Figure 3 – representing a regional deployment of scenario#2). This figure allows identifying the most cost-effective technologies, in each country or at the regional level. Interestingly, and due to their absence from the examined national plans, several technological options (e.g. district cooling systems / chillers or solar cooling for services) which could be key EE and small-scale RE investments for urban environments of the MPCs, do not appear in this cost curve. The results of this study therefore need to be considered with caution, as it does not reflect the whole energy efficiency potential in the region, because some technologies may not have been included in the national plans.

Among the limited range of technologies which were identified in the national plans, efficient lighting (both in buildings and for street lighting purposes), domestic solar water heating and efficient refrigerators appear the most cost-effective technologies in the region, with significant potentials for cost-efficient energy savings (RE production). Efficient lighting in residential buildings, in particular, presents the largest potential for cost-efficient energy savings. In addition, countries with low energy subsidies have a larger potential for cost-efficient energy savings (RE production) than countries with high energy subsidies.

[15] Subsidies were defined as the gap difference required by non-profitable technologies to become economically profitable.

[16] The purpose of the Cost of Energy Saved (CES) is to show the additional energy savings and net costs of technologies/measures from the societal perspective. Policy makers can use the cost of energy saved curves to easily identify the best option in terms of cost savings and energy savings priority (Durand, 2010). The more detailed calculation methodology is presented in Appendix 4.

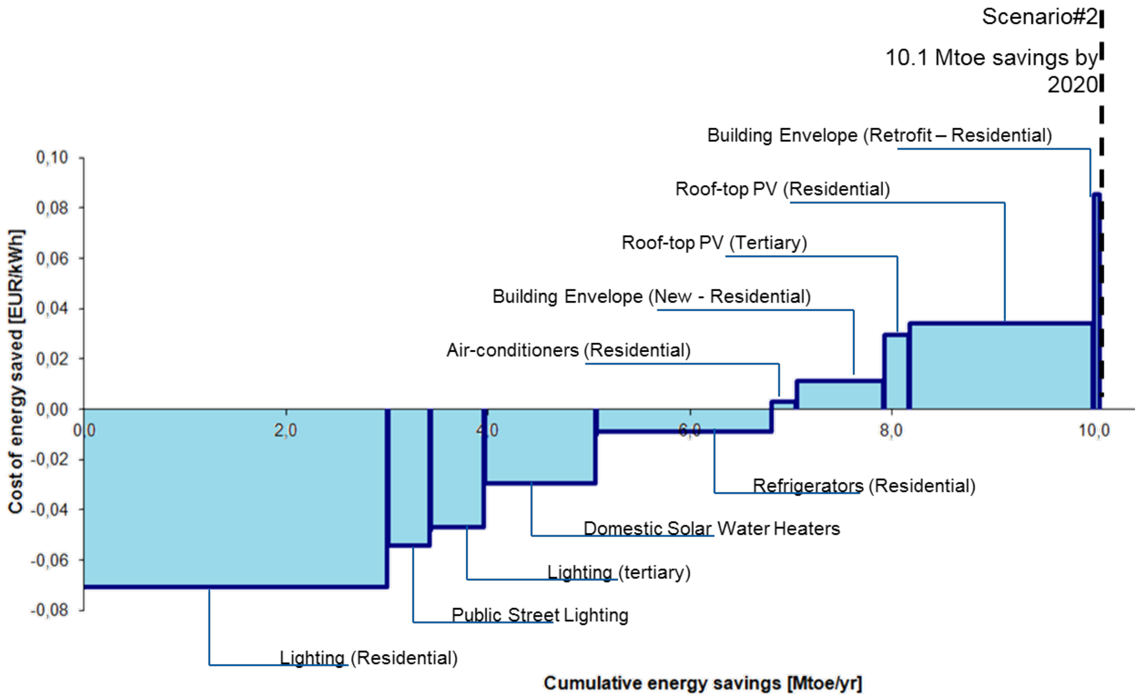


Figure 3: Ranking of economically justified investments (regional average) by Cost of Energy Saved (2020) –Scenario#2

BARRIERS TO EE AND SMALL-SCALE RE PROJECTS AND MITIGATION MEASURES

Given the limited range of technologies which were identified in the national plans examined in this study, it is essential that the MPCs successfully complete a revision of their national plans, in order to include additional EE and small-scale RE technologies in the urban environment which are economically profitable. This should take into account the latest international experience in the field. The limited range of technologies identified in national plans for this study therefore only gives a limited view of barriers and possible actions to face them.

Several economic & financial, organisational and technical barriers, which are currently preventing the dissemination of EE and small-scale RE technologies in the urban environment in general and in the MPC region, have been identified.

- Economic and financial barriers in diverse forms are the main constraints, in particular energy price subsidies, limited access to capital (particularly for low income organisations or households) for some of the EE and small-scale RE technologies. This is reflected in the use of a high discount rate by investors (e.g. households, building owners, etc.).
- Other barriers have also been abundantly evidenced, mostly split incentives, inadequate institutional and regulatory frameworks[17] and lack of awareness (and available information) about energy efficiency possibilities and opportunities.

[17] This is related to the centralised institutional frameworks in the region and the weak compliance and enforcement of currently existing regulatory frameworks.

- Finally anecdotal evidence suggests that there could be some technical barriers linked to the lack of capacity to implement some of these technologies, as well as their actual performance against initial expectations.

The Governments of the MPCs have started to implement energy efficiency policies, measures and instruments to address some of these barriers and promote the development of EE and small-scale RE technologies in the region. Some of these policies combine financial support (e.g. energy efficiency funds, fiscal support, incentives, etc.) and regulatory interventions (e.g. standards & labelling systems, building codes, capacity building, etc.) to promote these investments.

International organisations or financing institutions, such as the EIB, can provide support for MPCs to develop this potential and face these barriers, notably by sharing their experience with numerous EE and small-scale RE technologies which could be included in the national plans (currently being revised in many MPCs). More such support could also come in the form of technical assistance, capacity building programmes, or the bundling of projects into programmes at the national or regional levels. The EIB has a substantial experience in EE&RE, which can be useful to support national programmes in these areas.

PART I – REGIONAL OVERVIEW AND ANALYSIS

1.1 INTRODUCTION

This study has been developed as an EIB initiative to analyse the possibility to develop the urban EE&RE potential in the Southern and Eastern Mediterranean region similarly to the current actions the Bank is developing in the EU with the ELENA facility. This study was used as background information to analyse possible projects in this area.

Improving energy efficiency (EE) and developing small-scale renewable energy (RE) projects in the urban environment of the Mediterranean Partner Countries [18] [19] (MPCs) are essential to face the increasing energy demand and inefficient use of energy in the various sectors as well as to reduce pollution, in particular Greenhouse Gas (GHG) emissions in the region. Such investments could lead to greater energy security, increased industrial competitiveness and local employment opportunities. Ultimately such investments would support the objectives of the Mediterranean Solar Plan (MSP), which is a priority initiative of the Union for the Mediterranean (UfM).

1.1.1 OBJECTIVES AND GENERAL APPROACH

This study, prepared by a consultant under the supervision of the European Investment Bank (EIB) staff, analyses the EE and small-scale RE projects in the urban environment, as identified in the national plans of the MPCs as of 2011-12, with the purpose to highlight profitable investment projects that could be implemented in the region by 2020. The study covers EE and small-scale RE technologies in the residential and tertiary sectors, and does not cover the industry, transportation or rural sectors. The analysis of the identified projects aims at assessing:

- The energy savings (RE production[20]) and the required investment costs resulting from the total or partial implementation of the identified projects in the relevant national plans;
- A simplified estimate of the economic and financial profitability of these projects;
- The main barriers to the implementation of these projects.

[18] Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Syria, Tunisia, West Bank/Gaza.

[19] Following EU sanctions in November 2011, the EIB has suspended all loan disbursements and technical assistance contracts for projects with the Syrian state. Due to the current political situation in Syria, a significant part of the data collection which was undertaken over 2011 was deemed not relevant by the authors. The detailed data and results for Syria are therefore not presented in the same way as for the other countries covered by the study. Only a few key data was kept, and used in the remainder of the study for regional aggregation and comparison purposes.

[20] Energy production relates to small-scale RE technologies only. In this study energy production and energy savings are aggregated in line with how EE and small-scale RE technologies are aggregated by MPCs in their national plans. This also conceptually aligns with the often-used classification of sustainable energy technologies into two groups: supply-side technologies (e.g. large scale renewable power production) versus demand-side technologies (e.g. energy efficiency in residential sector). This study focuses on the latter group of technologies rather than the earlier group, which was more the focus of the previous EIB 2010 study.

In order to fulfil this objective the study used a bottom-up approach starting with the projects identified in the national energy plans to build a regional overview, including identifying the potential profitable EE and small-scale RE investments in the MPC region. This approach is summarised in five steps in Figure 4.

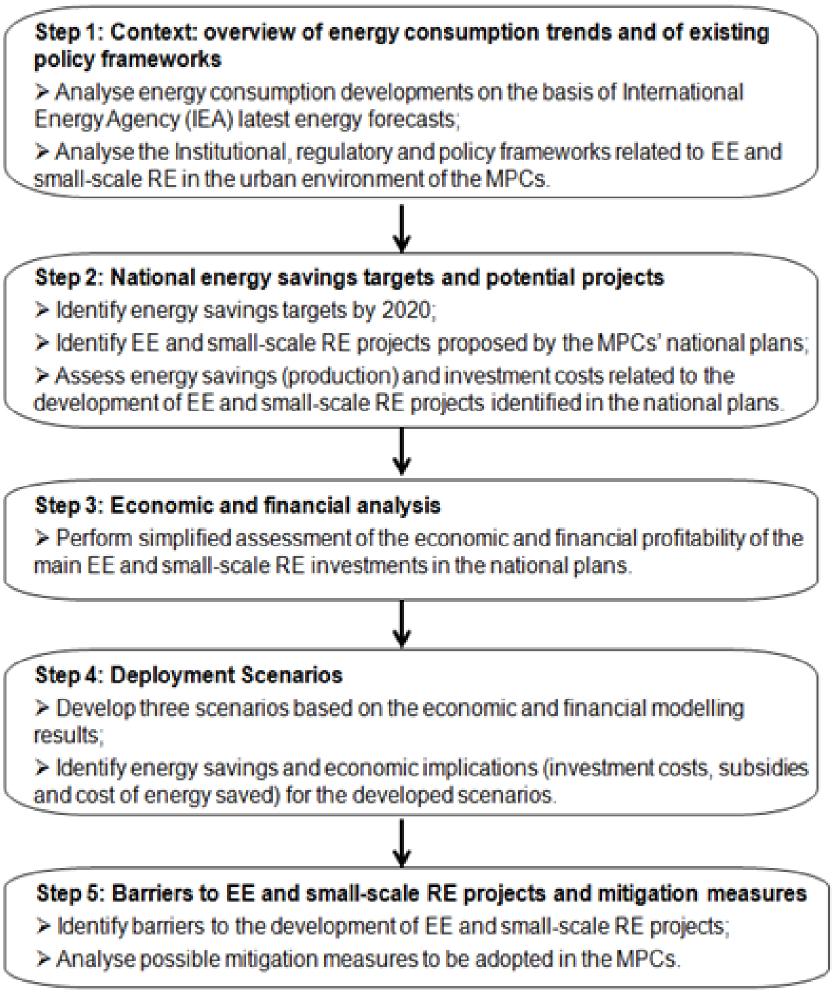


Figure 4: Overall general approach

First a systematic literature review of relevant public documents and current studies was undertaken together with an assessment of IEA energy consumption forecasts. The objective was to understand the context of the different MPCs' EE and small-scale RE sectors (Step 1). The literature review was then further used to draw a regional overview of envisaged energy savings targets, as well as already identified EE and small-scale RE projects and programmes (the so-called "pipeline"[21] - Step 2). A simplified model was then set-up (Step 3) to assess the economic and financial profitability of a representative mix of EE and small-scale RE technologies and measures. Based on the modelling results, three scenarios were developed (Step 4) to assess the economic and energy savings implications of the full or partial deployment of these technologies in the region by 2020. The modelling results, together with literature review, were finally used (Step 5) to identify and analyse potential barriers for EE and small-scale RE projects in the region.

1.1.3 Structure of the report

The report is structured in two parts, each of them aligning with the approach presented in the previous section.

Part I presents the results of the regional analysis undertaken, starting by an overview on regional energy consumption trends (Chapter 1.2) describing energy consumption patterns with respect to urban development. The chapter also evaluates the institutional, policy, regulatory and financial frameworks currently existing in the MPCs. Chapter 1.3 then goes on identifying the regional and individual energy savings targets by 2020, identifies the projects pipeline in the region, and culminates into a simplified assessment of energy savings achievable from the projects' pipeline. Chapter 1.4 presents the main results of economic and financial modelling of selected EE and small-scale RE technologies, highlighting the profitability of these technologies in each of the MPCs over 2011-2020. Chapter 1.5 describes the developed scenarios, the maximum penetration rates of the modelled technologies and the main impacts of the developed scenarios. Chapter 1.6 addresses the main barriers for the development of EE and small-scale RE projects and the MPCs' efforts to overcome them. Finally Chapter 1.7 presents the main conclusions of the regional analysis and the study.

In Part II the analysis and modelling results for each country are presented in turn, covering 9 Chapters from 2.1 to 2.9 (arranged in Alphabetic order for Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Syria, Tunisia, and West Bank/Gaza). Each chapter is organised in the same manner, covering first an Outlook on the EE and small-scale RE sector in the country. This outlook focuses on energy consumption patterns, the relevant stakeholders operating in the country, and the existing policy, regulatory and financial frameworks. Each chapter then goes on to cover the national energy savings target and the identified projects for the given country including the assessment of the energy savings. The modelling results obtained for the country (both in terms of economic & financial profitability and scenarios) are then presented and briefly discussed. Finally each country chapter identifies the main constraints for the implementation of EE and small-scale RE projects and the country's strategies to address them.

[21] The expression "projects' pipeline" is further used in the study to refer to these projects envisaged by the different countries in the region over the period of 2011-2020, as identified in national plans and relevant public documents. More details can be found in the Section 1.3 of the study on "National Energy savings Targets and Potential Projects".

1.2 CONTEXT: OVERVIEW OF ENERGY CONSUMPTION TRENDS AND OF EXISTING POLICY FRAMEWORKS

1.2.1 SCOPE

This chapter lays the foundation for the study by providing an overview of the context of the EE and small-scale RE sector in the MPC region. It first looks at trends and characteristics of energy consumption in the different end-use sectors. It links the energy consumption patterns to the urbanisation growth and increased building stock in the region in the coming two decades. The chapter then presents the main stakeholders active in the EE and small-scale RE sector and briefly describes the existing policy, regulatory and financial frameworks.

1.2.2 METHODOLOGY

Energy consumption analysis for each of the MPCs was performed based on statistical data available from the International Energy Agency (IEA) Energy Balance Database (2000-2009). The average annual growth rates over 2010-2030 were based on the Observatoire Méditerranéen de l'Energie (OME) study on the "Mediterranean Energy Perspectives" (OME, 2008). The analysis covered the following energy consuming sectors: industry, transport, residential, tertiary (including commercial, trade and public services), agriculture, and others[22].

The identification of the main stakeholders acting within the EE and small-scale RE sector as well as the current policy, regulatory and financial frameworks was based on desk review of policy papers, national energy efficiency plans and other relevant regional and country-based studies. The main stakeholders looked at were for each country its energy sector ministry, and where available the energy efficiency agency. Policy frameworks identified included national energy plans, programmes or strategies developed in each of the MPCs. The review regulatory frameworks focused on the energy efficiency primary and secondary laws. Finally, financial frameworks highlighted the availability (or else) of dedicated energy efficiency funds to promote EE and small-scale RE investments in each of the MPCs.

1.2.3 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

The MPC region is characterised by a growing population and increasing urbanisation rates. This urban growth - represented by increasing annual growth rates of population, new dwellings to be constructed and new cities to be built in the MPC region - would lead to increasing energy consumption occurring even more strongly in the urban environment of the MPCs.

The total population in the MPCs is approximately 210 million at present. It is expected to increase by 15% in the next ten years, which would be higher than the 11% growth rate in the world population for the same period (United Nations, 2010). Moreover, approximately 56% of the total population in the MPCs is currently living in urban areas. This percentage is expected to reach 60% and 75% of the total population by 2020 and 2050 respectively (United Nations, 2010).

[22] Others include fishery, non-energy use, and non-specified energy consumption.

Both growing population and increasing urbanisation rates in the next twenty years should result in an increased number of new dwellings (Figure 5) as well as the development of new cities (up to 1 million inhabitants each) in the region. Starting from a current 44 million existing dwellings at present (in 2010), it is estimated that 22.5 million additional new residential dwellings would be constructed in the MPC region over 2011-2030 representing a regional annual growth rate of 2.2%. The majority of these new dwellings would be in urbanised areas (Plan Bleu, 2011).

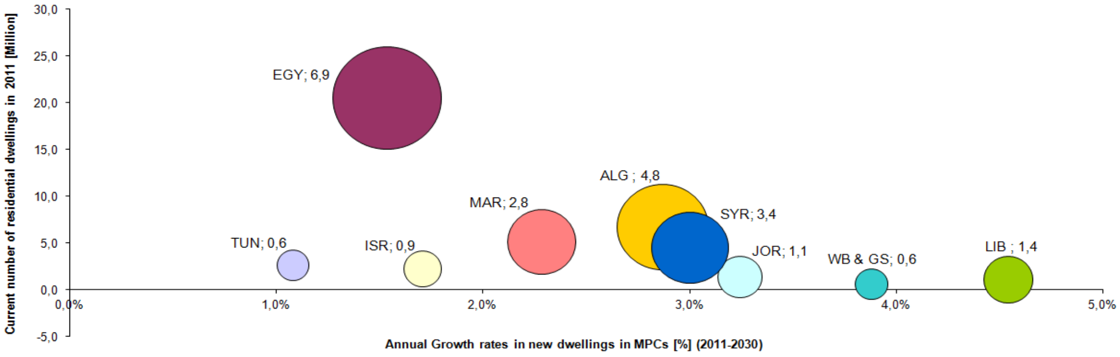


Figure 5: Evolution of residential housing numbers in the MPCs over 2011-2030

As a result, the total final energy consumption[23] is expected to continue its increase from 135 Mtoe in 2011 to respectively 165 Mtoe in 2020 and 208 Mtoe in 2030 (Figure 6) if no additional energy efficiency measures were adopted. Total primary energy supply[24] and electricity demand should follow the same trend.

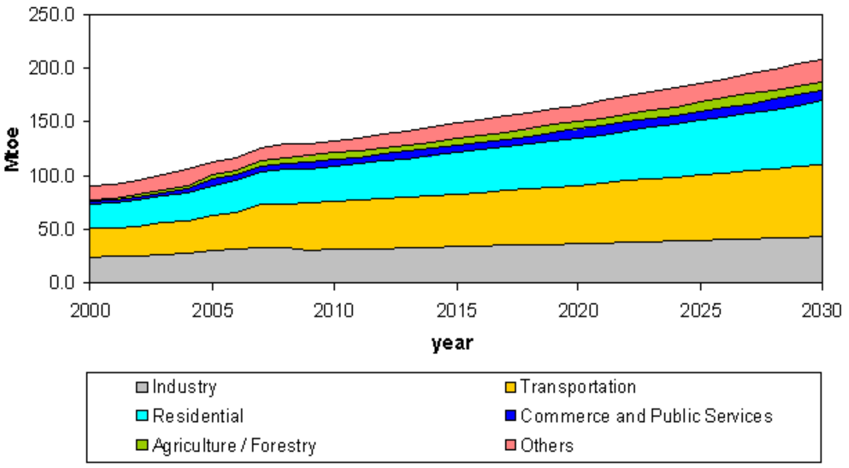


Figure 6: Total final energy consumption in the MPC region (2000-2030)

[23] Total final energy consumption is the sum of consumption by the different end-use sectors. It is broken down into energy demand in the following sectors: industry, transport, residential, tertiary, agriculture/forestry and non-energy use.

[24] Total primary energy supply is equivalent to primary energy demand (domestic demand only).

In general, energy consumption in the MPC region is relatively inefficient mainly due to high energy subsidies which lead to lower end-use energy prices and increased burden on governments' budgets (World Bank, 2009). The transport sector remains the largest energy consuming sector due to increased transportation of goods and people (attributed to rapidly growing population over 2000-2030) as well as subsidised fuel prices in many of the MPCs (IEA, 2005). The residential sector is expected to witness the largest growth over 2011-2030 as electricity consumption increases in this sector due to the increased use of household electric appliances and fuel switch towards electricity.

1.2.4 Stakeholders dealing with EE and small-scale RE

Effective institutional arrangements, starting with clear stakeholders, are key to developing and implementing effective energy efficiency policies and programmes. Table 2 summarises the main stakeholders identified in the EE and small-scale RE sectors of the different MPCs. From a regional perspective all countries have already assigned responsibility for energy savings to a given ministry, and often established dedicated centres. Further details on the responsibilities of each stakeholder are reported in the country chapters (Part II).

Table 2: Stakeholders dealing with EE and small-scale RE by country

Country	Ministry	Energy efficiency agency	Unit / Centre
Algeria	Ministry of Energy and Mines (MEM)	National Agency for the Promotion and Management of Energy Efficiency (APRUE)	Algerian Institute for Renewable Energy and Energy Efficiency (IAEREE)
Egypt	Ministry of Electricity and Energy (MEE)	Not Identified	Energy efficiency unit in the Energy Supreme Council (ESC)
Israel	Ministry of Energy and Water Resources (MEW) / Ministry of National Infrastructures (MNI)	Not Identified	Not Identified
Jordan	Ministry of Energy and Mineral Resources (MEMR)	Not Identified	National Energy Research Centre (NERC)
Lebanon	Ministry of Energy and Water Resources (MEW)	Not Identified	Lebanese Centre for Energy Conservation (LCEC)
Morocco	Ministry of Energy, Mines, Water and Environment (MEMEE)	Agency for Development of Renewable Energy and Energy Efficiency (ADEREE)	Not Identified
Syria	Ministry of Energy (MoE)	Not Identified	National Energy Research Centre (NERC)
Tunisia	Ministry of Industry and Technology (MIT)	National Agency for Energy Management (ANME)	Not Identified
West Bank/Gaza	Palestine Energy Authority (PEA)	Not Identified	Palestinian Energy and Environment Research Centre (PEC)

A line ministry is usually responsible for the development of energy policies in each of the MPCs. In Algeria, Morocco and Tunisia, dedicated energy efficiency agencies are responsible for the promotion of EE and small-scale RE investments through the implementation of national energy efficiency policies, preparation of energy efficiency laws, and management of energy efficiency funds.

In the absence of EE agencies, units and research centres (the case of Egypt, Jordan, Lebanon, Syria, and West Bank/Gaza) often take on the task of promoting EE and small-scale RE through training, capacity building, energy audits, R&D activities, development of energy efficiency codes, labels and standards, and of implementing of pilot projects.

Several private companies have been established in the region to provide energy auditing and management services especially in the industrial and tertiary sectors. This is the case in Algeria, Egypt, Lebanon and Tunisia where the creation of Energy Service Companies (ESCOs) has been initiated, often with international support.

1.2.5 Policy, regulatory and financial frameworks

Governments of the MPCs have already acknowledged the importance of energy efficiency as a strategic goal to be adopted within their national energy plans but EE policies and programmes have not yet been a policy priority in most of them (Ben Jannet Allal, 2011).

Adequate policy, regulatory and financial frameworks are necessary to create the favourable conditions to undertake effective energy efficiency programmes. Table 3 highlights the main aspects of these frameworks as they were identified in each MPC. Further details are reported in the country chapters (Part II).

Table 3: Policy, regulatory and financial frameworks in the MPCs

Country	Energy Efficiency Policy	Energy Efficiency Law	Energy Efficiency Fund
Algeria	National Programme of Energy Management (PNME) (2010-2014)	Energy efficiency law (1999)	National Fund for Energy Management (FNME)
Egypt	National Energy Efficiency Strategy (NEES) (2000)	Draft law (not approved)	Not Identified
Israel	National energy efficiency program (2010-2020)	Energy resources law (1989)	Not Identified
Jordan	National energy strategy (2007-2020)	Renewable energy and energy efficiency law (2010)	Jordanian Renewable Energy and Energy Efficiency Fund (JREEF)
Lebanon	National Energy Efficiency Action Plan (NEEAP)	Draft law on energy conservation (not approved)	National Energy Efficiency and Renewable Energy Account (NEEREA) - (under development)
Morocco	National Plan for Priority Actions (PNAP) - (2008-2012)	Law 16.09 on renewable energy and energy efficiency (2010)	Guarantee Fund for Renewable Energy and Energy Efficiency (FOGEER) - (under development)
Syria	Five year plan (2011-2015) – under preparation	Energy conservation law (2009)	Not Identified
Tunisia	Tunisian Solar Plan (TSP) - (2010-2016)	Law 2004-72 (August 2004) and its later modification, Law 2009-7 (February 2009)	National Fund for Energy Conservation (FNME) - 2005
West Bank/ Gaza	National Energy Efficiency Action Plan (NEEAP)	Draft for national regulations on rational use of energy and renewable source of energy – under preparation (2010)	Not Available

Almost all the countries of the region have passed a law or are preparing to pass primary legislations on energy efficiency. Such primary laws normally constitute the umbrella for secondary legislations, such as provisions concerning building codes and energy audits.

Almost all the MPCs have passed energy efficiency laws or draft laws. The associated national policies and supporting frameworks, however, vary among the MPCs and some have already adopted comprehensive strategies and action plans. Some countries, such as Egypt, Israel, Morocco and Tunisia have adopted comprehensive energy efficiency strategies and action plans that include financial support, fiscal incentives, market initiatives, pilot projects and international cooperation. Dedicated energy efficiency funds exist in Algeria, Jordan and Tunisia. A fund for EE and RE is currently under development in Morocco. These funds provide soft loans, grants and financial incentives for EE and small-scale RE investments.

It is to be noted, however, that national plans in some MPCs are currently being revised and updated, notably in line with the League of Arab State (LAS) guidelines[25]. The remaining MPCs are thus expected to follow and develop similar comprehensive strategies and action plans in the short to medium term.

[25] The council of electricity ministers in the League of Arab States (LAS) prepared the "Arab guideline to improve electricity efficiency and its rationalisation at the end-user" in November 2010. Arab states were encouraged to prepare National Energy Efficiency Action Plans (NEEAP) adopting the Arab guideline on the national level. As of October 2012, NEEAPs (up to 2015) were prepared and approved (by the corresponding Governments) in Egypt, Lebanon and West Bank/Gaza. Final drafts of NEEAPs were prepared in Jordan and Syria and still awaiting the Governments' approval (RCREEE, 2012). This is further discussed in Section 1.3.3 on "National Energy Savings Targets by 2020".

1.3 NATIONAL ENERGY SAVINGS TARGETS AND POTENTIAL PROJECTS

1.3.1 SCOPE

This chapter identifies the energy savings targets in each of the MPCs based on a review of their national energy efficiency plans. Most of these plans indicate an overall energy savings targets rather than sector-based targets.

This chapter also identifies national EE and small-scale RE a projects' pipeline, comprising all currently planned projects[26] in the region over the period of 2011-2020 as identified in national plans and relevant public documents. Although the identified projects' pipeline covers other measures (technical assistance, norms, etc.) in addition to investment projects, the analysis done in this chapter and the rest of the study focuses on investment projects that would result in direct energy savings.

1.3.2 METHODOLOGY

Energy savings targets for each of the MPCs were obtained from national plans. These plans included energy efficiency action plans, strategies, programs and policy papers issued by the regulatory bodies and agencies responsible for the energy sector. The defined targets often lacked clarity in terms of baseline and timeframe and transparency in terms of the adopted methodology. For the analysis undertaken in this study, energy savings targets were therefore homogenised in terms of timeframe (2011-2020) in order to allow for regional comparison of national targets. This was done by assuming a linear distribution of the targets over the 2011-2020 period. A regional energy savings target was then calculated as the sum of the homogenised individual targets.

In addition to the energy savings targets, an identification of EE and small-scale RE projects (the so-called pipeline) was conducted through a desk review of relevant public documents and sector-specific studies. Projects were identified in each country and classified based on the corresponding end-use sector and the type of deployed technology. The selection criterion for the identified projects was based on their completion (or commissioning) dates. Projects starting before 2011 but expected to be completed within the 2011-2020 period were included. The main projects' parameters (investment costs, energy savings, and avoided CO_2 emissions) were either obtained from the national plans or estimated based on similar reference projects.

1.3.3 NATIONAL ENERGY SAVINGS TARGETS BY 2020

In recent years, most of the MPCs have set energy savings targets in their national plans or policy papers. Table 4 summarises the energy savings targets identified in each MPC as well as the homogenised targets by 2020. As of 2012 and based on these targets, the region would experience a significant decrease in its final energy consumption, totaling 12 Mtoe or approximately 7% of the regional final energy consumption by 2020.

[26] By "project", this study refers to programmes, initiatives and projects related to EE and small-scale RE in the MPCs.

Table 4: National energy savings targets and homogenised targets by 2020

Country	National energy savings target	Timeframe	Source	Homogenised energy savings target by 2020
Algeria	200 ktoe / year	2010-2014	National Plan for Energy Sector (PNME)	0.2 Mtoe
Egypt	8.3% of energy demand by 2022	2022	Egyptian Energy Strategy (EES)	5.8 Mtoe
Israel	20% reduction in electricity consumption by 2020	2010-2020	National Energy Efficiency Program (NEEP)	1.2 Mtoe
Jordan	20% savings on energy demand by 2020	2020	National Energy Strategy	1.1 Mtoe
Lebanon	Minimum 5% of energy consumption	2020 [a]	Policy paper for the electricity sector	0.3 Mtoe
Morocco	12% savings in energy use	2020	National Energy Efficiency Plan (NEEP)	1.8 Mtoe
Syria	1.8% reduction in energy consumption [b]	2011	Supply-side Efficiency and Energy Conservation and Planning Project (SSEECP)	0.2 Mtoe
Tunisia	24% savings in energy	2016	Tunisian Solar Plan (TSP)	1.4 Mtoe
West Bank/Gaza	5% reduction in energy consumption [c]	2020	National Energy Efficiency Action Plan (NEEAP)	0.06 Mtoe
Regional			**Total**	**12 Mtoe**

Notes to table:

[a] There is no specified timeframe in the case of Lebanon. It was assumed that the envisaged 5% reduction in energy consumption is by 2020.

[b] The SSEECP project set an unofficial target to reduce energy consumption by 1.8% by 2011.

[c] No explicit national target for energy efficiency has been specified. A presentation on NEEAP indicates a reduction of 5% in end-use energy consumption by 2020 (Amleh and Yasin, 2010).

Significant differences exist between the targets of the individual MPCs. Jordan, Tunisia and Morocco have committed to higher energy savings targets (12%-24% of energy consumption) by 2020 compared to the other MPCs. Lebanon, Syria and West Bank/Gaza, on the other hand, have the lowest energy savings targets by 2020 (less than 5% of energy consumption). This difference could be partly explained by the countries' limited development of the policy, regulatory and financial frameworks presented previously in Section 1.2.5.

Most of the national plans are currently being revised or updated in the region. The new plans in the MPCs, excluding Israel, would be in line with the Pan Arab Strategy and the Arab guidelines to improve energy efficiency and its rational use which were published by the League of Arab States (LAS, 2010). The guidelines were based on the European Commission (EC) End-use Energy Efficiency Directive (2006/32/EC) and encourage Arab countries to adopt energy efficiency practices in generation and consumption. Thus the situation could change in the short term and new energy savings targets could be expected[27].

1.3.4 EE AND SMALL-SCALE RE PROJECTS PIPELINE IDENTIFICATION

In parallel to the national energy savings targets of each country, a total of 55 EE and small-scale RE projects to be implemented in the MPC region over 2011-2020 have been identified (Table 5). Most of them (40) are investment projects and the rest (15) corresponds to other measures (technical assistance[28], norms, etc.). Detailed lists of identified EE and small-scale RE projects in each MPC are presented in the country chapters (Part II).

Table 5: Summary of identified projects pipeline

Project Type	Target sector(s)	No. of projects	Energy savings [ktoe/year]	Investment costs [MEUR]
Investment Projects				
Efficient Lighting	Residential and Tertiary	10	239	156
Building Envelope	Residential and Tertiary	8	134	142
Solar Water Heaters	Residential	4	25	120
Efficient Refrigerators	Residential	2	25	94
PV Systems	Residential and Tertiary	3	6	83
Efficient Heating and Cooling	Tertiary and Industry	5	4.3	45
Liquefied Petroleum Gas (LPG) car kits and ICT for vehicles	Transport	5	4	78
Solar Pumping	Agriculture / Forestry	3	1	12
Total		***40***	***440***	***730***
Technical Assistance				
Energy Audits and Feasibility Studies	Residential, Tertiary, Industry and Transport	11		
Market Development for SWH	Residential	1		
Building codes	Residential and Tertiary	3		
Total		***15***		

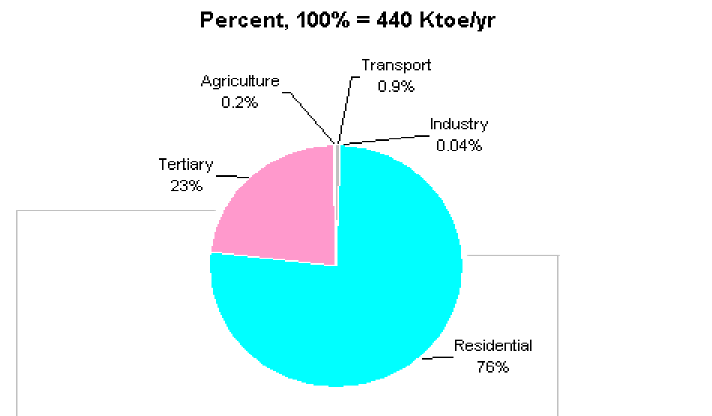
[27] On the basis of the information available to the authors at the time of publication it is expected that the LAS guidelines would result in more homogenised energy savings targets in the MPCs and address some of their earlier issues, related *inter alia* to a lack of homogeneity in terms of baseline, timeframe and methodology. Furthermore the process envisaged includes a 3-year review of the prepared National Energy Efficiency Action Plans (NEEAP), which would enable the MPCs to monitor progress towards the set targets. The NEEAPs of Egypt, Lebanon and West Bank/Gaza were approved by the prime ministry in each of these countries (RCREEE, 2012). The NEEAP of Egypt (2012-2015) declared a target of 5% electricity saving in 2105 of baseline consumption equals the average consumption of the last five years. The NEEAP of Lebanon (2011-2015) was approved by the Lebanese government in November 2011 and included projects in EE and RE approved by the Lebanese government. The NEEAP of West Bank/Gaza was also approved by the Palestinian Council of Ministers in 2012 and aimed at saving electricity at least 5% of the total electricity demand in various sectors by 2020. For Jordan and Syria, draft NEEAPs were prepared and are on the way of their approval. Both Algeria and Morocco have no NEEAPs so far while Tunisia, through the presidential programme (2016) adopted energy intensity as an EE measure.

[28] The majority of technical assistance projects were identified in Algeria and Lebanon.

On a regional level, the identified EE and small-scale RE projects in the urban environment of the MPCs account for small share of the energy savings expected by 2020. The investment projects would result in annual energy savings (or RE production) of 440 ktoe (only 4% of the total envisaged 2020 targets). Within this figure, the identified small-scale RE projects (solar water heaters, small-scale PV, etc.) would result in annual energy production of 37 ktoe or 8% of the total estimated energy savings.

The identified projects suggest that the MPCs would require more efforts to identify and develop EE and small-scale RE investment projects if their national targets were to be achieved by 2020. First of all, since planned investment projects could only be identified for the period 2011-2016, it would be expected that the projects pipeline alone does not generate enough savings to fulfil the regional 2020 targets. Second, it is very likely that the MPCs have only identified a part of the EE and small-scale RE potential, especially in some sectors such as transportation and industry, which were not the focus of the study and whose potential appears relatively untapped.

When looking closer at the identified projects' pipeline, the distribution of energy savings among the various energy end-use sectors does not reflect the balance of final energy consumption in each sector. Most total energy savings (Figure 7) correspond to projects in the residential (76%) and tertiary (23%) sectors (mainly buildings), accounting for 98% of total energy savings. For these sectors the majority of savings are expected to be generated from only a few technologies, namely efficient lighting (55%), efficient building envelope (31%) and solar thermal space and water heating (7%) projects. Consequently, less than 1% of the envisaged savings correspond to projects identified in the transport and industry sectors, whereas they both account for approximately 55% of the final energy consumption by 2020.



Tertiary	Ktoe/yr	Residential	Ktoe/yr
Building Envelope	83	Efficient Lighting	226
Efficient Lighting	14	Building Envelope	51
Solar Thermal Heating	4	Solar Thermal Heating	26
PV Systems	0.4	Efficient Electric Appliances	25
Street Lighting	0.2	PV Systems	6

Notes:

Five projects (LPG car kits and ICTs for vehicle monitoring) were identified within the transport sector.

Three projects (solar pumping) were identified within the agriculture sector.

Two projects (efficient heating and cooling) were identified within the industry sector.

Figure 7: Energy savings (production) of investment projects by sector/technology (2020)

The estimated investment cost of the identified projects in the national plans is EUR 730 million with the majority of these investments (approximately 80%) in the building sector (residential and tertiary) and related mainly to the building envelope (retrofit and new built), solar water and space heating, efficient lighting and photovoltaic applications. According to the plans, the majority of investment costs correspond to efficient lighting (21%), efficient building envelope (20%) and solar thermal water heating (21%) projects. Only few measures relate to electric appliances (refrigerators, washing machines, and air-conditioners) although such measures, if properly targeted by the MPCs, would present a large energy savings potential, based on international experience (e.g. in EU and in the US).

Based on the identified projects' pipeline, Algeria, Morocco and Tunisia represent the highest share of envisaged savings generated by 2020 in the region (approximately 90% - Figure 8). These savings would correspond to 95% of the total estimated investment cost of the identified projects in the national plans. This could be explained by the fact that these countries have already dedicated energy efficiency agencies as well as comprehensive energy efficiency strategies and action plans.

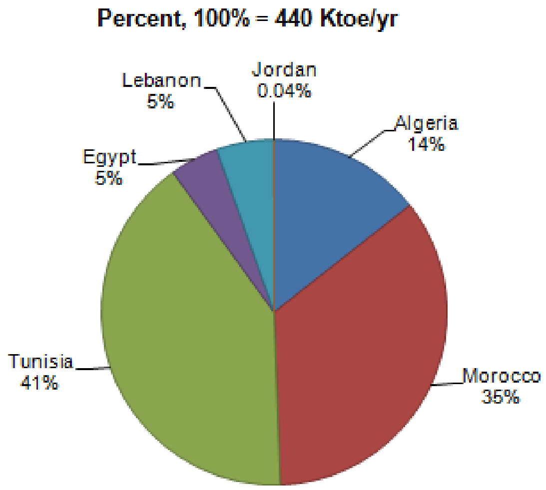


Figure 8: Energy savings (production) of investment projects by country (2020)

No MPC would fulfil its individual 2020 energy savings target on the basis of the identified projects' pipeline only. Algeria, Morocco and Tunisia would still achieve relatively high share of their energy savings targets by implementing their identified projects whereas very few specific investments were identified in Egypt and Jordan as compared to their relatively high energy savings targets. No investment project was identified in Israel, Syria and West Bank/Gaza plans. These findings may reflect that some of the EE and small RE measures considered do not require substantial investments. There might also be other planned measures and projects in these countries that have not been identified in the consulted documents and policy papers.

1.4 ECONOMIC AND FINANCIAL ANALYSIS

1.4.1 SCOPE

This chapter assesses the profitability of a representative set of technologies and measures considered in the MPCs' national plans, covering energy efficiency (building envelope, lighting, street lighting and electric appliances) and small-scale RE (roof-top photovoltaic and solar water heaters – see Table 6). The remaining energy consuming sectors (industry, transport, agriculture/forestry, and others) were not covered.

Table 6: Scope of economic and financial analysis

Elements	Covered / included in the economic and financial analysis	Not explicitly covered in the economic and financial analysis
Energy end-use sectors	Residential and tertiary	Industry, transport, agriculture/forestry, and others
Modelled Technologies and measures	Efficient building envelope, efficient lighting, solar water heating, roof-top PV, efficient electric appliances and street lighting	Technical assistance projects, industrial thermal heating and cooling, LPG car kits, solar pumping, etc.
Type of energy end-use	Space heating and cooling, water heating, lighting, and electricity	Cooking, transport, industrial processes, water pumping, etc.

1.4.2 METHODOLOGY

A simplified model was used to assess the economic and financial profitability (internal rate of return, payback period, net present value etc.) of some EE and small-scale RE investments (Figure 9).

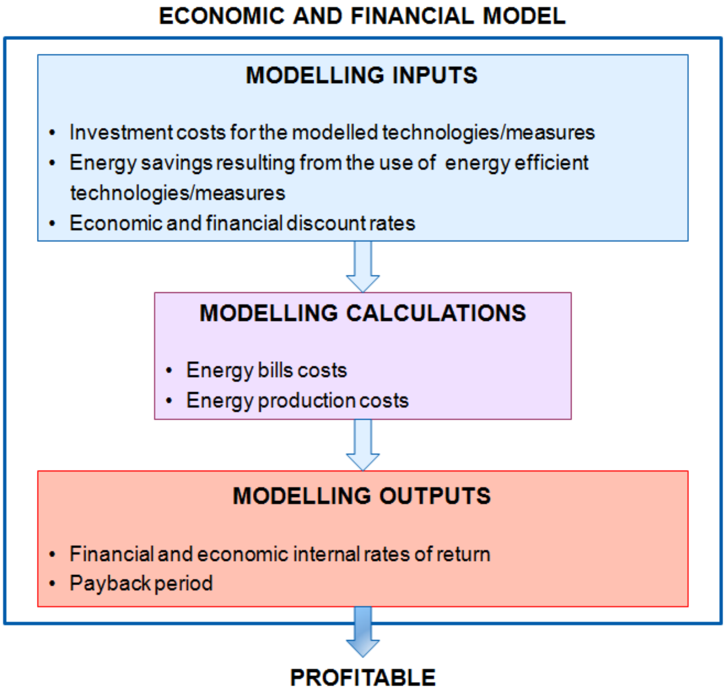


Figure 9: Methodology for economic and financial profitability modeling

As briefly highlighted previously (Section 1.4.1 on Scope), the modelled technologies were chosen to match the indicative technology mix reflected in the national plans as these would be likely deployed in the region in the next ten years to achieve 2020 energy savings targets (Table 7).

Table 7: Modelled EE and small-scale RE technologies

Item	Technology / measure	Energy consuming sector	End-use
RES_ENV	Efficient building envelope (thermal insulation, efficient windows with films and sunscreen)	Residential	Space heating and cooling
RES_SWH	Domestic solar water heater	Residential	Water heating
RES_LTG	Efficient lighting (compact fluorescent lamp - CFL)	Residential	Lighting
RES_PV	Roof-top Photovoltaic	Residential	Electricity
RES_REF	Efficient refrigerator	Residential	Electric appliances
RES_AC	Efficient air-conditioner	Residential	Electric appliances
RES_WM	Efficient washing machine	Residential	Electric appliances
TER_ENV	Efficient building envelope (thermal insulation, efficient windows with films and sunscreen)	Tertiary	Space heating and cooling
TER_PV	Roof-top Photovoltaic	Tertiary	Electricity
TER_LTG	Efficient lighting (compact fluorescent lamp - CFL)	Tertiary	Lighting
PUB_STR_LTG	Public street lighting	Public	Lighting

Financial and economic indicators were calculated for each of the modelled technologies (Table 8). The economic analysis took into account the economic benefits from the energy saved or produced without energy subsidies or taxes and including some external environmental benefits. The financial analysis, on the other hand, was based on actual energy prices in the different MPCs.

Table 8: Economic and financial profitability calculation overview

Analysis	Profitability (indicators)	Costs	Benefits
Economic	Economic Internal Rate of Return (ERR), Economic Net Present Value (ENPV) and economic payback period	Investment costs	Saved energy production costs and avoided replacement costs
Financial	Financial Internal Rate of Return (FRR), Financial Net Present Value (FNPV), and financial payback period	Investment costs	End-user energy bill savings and avoided replacement costs

Financial and economic discount rates[29] of 10% were considered for the analysis to account for the risks involved in the development of EE and small-scale RE projects in the MPC region. Economic and financial profitability of each of the modelled technologies in each of the MPCs was then determined based on comparing the respective ERR and FRR with the discount rate values (i.e. 10%).

Two possible types of investments were considered (Table 9): (a) investments related to existing buildings or existing energy equipment and electric appliances ("Existing"); (b) investments related to new buildings or new equipment and appliances ("New"). For each type of investment a slightly different modelling approach was used in terms of investment costs and unitary energy savings generated.

Table 9: "Existing" versus "New" investments: key difference in modelling approaches

Configuration	Application	Impact on investment cost	Impact on energy savings
"Existing"	• Retrofit measure[a] in an existing building; • Replacement of an existing technology (still functioning) with a new, energy-efficient technology.	***Full cost*** = Total investment cost of efficient technology	***Savings*** = Consumption of old technology – consumption of efficient technology
"New"	• Installation of EE technology/measures in a new building/construction with energy efficiency features beyond building standards at time of construction; • Replacement of an obsolete[b] technology by a new, energy-efficient technology.	***Incremental cost*** = Cost of efficient technology – Cost of standard[c] technology	***Savings*** = Consumption of standard[c] technology – consumption of efficient technology

Notes to table:

[a] Retrofit measure in this study refers to any improvement made to an existing building by installation of technologies or adopting measures that would result in overall energy savings in existing building.

[b] The concept of obsolete technology refers to one that has reached the end of its useful (economic) life and would need to be replaced by a new technology/measure to fulfil the same energy service.

[c] The concept of standard technology refers to one that corresponds to the most commonly used type of technology (alternative to the modelled energy-efficient technology) strictly in line with energy-efficiency regulation (including standards) in place at the time of the investment.

Key assumptions for the economic and financial analyses (investment costs, energy prices, final energy consumption, fuel types and average heating/cooling hours) are summarised in Table 10. More details, in particular on retail prices of different energy sources (electricity, LPG, Natural Gas, Kerosene and Diesel) and electricity production costs can be found in Appendices 1 and 2.

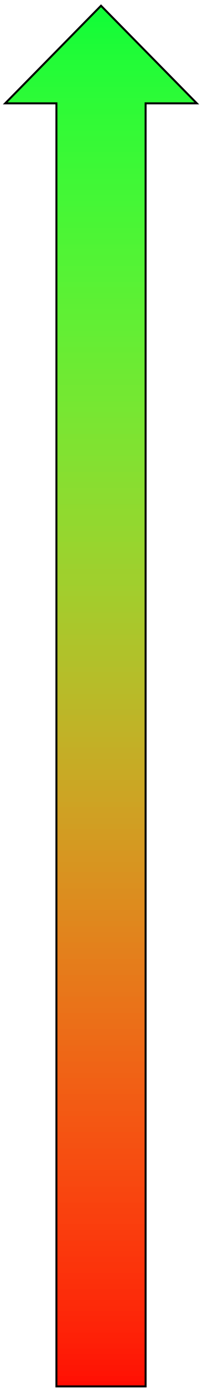
[29] A discount rate of 10% was chosen in line with that used by EIB operations when looking at economic and financial viability of EE and RE projects in the MPC region.

Table 10: Summary of main assumptions used in the economic and financial modelling

Parameter	Assumptions	Notes
Investment costs	• Technology investment costs were assumed the same for all the MPCs; • PV learning curve (i.e. cost decrease) of 5% per year; • Solar water heaters learning curve of 4% per year.	Further details on investment costs, learning curves and technical parameters of the modelled EE and small-scale RE technologies are provided in Appendix 1.
Energy prices	• Energy price assumptions were based on the IEA fossil-fuel import price assumptions; • The level of taxation/subsidisation of retail energy prices was assumed constant over 2010-2020; • Electricity prices were assumed constant over the 2011-2020 period.	Further details on energy prices from IEA scenarios, retail fuel prices, economic fuel costs, electricity production costs and electricity tariffs are provided in Appendix 2.
Final energy consumption by end-use	• Residential building stock was based on Plan Bleu (2011); • Tertiary building stock was estimated as proportional to energy consumption in the tertiary sector.	The percentages of energy consumption by end-use within the residential and tertiary sectors were based on Plan Bleu (2011) and are provided in Appendix 5.
Fuel types by end-use	• Electricity, natural gas, LPG, gas/diesel oil, and kerosene were considered for space and water heating; • Electricity was considered for air-conditioning, lighting and electric appliances.	Fuel types by energy end-use in each of the MPCs were based on IEA Energy database.
Average heating and cooling hours	• Average heating and cooling hours per year were estimated based on heating and cooling degree days at the capital city in each of the MPCs.	Details for average heating and cooling hours are provided in Appendix 1.

1.4.3 RESULTS

A qualitative representation of the results from the economic and financial analyses is presented in Figure 10.



Among the modelled technologies, **efficient lighting** appears the most attractive. Financial payback periods were estimated at less than a year in residential buildings in MPCs, expect for the case of Egypt and Syria where electricity tariffs are particularly highly subsidised (the lowest in the MPC region).

Street lighting would also be financially profitable in most of the MPCs with payback periods ranging from 8 months (Morocco) to 3 years (Syria). All the modelled efficient lighting technologies (residential, tertiary and street lighting) are also economically profitable in all the MPCs.

Domestic solar water heaters appear attractive small-scale RE technologies to be deployed in the region over 2011-2020 and are financially and economically profitable in most MPCs. Payback periods range between 2 to 5 years in MPCs with low energy subsidies and 6 to 9 years in MPCs with high energy subsidies.

Building envelope (thermal insulation) projects for new buildings appear financially profitable in the short-term in Israel, Jordan, Lebanon and West Bank/Gaza due to their relatively high energy prices. Payback periods are between 6 to 9 years in these countries.

Roof-top PV seems also financially profitable in Israel, Jordan, Morocco, Tunisia, and West Bank/Gaza starting in the second half of the decade. Payback periods range between 7 and 10 years in these MPCs. Thanks to the recent significant drop in the cost of PV modules, investing in roof-top PV would be economically justified in most of the MPCs in the next few years.

Overall the replacement of older **refrigerators** by energy efficient ones (class A and above) seems to be economically justified in all MPCs. Financially, the purchase of the most efficient model of refrigerators (A++) instead of one with a modest performance (B), despite not financially profitable at present, should become so in the short term in MPCs with low energy subsidies. Payback periods of 5 to 7 years were calculated in MPCs with low energy subsidies.

Efficient washing machines or **air-conditioners** should become economically justified towards the end of the decade for most residential users but would be profitable for energy intensive users (e.g. hotels, hospitals, commercial centres, etc.) even sooner.

Thermal insulation of existing buildings (retrofit projects) in both residential and tertiary sectors do not appear economically or financially profitable in the region at this stage.

Figure 10: Qualitative ranking of modelled technologies based on economic and financial profitability analysis

Many of the modelled EE and small-scale RE technologies would be economically profitable by 2020. This is with the exception of retrofitting the building envelope in existing residential and tertiary buildings and replacing existing washing machines or air-conditioners by new more efficient ones before they reach the end of their life.

Solar water heating for residential use and efficient lighting investments (residential, tertiary and street lighting) appear financially justified in most of the MPCs.

Thermal insulation of buildings would be financially justified in new built only and mainly in MPCs with low (or no) energy subsidies. This is the case for Israel, Jordan and Lebanon. Thermal insulation of existing buildings, on the other hand, is generally not economically justified in the MPCs at this stage.

Thanks to the recent significant drop in the cost of PV modules, investing in roof-top PV would be economically justified in many of the MPCs in the next few years.

As energy prices are generally highly subsidized in many MPCs (mainly in the oil/gas exporters), some of the economically justified investments are not financially viable (e.g. the replacement of existing energy efficient refrigerators and the installation of roof-top PV panels).

Overall, adopting energy efficiency standards and technologies in new buildings appears to be justified. Rehabilitating existing buildings or replacing some of its existing appliances before reaching the end of their life is often difficult to justify financially and economically. Therefore, new buildings seem, in principle, an attractive option to implement EE and small-scale RE programmes, as new construction in MPCs is expanding fast (it may account up to 20% of the regional building stock by 2020).

The analysis for electric appliances was more difficult, with results showing larger variations in terms of financial profitability. This is mainly due to the large variation of equipment prices in the market for a given appliance (related e.g. to the various available brands for the same appliance). In fact very little specific data exist in the literature on investment cost for electric appliances in the MPCs. Assumptions were based on data from the European countries (Table 11).

Table 11: Range of market prices of electric appliances[30] in several European countries[31]

Electric Appliance	Market prices	
	Most Efficient	**Conventional**
Refrigerator (A++ vs. B)	EUR 376 - 606	EUR 163 - 329
Washing Machine (A+ vs. B)	EUR 336 – 540	EUR 199 - 490

As with other EE technologies, many of the modelled energy efficient appliances would be economically profitable by 2020.

- Overall the replacement of older refrigerators by energy efficient ones (class A and above) seems to be economically justified in all MPCs.
- Financially, the purchase of the most efficient model of refrigerators (A++) instead of one with a modest performance (B), despite not financially profitable at present, should become so in the short term in MPCs with low energy subsidies, as the market for more efficient appliances develops.

[30] For air-conditioners, data from Power and Conservation Council (2009) were used. Please refer to Appendix 1 for more details.
[31] Market prices were obtained for France, Greece, Spain, Italy, Portugal, Germany, United Kingdom, and Netherlands from ECORYS (2011).

- Efficient washing machines or air-conditioners should become economically justified towards the end of the decade for most residential users but would be profitable for energy intensive users (e.g. hotels, hospitals, commercial centres, etc.) even sooner.

In addition, the development of the market of more efficient appliances (supported via energy performance labelling and other measures) should reduce the difference between more and less efficient appliances and thus facilitate the adoption of more efficient appliances.

1.5 DEPLOYMENT SCENARIOS

1.5.1 SCOPE

Based on the identified projects' pipeline of Section 1.3, achieved energy savings are significantly lower than the 2020 envisaged energy savings targets in the MPCs. On the other hand the results of the economic and financial analyses (Section 1.4) suggest that many of these technologies becoming profitable by 2020, they could potentially be deployed on a large-scale. Therefore the next step in the study was to establish three technology deployment scenarios and assess what share of MPCs' 2020 targets in these areas could be achieved.

1.5.2 METHODOLOGY

Based on the same mix of EE and small-scale RE technologies than for the economic and financial analyses (in line with the MPCs national plans), three scenarios were set up. Two of them ("financially profitable deployment" and "economically profitable deployment") assumed a progressive implementation of the profitable modelled EE and small-scale RE technologies over the period 2011-2020. A third scenario ("full deployment") assumed a progressive implementation of all the modelled technologies as of 2011.

These scenarios have been developed to show the implications of developing the existing national plans (at the time of the study). They do not intend to be forecasts of future developments of the urban EE&RE projects, as there is no evidence that these plans will be developed (or the objectives reached) by the countries concerned.

The criterion to include a modelled technology in each scenario was based on their modelled financial or economic rates of return (Table 12).

Table 12: Overview of the developed scenarios

Scenario	Criteria for technology inclusion	Description / meaning
Scenario#1 - financially profitable deployment	Technologies are deployed progressively from the year they become financially profitable (FRR > 10%).	This scenario could be theoretically deployed without financial incentives (based on end-use energy prices).
Scenario#2 - economically profitable deployment	Technologies are deployed progressively from the year they become economically profitable (ERR > 10%).	This scenario assumes that the governments cover the differences between the financial and economic prices of energy.
Scenario#3 – full deployment	All investments considered in the national plans are deployed, even if they are neither financially nor economically profitable before 2020.	As for the previous scenario, the governments will need to cover the additional costs. In addition, subsidies will be needed to ensure a reasonable economic profitability for all these investments.

Penetration of a given technology was limited to its estimated technical potential (using a percentage of the 2020 building stock, in line with other relevant international studies) (Table 13). In order to model technology penetration over time, this maximum (2020) penetration level was linearly distributed over the period from when a technology becomes profitable (based on the economic and financial modelling) till 2020. More details are available in Appendix 3.

Table 13: Maximum 2020 penetration levels for modelled technologies

Technology	Maximum penetration levels by 2020		Source / reference (Appendix 3)
	Existing	New	
Building envelope	10%	50%	Plan Bleu (2011)
Solar water heater	20%	25%	Plan Bleu (2011)
Efficient indoor lighting	100%	100%	Plan Bleu (2011)
Street lighting	50-100%	50-100%	Appendix 6
Household electric appliances (refrigerator, air conditioner, washing machine)	50%	50%	Plan Bleu (2011)
Roof-top Photovoltaic	20%	25%	Assumed similar to solar water heater

For each of the developed scenarios, the maximum achieved 2020 energy savings and economic implications (investment costs, cost of energy saved (produced), and subsidies if required) were estimated and analysed. As briefly explained previously, the deployment of technologies that are not financially or economically profitable (in scenario#3) will require some subsidies, so as to ensure that reasonable level of economic profitability is achieved. For all the non-profitable technologies, these subsidies (cumulative) were calculated as the net present value (discounted to 2011 prices) of the difference between their actual investment costs and one that would allow them to have an ERR of 10% over 2011-2020 period.

Finally the deployment of profitable technologies was represented by ranking them according to their economic Cost of Energy Saved. This representation allowed ranking the modelled technologies in an increasing order of cost of energy saved per unit (i.e. EUR/kWh) and identifying the best option in terms of cost savings and energy savings priority in each country and at the regional scale (Durand, 2010). The more detailed calculation methodology is presented in Appendix 4.

1.5.3 Results

1.5.3.1 Energy savings (renewable energy production) in the MPCs by 2020

Based on the national targets, a significant share of the energy savings by 2020 could be achieved by focusing on a few economically profitable technologies in the residential and tertiary sectors (Figure 11). In fact, if all the technologies considered in the national plans were fully deployed (scenario#3), the resulting energy savings (RE production) would almost meet the national targets by 2020 (i.e. 12 Mtoe for the whole MPC region). In addition, it is likely that much more energy savings and RE production could be achieved with economically profitable EE and small-scale RE investments by further developing further the potential, even above the current targets (e.g. with other technologies not yet mentioned in the national plans) in these sectors.

The implementation of the economically profitable technologies (scenario#2) could lead to a yearly energy saved or produced of 10.1 Mtoe by 2020, or close to 85% of the regional target. The deployment of the financially profitable technologies of scenario#1 only would lead to approximately 5.5 Mtoe of yearly energy saved or produced by 2020, or 46% of the regional 2020 energy savings target. Scenario#3, where all the technologies are deployed, could save or generate 11.3 Mtoe or 94% of the regional energy savings target by 2020. A significant part of the investments considered in the last scenario, however, do not appear economically justified and thus should not be developed (see the following sections).

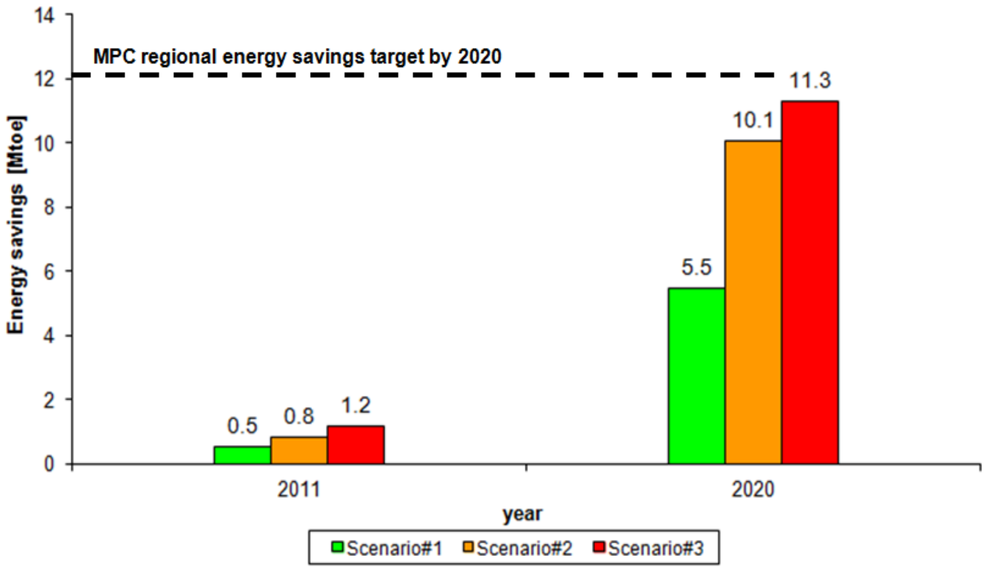


Figure 11: Evolution of energy savings resulting from the developed scenarios over 2011-2020 period (repeated)

The established scenarios show that there is a significant potential for energy savings in the MPC region. This is in line with the conclusions of similar studies on the potential of energy savings in the southern and eastern Mediterranean region. For instance, the OME "proactive" scenario estimates that 10% of energy demand by 2030 could be saved in the region with prudent application of energy efficiency measures (Ben Jannet Allal, 2011). Similarly the Plan Bleu (2011) "rupture" scenario estimates that up to 30% of energy consumption could be saved by 2030. However, it is to be noted that the current regional estimated target is only 7% of the total final energy consumption by 2020 and thus could be considered modest when compared to the potential energy savings estimated by the different scenarios and to the 2020 20% energy savings target by the European Union (EU).

In absolute terms and under all scenarios (Figure 12), the most significant reductions would be due to the use of efficient lighting in the residential, tertiary and public street lighting sectors (up to 68% under scenario#1). Significant share of total energy savings (RE production) could be also realised by the use of roof-top PV (up to 21% under scenario#2) and household electric appliances (up to 22% under scenario#3). Efficient lighting would represent the "low-hanging fruit" among these technologies due to its low initial costs and high energy savings potential.

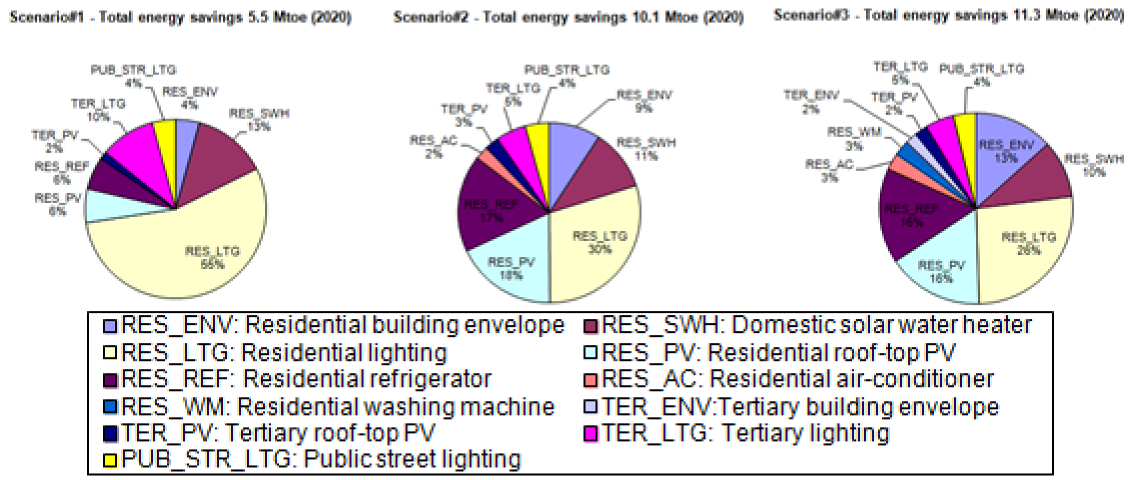


Figure 12: Breakdown of energy savings by technology

Most of these savings would be realised in Algeria and Egypt, the two countries with the largest building stocks and the highest population among the MPCs (Figure 13). It can be noted as well that the MPCs with low energy subsidies have most of their energy savings coming from financially profitable technologies (more than 70%) whereas this share is less in the remaining MPCs.

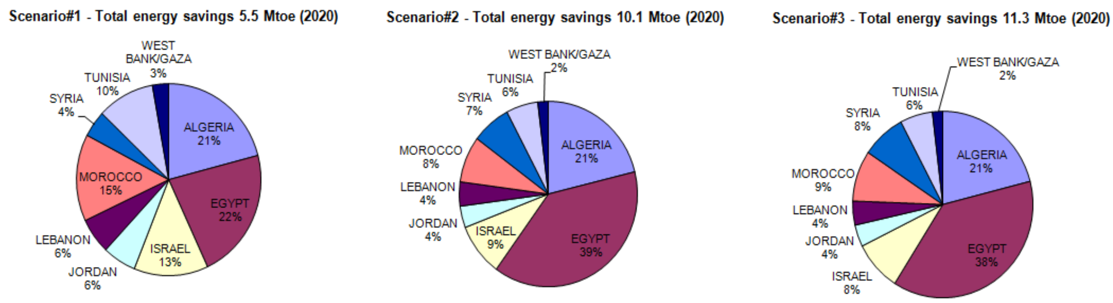


Figure 13: Breakdown of energy savings by country

1.5.3.2 INVESTMENT COSTS FOR EE AND SMALL-SCALE RE IN THE MPCS

Significant investment needs would be required in the MPCs in order to implement the EE and small-scale RE technologies considered in the national plans and to reach their 2020 targets (Figure 14). Deploying all technologies, including those not economically profitable (scenario#3), would require EUR 91 billion by 2020 (in 2011 prices). The achieving of the large majority (approx. 85%) of the 2020 target via investments in economically viable technologies (scenario#2) would require EUR 30 billion.

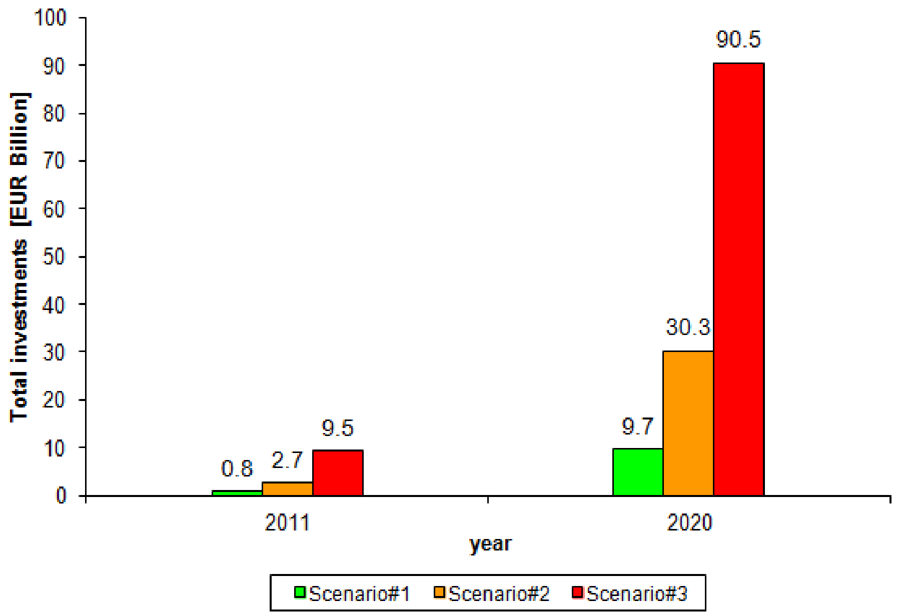


Figure 14: Evolution of investment costs resulting from the developed scenarios over 2011-2020 period (repeated)

The results of the scenarios also show that non-profitable technologies (scenario#3) are much more investment-intensive than the profitable ones (scenario#1 and #2). In fact, an increase of 10% in energy savings (RE production) under scenario#3 as compared to scenario#2 would require a three-fold increase in investment costs. This shows that refocusing some of the national plans in the MPCs to more profitable investments seems justified.

In all scenarios, the largest share of investment costs (Figure 15) corresponds to efficient building envelope (up to 64% under scenario#3), electric appliances (up to 40% under scenario#2) and efficient lighting (up to 36% under scenario#1). In terms of unitary cost (EUR/toe saved), building envelope and electric appliances (especially efficient washing machine) would require the largest unitary investment for each toe saved. On the contrary, efficient lighting and roof-top PV would require the lowest unitary investment cost among the modelled EE and small-scale RE technologies.

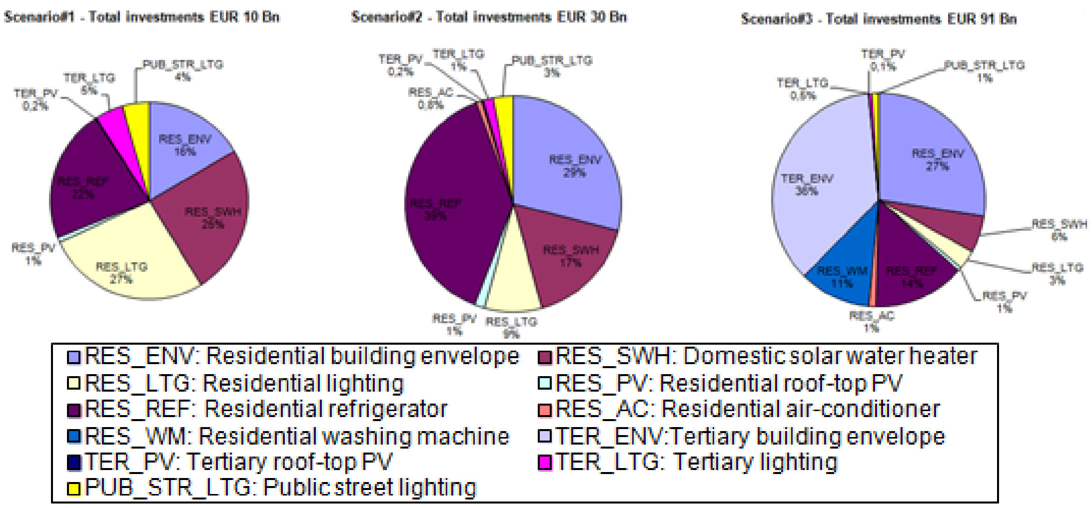


Figure 15: Breakdown of investment costs by technology

Egypt and Algeria (Figure 16) account for most of the investment needs (up to 60%). Both countries, containing the largest building stocks among the MPCs, would require respectively up to 19% and 43% of total investment costs under scenario#2 and #3. For scenario#1, where only financially profitable technologies were considered, Morocco, Tunisia and Israel would require the largest investment share since many of the modeled technologies would be financially profitable in these countries by 2020.

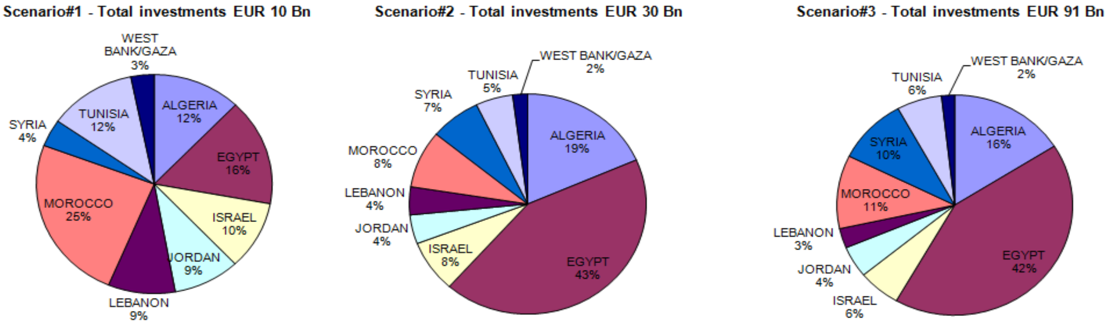


Figure 16: Breakdown of investment costs by country

1.5.3.3 SUBSIDIES FOR FULL DEPLOYMENT OF MODELLED TECHNOLOGIES

The full deployment scenario#3 (including the non-profitable technologies (such as efficient building envelope in existing buildings, air-conditioners and washing machines)) would require an additional EUR 29 billion in subsidies[32] (estimated in net present value terms at 10% discount rate), so as to ensure a reasonable economic profitability for all considered investments.

Again, this seems to indicate that economic considerations may not have played a role in the development of the analysed national plans. In addition, some profitable investments may exists that have not been included in the plans, considering that many studies show that the EE potential in these countries is large.

Among the investments envisaged in national plans, those needing subsidies mostly appear to be efficient building envelope (82% of the subsidies), followed by washing machines (15%). In line with its large existing and new building stock, Egypt would be the country needing the largest share of subsidies (45%).

[32] As explained in section 1.5.2 on “Methodology”, subsidies as estimated here were defined as the gap difference required by non-profitable technologies to become economically profitable.

1.5.3.4 COST OF ENERGY SAVED

The deployment of profitable technologies can be represented by ranking them according to their economic Cost of Energy Saved, as shown in Figures 17, 18 and 19. This figure allows identifying the most cost-effective technologies, in each country or at the regional scale. Interestingly, and due to their absence from the examined national plans, several technological options (e.g. district cooling systems / chillers or solar cooling for services) which could be key EE and small-scale RE investments for urban environments of the MPCs, do not appear in this cost curve. The results of this study therefore need to be considered with caution, as it does not reflect the whole energy efficiency potential in the region, because some technologies may not have been included in the national plans.

Among the limited range of technologies which were identified in the national plans, efficient lighting (both in buildings and for street lighting purposes), domestic solar water heating and efficient refrigerators appear the most cost-effective technologies[33], with significant potentials for cost-efficient energy savings or RE production. Efficient lighting in residential buildings, in particular, presents the largest potential for cost-efficient energy savings under all scenarios.

Comparing the three scenarios, the main difference would be related to the total number of technologies penetrating under each of the developed scenarios. This would be reflected in the size of energy savings potential of each technology.

On a country basis, countries with low energy subsidies tend to offer a larger potential for cost efficient energy savings (RE production) than countries with high energy subsidies. Efficient lighting, solar water heating, efficient refrigerator and building envelope in new construction are cost-effective in all MPCs with low or no energy subsidies. In the remaining MPCs, only efficient lighting appears cost-efficient. Residential lighting presents the highest energy savings potential in all the MPCs whereas residential roof-top PV (though not yet cost-efficient) presents high energy savings potential in Egypt and Syria. Individual curves presenting the modelled technologies for each of the MPCs are available in the country analysis chapters (Part II).

[33] A technology is cost-effective when the cost of energy saved is below the cost of energy supply. For this analysis, cost-effective technologies were assumed to have cost of energy saved below zero.

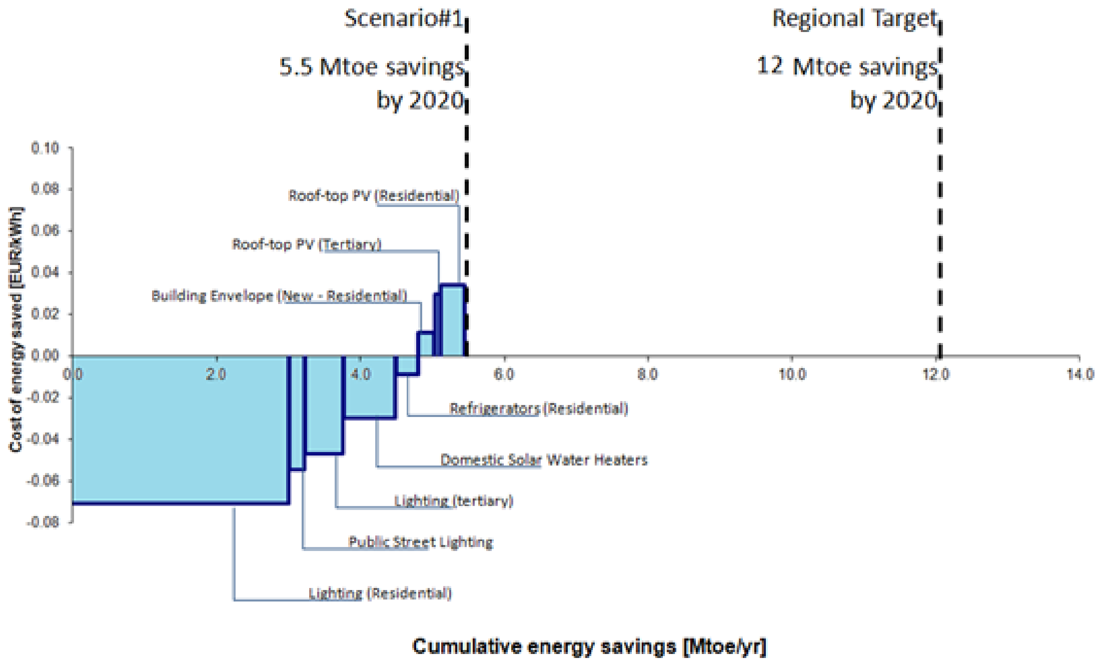


Figure 17: Cost of energy saved (2020) – Scenario#1

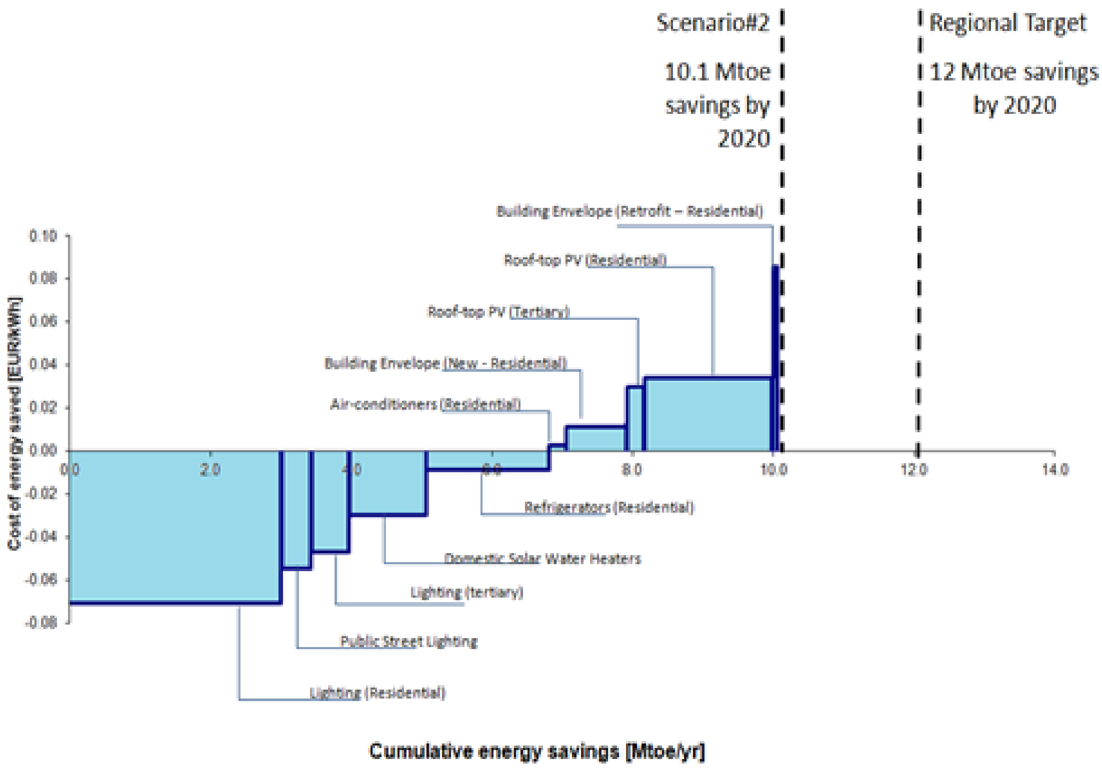


Figure 18: Cost of energy saved (2020) - Scenario#2 (repeated)

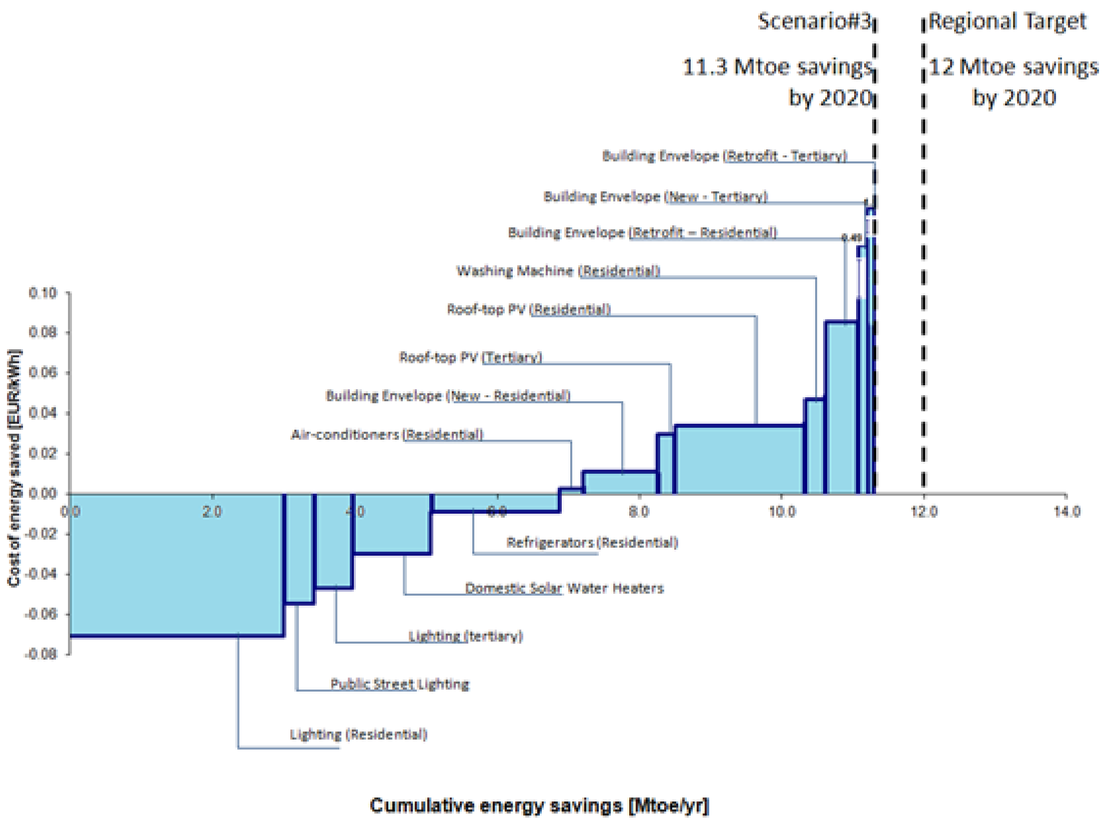


Figure 19: Cost of energy saved (2020) –scenario#3

1.6 BARRIERS TO EE AND SMALL-SCALE RE PROJECTS AND MITIGATION MEASURES

1.6.1 Scope

The previous chapters present some profitable key EE and small-scale RE technologies that could be deployed in the MPC residential and tertiary sectors and could significantly contribute to achieving energy savings targets by 2020. This chapter focuses on barriers pertaining to the deployment of the modelled EE and small-scale RE technologies, mainly in the residential and tertiary building sectors, in the region. The chapter also presents the MPCs efforts to address some of the identified barriers as well as additional strategies, policy measures and instruments the MPCs could implement to address all the remaining ones.

1.6.2 Methodology

The key barriers to the development of EE and small-scale RE projects in the residential and tertiary sectors were identified based on literature review of relevant documents and studies. They were classified into three categories: economic & financial barriers, organisational barriers and technical barriers (Table 14). More details on the identified barriers can be found in Appendix 7.

Table 14: Key barriers' categories and overview for the modelled EE and small-scale RE technologies

Category	Overview / description
Economic & financial barriers	Constraints or features of the investment in energy-saving technologies that are ultimately affecting their economic or financial performance (i.e. rate of return, payback period, etc.).
Organisational barriers	Constraints stemming from the "organisational" aspects of energy-saving projects' implementation ultimately affecting their practical market deployment or uptake (for example, split incentives).
Technical barriers	Technological characteristics or other constraints ultimately affecting the technical performance of energy-saving technologies (for example, quality and performance of available technology).

Modelling results as well as the situation of MPCs' institutional, policy, regulatory and financial frameworks were then used to discuss the identified barriers in each of the MPCs. The MPCs have already adopted measures to address some of the identified barriers in the region, and these were presented based on a review of relevant strategy and policy documents. Further possible mitigation measures to address the remaining barriers were also formulated.

1.6.3 BARRIERS TO THE FULL DEPLOYMENT OF MODELLED EE AND SMALL-SCALE RE TECHNOLOGIES

Given the limited range of technologies which were identified in the national plans examined in this study, it is essential that the MPCs successfully complete their revision of national plans, in order to include additional EE and small-scale RE technologies in the urban environment which are economically profitable. This should take into account the latest international experience in the field. The limited range of technologies identified in national plans for this study therefore only gives a limited view of barriers and possible actions to face them.

Several economic & financial, organisational and technical barriers, which are currently preventing the dissemination of EE and small-scale RE technologies in the urban environment in general and in the MPC region, have nevertheless been identified. They are briefly described in the next sections.

1.6.3.1 ECONOMIC & FINANCIAL BARRIERS

Economic and financial barriers in diverse forms are the main constraints, in particular energy price subsidies, limited access to capital (particularly for low income organisations or households) for some of the EE and small-scale RE technologies. This is reflected in the use of a high discount rate by investors (e.g. households, building owners, etc.).

Energy price distortion

The main economic and financial barrier to the implementation of the modelled EE and small-scale RE technologies is energy price distortion stemming from energy subsidies in most MPCs and the lack of internalisation of the economic externalities of energy production and use (notably GHG emissions). This is particularly the case for the technologies which have been modelled as the least profitable (e.g. building envelope retrofit) and implemented in high energy subsidies MPCs for energy-intensive households, services or businesses. Other technologies such as solar water heaters, roof-top PV, efficient building envelope in new construction and efficient refrigerators show better profitability (and thus become more attractive to end-users) in MPCs with low or no energy subsidies compared to MPCs with high energy subsidies.

Discount rate / financial risk perception

The financial risk perception of most investors in EE and small-scale RE technologies has been identified as an additional barrier to project implementation. This is notably because the monetisation of energy savings is linked to dynamic energy consumption and savings patterns, which can be complex to model. This is particularly the case for the more complex or less standardised technologies, or in sectors where little or poor-quality information is available (e.g. when no audits have been undertaken).

Thus a relatively high discount rate (i.e. 10%) was used in the economic and financial modelling to account for the risks involved in the development of EE and small-scale RE projects in the MPC region. This high discount rate would result in lower rates of return for the modelled technologies and thus decrease the probability of their penetration over 2011-2020 period.

The picture can be further complicated where other hidden costs (e.g. cost of information gathering and analysis, overhead costs, etc.) associated with project development were not identified. Such costs would be incurred in reality and thus affect the project’s actual economic and financial profitability.

1.6.3.2 Organisational barriers

Organisational barriers have also been abundantly evidenced, mostly split incentives, inadequate institutional and regulatory frameworks and lack of awareness (and available information) about energy efficiency possibilities and opportunities.

Inadequacies in the Institutional and regulatory frameworks

Other organisational barriers identified relate to the weak compliance and enforcement of currently existing regulatory frameworks, and the centralised institutional frameworks in the region.

- The absence of favourable frameworks and the weak compliance/enforcement of existing ones (building codes, standards and labelling programmes, certification system, etc.) inhibit the development of EE and small-scale RE projects and contributes to the slow dissemination of these technologies in the residential and tertiary sectors.

- Institutional frameworks are rather centralised in the MPC region. The main obstacles are the slow-decision making process and the limited fiscal autonomy in public local authorities of many countries in the region. Moreover, local governments in many cases do not have the adequate internal capacity, financial independence or the tools to conduct and develop large-scale EE and small-scale RE projects.

Split incentives issue

A first organisational barrier identified is split incentives or principal-agent issues which relate to investment in technologies for which multiple stakeholders are involved during the design, construction and implementation stages. This would mainly correspond to the building sector where investment decisions in existing or new buildings are made by people (e.g. landlord, builder, project developer, architect, etc.) who are not responsible to pay the energy bill (i.e. tenants) and thus the two parties involved would have different goals (lowering investment costs vs. operation costs of the building) and different information levels (European Commission, 2012). In general, this barrier would have significant implications on the deployment of all the modelled EE and small-scale RE technologies as efficient technologies are generally more expensive to install and could possibly be less attractive to the building owner or developer.

Lack of awareness and qualified capacity

Finally information barriers, lack of awareness and capacity among suppliers, promoters, financiers, and end-users can impede decisions to invest in EE and small-scale RE technologies and measures in the MPCs.

- Information about energy cost by end-use, market available EE and small-scale RE technologies and financing options is scarce and sometimes difficult to get in many of the MPCs. As end-users would not be aware of the available opportunities, they would not have the motivation to identify, request and implement potential EE and small-scale RE technologies and measures. Similarly, the professionals would not have the motivation to offer energy efficiency solutions as they were not requested (Wenzel, 2009).

- The lack of adequate training and sufficient awareness campaigns (e.g. general and targeted advertising campaigns) for all the stakeholders involved in the EE and small-scale RE value chain (e.g. manufacturers, suppliers, promoters, financiers, consumers) contribute to widening the informational gap and affect the consumers' investment decisions (De Filpo, 2011).

- The lack of local skilled labour for the installation and maintenance of building insulation, roof-top PV, street lighting, and solar water heaters is a general barrier in all the MPCs. In general, there is a limited technical know-how and lack of experience to identify and install appropriate EE and small-scale RE technologies in the region (Wenzel, 2009).

1.6.3.3 Technical barriers

Finally anecdotic evidence suggests that there could be some technical barriers linked to the lack of capacity to implement some of these technologies, as well as their actual performance against initial expectations.

- Several types of EE and small-scale RE technologies, with varying quality levels, can co-exist in some markets. Investing in low quality technologies would affect the performance and reliability of the technology and would result in decreased levels of energy savings.
- The low power quality provided by the national grid in some of the MPCs (e.g. electricity sector in Lebanon) could also affect the performance of the installed technologies (mainly efficient electric appliances and lighting) and might cause physical damage.

1.6.4 MPCs' strategies and additional mitigation measures to address barriers

The Governments of the MPCs have started to implement energy efficiency policies, measures and instruments to address some of these barriers and promote the development of EE and small-scale RE technologies in the region. Some of these policies combine financial support (e.g. energy efficiency funds, fiscal support, incentives, etc.) and regulatory interventions (e.g. standards & labelling systems, building codes, capacity building, etc.) to promote these investments. Other additional measures that MPCs' Governments could possibly adopt were presented as well.

International organisations or financing institutions, such as the EIB can support MPCs to develop this potential and face these barriers, notably by sharing their experience with numerous EE and small-scale RE technologies which could be included in the national plans (currently being revised in many MPCs). Additional such support could also come in the form of technical assistance, capacity building programmes, or the bundling of projects into programmes at the national or regional levels. The EIB has a substantial experience in EE&RE, which can be useful to support national programmes in these areas.

1.6.4.1 STRATEGIES AND MITIGATION MEASURES TO ADDRESS ECONOMIC AND FINANCIAL BARRIERS

Strategies initiated to address economic and financial barriers

The MPCs are aware of the current high energy subsidies and their implications on the national budget as well as on the increased energy consumption. Lifting energy subsidies, though economically and environmentally desirable, is socially sensitive especially in the residential sector as it might cause additional financial burden on low-income households in the MPCs. There have been recently successful attempts[34] to gradually reduce energy subsidies and increase electricity tariffs especially in Egypt, Jordan Lebanon and Morocco.

Dedicated energy efficiency funds have been established (Algeria, Jordan and Tunisia) or are currently under development (Morocco). Such funds play a significant role in providing soft loans, grants, incentives and fiscal support for the deployment of EE and small-scale RE technologies in the MPCs (e.g. PROSOL mechanism for SWH in Tunisia). Other MPCs (mainly Algeria, Syria and Tunisia) have adopted fiscal tools such as the reduction of custom duties and Value Added Taxes (VAT) on imported energy efficient appliances, equipment and material (household electric appliances, compact fluorescent lamps, solar water heaters, building insulation, etc.).

Possible additional measures to address economic and financial barriers

The MPCs could adopt additional strategies and measures to address the remaining economic and financial barriers.

- Energy subsidy removal could be combined with social compensation programmes to help low-income communities invest in EE and small-scale RE technologies.
- Moreover, financial support could be provided through capital subsidy programmes, tax credit (or tax exemption) schemes or preferential loans and funds (IPCC, 2007).
- Private bank loans combined with public subsidies could also play an effective role in reducing the impacts of high initial, hidden and transaction costs as well as providing access to capital for consumers.
- Standardised measurement and evaluation techniques adapted to EE and small-scale RE projects taking into account the quantification of ancillary benefits (e.g. job creation, human well being, health conditions, etc.) could be used by financiers and promoters to address the uncertainty levels associated with these investments (Thollander, 2010).

1.6.4.2 STRATEGIES AND MITIGATION MEASURES TO ADDRESS ORGANISATIONAL BARRIERS

Strategies initiated to address organisational barriers

The MPCs have taken several steps to improve the institutional and regulatory frameworks for the development of EE and small-scale RE investments.

[34] Jordan undertook fuel price reform in 2005 and 2008 after which retail prices reflected international prices. Similarly, fuel subsidies were eliminated in Lebanon in 2008. Egypt has been trying to phase out energy subsidies which have been decreasing as of 2004. Morocco has adopted a tariff structure which would provide reductions on electricity bill for customers whose energy consumption is less than identified specific targets. However, and with the current political changes in some of the MPCs and due to increasing social and economic pressure, some MPCs reduced fuel prices and the corresponding taxes (Fattouh and El-katiri, 2012).

Most of the MPCs have standards and labelling systems already in place. Labels cover mainly household electric appliances (refrigerators, air-conditioners, washing machines, compact fluorescent lamps, etc.). MPCs such as Egypt, Syria and Tunisia have established energy efficiency testing facilities to support their standards and labelling programs.

Similarly, the MPCs have developed building codes (thermal insulation) especially for new residential and tertiary buildings. The MPCs aim to reduce energy consumption levels by 30%-40% in new buildings as compared to current standards. Building codes are still voluntary in Algeria, Jordan, Lebanon and West Bank/Gaza whereas they are mandatory in Egypt, Syria and Tunisia. Only Algeria notably has so far established a specific body to monitor and verify the implementation of building code requirements. Local authorities such as municipalities could play a significant role in this regard especially when these authorities are responsible to issue construction permits for new buildings (the case of Lebanon for example).

There have been several capacity building and awareness campaign programmes in public and private sectors to raise awareness of energy savings potential and opportunities. For instance, in Algeria and Tunisia, several awareness programs were organised for households and schools. Another example is the MED-ENEC project, a regional cooperation initiative, which developed several information campaigns and implemented 10 pilot projects to increase the awareness about energy efficiency potentials especially in buildings (MEDENER, 2012).

Energy audit programmes, especially for large energy consumers, have been initiated and implemented in almost all the MPCs with financial schemes (mainly grants) provided to support these programmes in some MPCs (Tunisia for instance). Such audits usually target large energy consumers including hospitals, factories, government offices, universities and commercial premises. Details on the number of performed energy audits in some MPCs are available in the country chapters.

Possible additional measures to address organisational barriers

The MPCs could also adopt additional strategies and measures to address organisational barriers.

- Building labelling and certification could be used to provide information related to the state, age and energy performance of building. Such information would minimise potential disputes between the tenant and the landlord (split incentive barrier) as tenants can be aware of their future energy bills.
- Energy policies in the MPCs could further address EE and small-scale RE measures in existing buildings (building retrofits) by establishing requirements for minimum levels of performance, replacing conventional technologies with energy efficient ones and performing regular inspections of heating and cooling systems in these buildings.
- Moreover, harmonisation of test procedures, labels and standards among the different MPCs would improve the cost-effectiveness and market impacts of standards and labelling programmes in the region.
- Comprehensive, integrated education and training programmes could be developed to target all stakeholders involved in the building sector from building officials and inspectors to professionals and end-users (IPCC, 2007).

International assistance could help develop regional co-operation initiatives that could be effective in harmonising energy efficiency policies in the region and developing cross-border programmes (e.g. Mediterranean Solar Plan).

1.7 CONCLUSIONS

- This study aimed to analyse the EE and small-scale RE projects in the urban environment of the MPCs as identified in their current national plans. It looked at opportunities and barriers to the implementation of EE and small-scale RE investments in the region.
- Given the limited range of technologies which were identified in the national plans examined in this study, it is essential that the MPCs successfully complete their revision of national plans, in order to include a maximum number of EE and small-scale RE technologies adapted to the urban environment, and taking into account the latest international experience in the field.
- The EE and small-scale RE projects identified in MPCs' national plans (within the residential and tertiary sectors) can deliver only a small share of the 2020 energy savings (RE production) targets. There is a need for the MPCs to identify more EE and small-scale RE investment projects especially to be implemented in the second half of the decade. Adding projects in some sectors not covered by the study (i.e. transportation and industry) could further support the reaching of the 2020 targets.
- Based on the economic and financial modelling results, investments in only few of the modelled technologies would be financially profitable whereas investments in most of the technologies could be economically justified by their energy savings. In general, efficient lighting (residential, tertiary and street lighting), domestic solar water heaters, efficient refrigerators, efficient building envelope in new construction and roof-top photovoltaic investments seem to offer the largest potential for cost-effective energy savings (RE production) in the region over the period 2011-2020.
- Up to 85% of the 2020 envisaged energy savings targets could be achieved by investing EUR 30 billion in a few economically profitable technologies considered in the national plans. If profitable EE and small-scale RE technologies and measures in other sectors not covered by the study (e.g. industry and transport) were also implemented, more savings could be achieved in the region.
- Significant investment needs would be required in the MPCs in order to implement the EE and small-scale RE technologies considered in national plans and to reach their 2020 targets. Deploying all envisaged technologies (scenario#3) would require EUR 91 billion of investments plus an estimated EUR 29 billion in subsidies.
- Several economic & financial, organisational and technical barriers still hinder the deployment of the EE and small-scale RE technologies considered in the national plans. In particular, high energy subsidies, inadequate institutional and regulatory frameworks and lack of public awareness are the most commonly encountered barriers in the MPCs.
- International organisations or financing institutions, such as the EIB can support MPCs to develop this potential and face these barriers, notably by sharing their experience with numerous EE and small-scale RE technologies which could be included in the national plans (currently being revised in many MPCs). Additional such support could also come in the form of technical assistance, capacity building programmes, or the bundling of projects into programmes at the national or regional levels.

- More work is needed to investigate in details the technical assistance needs and feasibility of EE and small-scale RE projects. For this purpose, the EIB intends to focus on pilot projects/programmes to promote urban EE and small-scale RE in the region. Such work could ultimately help address some of the identified barriers and promote economically profitable EE and small-scale RE technologies in the MPCs.

PART II – COUNTRY ANALYSIS

NB: It is important to note that the pipeline and analysis presented in the country chapters correspond to a systematic desk review undertaken between January and December 2011. This desk review enabled the identification of the typical energy efficiency and small-scale renewable energy investments envisaged in urban areas of the MPCs. By nature the pipeline of projects is evolving on a daily basis. At the date of publication some of the results presented in the country chapters may therefore not fully reflect the latest developments experienced in all countries. These latest developments have been incorporated at best by the authors, and further work on maintaining an up-to-date list of such EE and small-scale RE projects would be useful. *The authors thank the readers in advance for their understanding in this respect and for the reproduction and citing of the related results with caution.*

2.1 ALGERIA

2.1.1 OUTLOOK ON EE AND SMALL-SCALE RE SECTOR IN ALGERIA

2.1.1.1 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

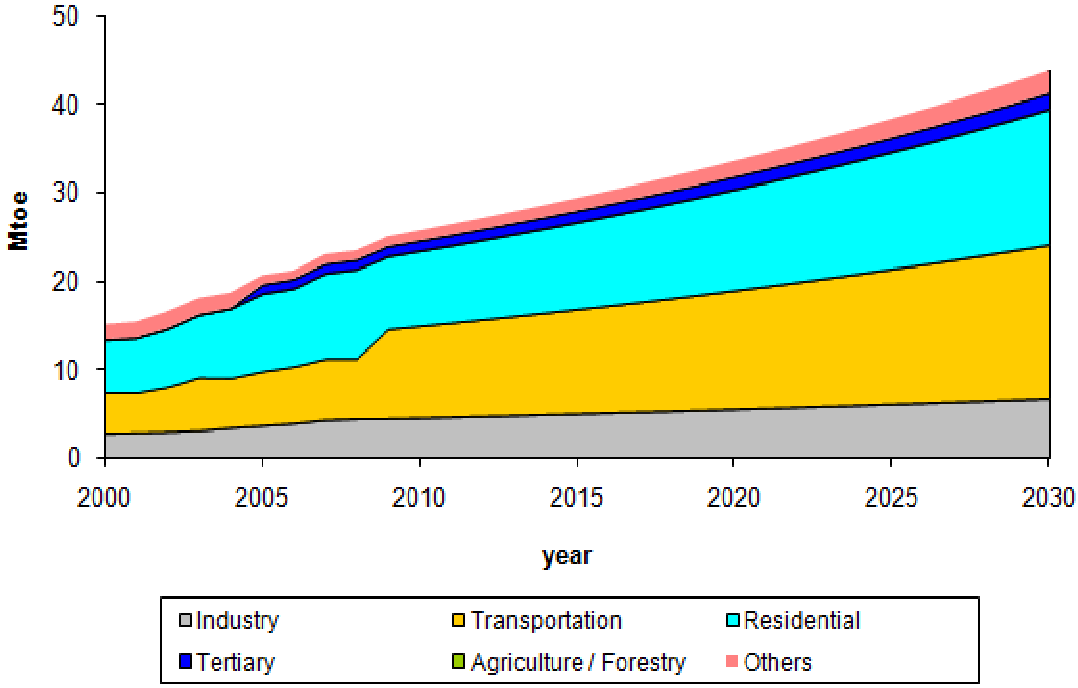


Figure 20: Total final energy consumption in Algeria (2000-2030)

Algeria is an exporter of oil and natural gas with the country's energy supply being highly dependent on fossil fuels. Transportation is the largest energy consuming sector (approximately 40% of the total final energy consumption) with 90% corresponding to road transport (Hamdani, 2010). The residential sector accounts for 33% of the total final energy consumption and is expected to witness the largest growth over 2011-2030 (Figure 20).

Algeria has a total population of 35.4 million (2010) with 67% living in urban areas (United Nations, 2010). The total existing residential building stock is 6.5 million dwellings (2010). A total of 4.8 million dwellings and two additional agglomerations (size of 0.5-1 million inhabitants) would be expected over 2011-2030 (Plan Bleu, 2011; United Nations, 2010).

2.1.1.2 STAKEHOLDERS DEALING WITH EE AND SMALL-SCALE RE

The Ministry of Energy and Mining (MEM) is responsible for the development of the general policy of the Algerian government on research, production and use of hydrocarbon, mining and energy resources (MEM, 2011). In particular, MEM's activities cover the field of renewable energy and energy efficiency.

The National Agency for the Promotion and Management of Energy Efficiency (APRUE) is a public institution created by a Presidential Decree[35] in 1985 under the Ministry of Energy and Mining. The main missions of APRUE are the coordination and implementation of the national energy efficiency policy and action plans, as well as the leading of awareness campaigns and programmes (detailed in Law 99-09 from 28 July 1999 on energy efficiency).

The Algerian Institute for Renewable Energy and Energy Efficiency (IAEREE) was created in early 2011 following the publication of Decree 11-33. According to this decree, IAEREE's mission covers capacity building in public and private institutions, applied research in EE and small-scale RE and pilot projects development.

Private sector

The Algerian energy industry is organised around a few large companies (mainly state-owned) and many very small enterprises; medium-sized companies are quite rare. No systematic ESCO activity exists in Algeria (Wuppertal Institute and MVV Decon, 2010a).

2.1.1.3 POLICY, REGULATORY AND FINANCIAL FRAMEWORKS

The Algerian government has recognised the necessity for reducing energy demand and has established a policy framework to improve energy efficiency. The regulatory and legislation frameworks appear consistent and balanced, and cover all aspects of regulation, financing and implementation of the national energy efficiency policy (Wuppertal Institute and MVV Decon, 2010a).

Policy framework

The different interventions under the national energy efficiency policy have been set with targets for five-year period. The National Programme of Energy Management (PNME) is articulated around the enacting of the energy efficiency law in 1999 and the creation of the National Fund for Energy Management (FNME). The Algerian energy efficiency law defines the Algerian strategy for energy efficiency and the framework to reduce and manage energy demand. The law states that energy efficiency is an activity of public interest (Wuppertal Institute and Adelphi Consult, 2009). The FNME provides funding for renewable energy and energy efficiency projects and acts as a catalyst for actions and programmes.

Specific energy efficiency programmes are set for 5-year period, starting in 2006. The objectives are defined on the basis of sectoral priorities (industry in the short-term; residential, tertiary, agricultural

[35] Decree 85-235 from 25 August 1985 on the creation of an agency for the promotion of energy efficiency.

and transport sectors in the medium and long-term), different final energy-use (lighting, cooling, water heating, pumping and irrigation) and products (oil and electricity) taking into account their respective energy savings potentials (APRUE, 2010). The latest released detailed plan for 2010-2014 covers buildings, industry, transport, and agriculture as main sectors.

Regulatory framework

Policies outlined in the energy efficiency law and the PNME are specified in executive decrees. The decrees are implemented by the APRUE. The decrees cover energy efficiency measures such as labelling for household appliances (refrigerators, freezers, light bulbs, etc.), energy audits for large energy consumers and certification process for companies.

Financial framework

The FNME is the dedicated financing instrument to support the Algerian energy efficiency policy. Its objective is to contribute to the kick-starting and deployment of an energy efficiency market via specific loans with reduced interest rates and investment guarantees to facilitate access to finance.

The MEM is the main regulator of the FNME and is responsible for the definition of the PNME as explained in Decree 2000-116 from May 29, 2000.

Most of the FNME's funding is used to support actions and projects selected within the PNME. At present, this funding is provided from either energy consumption taxation or other sources such as special state subsidies and grants.

Financing needs for energy efficiency projects has been estimated at DZD 10 billion per year whilst DZD 1.5 billion are already available (Hamouda 2010). Thus the reinforcing of the FNME should come from additional State subsidies and/or the potential reform of the energy consumption tax.

2.1.2 NATIONAL TARGETS AND IDENTIFIED PROJECTS PIPELINE

As part of the PNME, energy savings of 200 ktoe/year are targeted in order to reach 900 ktoe over 2010 - 2014. No energy savings targets have been identified after 2014.

Based on the desk review carried out in 2011, a total of 24 EE and small-scale RE projects were identified in Algeria, out of which 20 were classified as investment projects (Table 15). Total cost for the identified investments is approximately EUR 150 million. These projects are expected to result in energy savings of 63 ktoe/year (by 2014). A large share of the identified projects (approximately 45% of the total investment costs) is for the promotion of LPG in transportation. Efficient lighting projects would result in the majority of the estimated energy savings.

Table 15: Identified EE and small-scale RE projects in Algeria

Project Description	Targeted Sector	Technology	Objectives	Period	Sponsors	Investment Costs [MEUR]	Energy Savings [Ktoe/year]	CO2 Avoided [KtCO2/year]
INVESTMENT PROJECTS								
Thermal renovation for existing building stock	Residential	RES_ENV	Renovate 4,000 existing dwellings for more energy efficient performance	2010-2014	APRUE; OPGI	12.3	0.6	3.0
High energy performance in new buildings	Residential	RES_ENV	Construct 3,000 new dwellings following the principles of High Energetic Performance (Haute Performance Energétique – HPE)	2010-2014	APRUE; OPGI	7.1	0.6	2.7
High energy performance in social housing	Residential	RES_ENV	Implement the principles of High Energetic Performance (Haute Performance Energétique – HPE) in 600 social housing units	2007-2011	APRUE	1.8	0.1	0.5
Thermal renovation for existing residential building stock	Residential	RES_ENV	Renovate 100 existing dwellings for more energy efficient performance	2007-2011	APRUE	0.3	0.02	0.08
Solar water heating in dwellings	Residential	RES_SWH	Deploy 10,000 solar water heaters in dwellings	2007-2011	APRUE	6.0	1.5	5.3
Solar water heaters	Tertiary	Solar Thermal Heating	Deploy 10,000 solar water heaters in health centres, hotels and steam rooms	2010-2014	APRUE; MEM	6.0	1.5	5.3
Solar space heating for service sector buildings	Tertiary	Solar Thermal Heating	Deploy 2,000 sqm of solar thermal captors in service sector buildings	2007-2011	APRUE	0.6	0.15	0.5
Efficient indoor lighting	Residential	RES_LTG	Deploy 5 million low consumption light bulbs inside buildings	2010-2014	APRUE; MEM	18.9	36.5	291.7
Efficient indoor lighting	Residential	RES_LTG	Deploy 1 million low consumption light bulbs in dwellings	2007-2011	APRUE	3.8	7.3	58.3
Efficient residential refrigerators	Residential	RES_REF	Install 10,000 energy efficient refrigerators in residential buildings	2007-2011	APRUE	8.8	0.7	5.9
High energy performance in service sector buildings	Tertiary	TER_ENV	Implement the principles of High Energetic Performance (Haute Performance Energétique – HPE) in 10 service sector buildings	2007-2011	APRUE	0.3	0.0018	0.01
Efficient public lighting	Tertiary	TER_LTG	Install 50,000 CFLs and 250 variable-voltage regulators for the enhancement of energy efficient public lighting	2010-2014	APRUE; MEM	0.2	0.3	2.7
Efficient indoor lighting for services	Tertiary	TER_LTG	Deploy 1 million low consumption light bulbs	2007-2011	APRUE; MEM	3.8	6.7	53.3
Efficient indoor lighting for public local authorities	Tertiary	TER_LTG	Deploy 1 million low consumption light bulbs	2007-2011	APRUE	3.8	6.7	53.3
Promotion of LPG for private transport	Transportation	LPG Car Kits	Convert 50,000 private (light) vehicles to LPG via the financing & installation of LPG car kits	2010-2014	APRUE; BDL	56.50	N/A	N/A
Promotion of LPG for captive fleets	Transportation	LPG Car Kits	Convert 5,000 captive fleet vehicles (both in public and private sectors) to LPG via the installation of LPG kits	2010-2014	APRUE; BDL	5.65	N/A	N/A
Promotion of LPG for private transport	Transportation	LPG Car Kits	Convert 4,000 private vehicles (light and trucks) to LPG via the installation of LPG car kits	2007-2011	APRUE	6.3	N/A	N/A
Promotion of LPG for captive fleets	Transportation	LPG Car Kits	Convert 400 captive fleet vehicles (both in public and private sectors) to LPG via the installation of LPG kits	2007-2011	APRUE	0.5	N/A	N/A
Solar pumping for irrigation	Agriculture / Forestry	Solar Pumping	Install 200 solar pumping & irrigation systems	2010-2014	APRUE	5.0	0.4	0.9
Solar pumping for irrigation	Agriculture / Forestry	Solar Pumping	Install 80 solar pumping & irrigation systems	2007-2011	APRUE	2.0	0.2	0.4
Technical Assisstance								
Energy audits for industry	Industry	EE - General & Studies	Undertake energy audits for 130 large energy intensive industrial sites	2010-2014	APRUE	N/A	N/A	N/A
Feasibility studies for energy efficient industrial installations	Industry	EE - General & Studies	Undertake 60 feasibility studies for the installation of energy efficient industrial processes	2010-2014	APRUE	N/A	N/A	N/A
Energy audits for tertiary sector	Residential	EE - General & Studies	Undertake energy audits for 20 large energy intensive tertiary businesses	2010-2014	APRUE	N/A	N/A	N/A
Energy audits for transport	Transportation	EE - General & Studies	Undertake energy audits for 4 large energy intensive transport companies	2010-2014	APRUE	N/A	N/A	N/A

2.1.3 MODELLING RESULTS

Results of the profitability assessment carried out suggest that investments in efficient residential and tertiary lighting and domestic solar water heating are financially justified in Algeria. High energy subsidies tend to lower the financial profitability of other assessed investments. Efficient building envelop investments in new built appear economically justified. Given this result, such projects could represent another profitable market segment considering that 42% of the building stock in Algeria by 2030 is expected to correspond to new constructions (i.e. 4.8 million additional dwellings over 2011-2030). Roof-top PV investments appear economically justified in Algeria towards the second half of the decade.

Examining the project mix in Algeria, efficient lighting (residential, tertiary and public street lighting) would result in the majority of energy savings in the three scenarios (Figure 21).

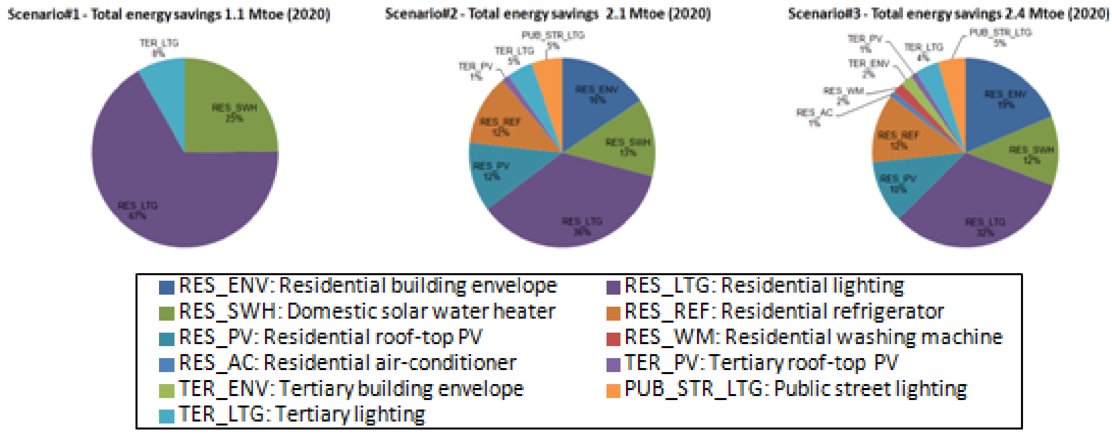


Figure 21: Breakdown of energy savings by technology – Algeria

Figure 22 shows that the majority of investment costs would be associated with building envelope projects (up to 60% of total investment costs under the full deployment scenario).

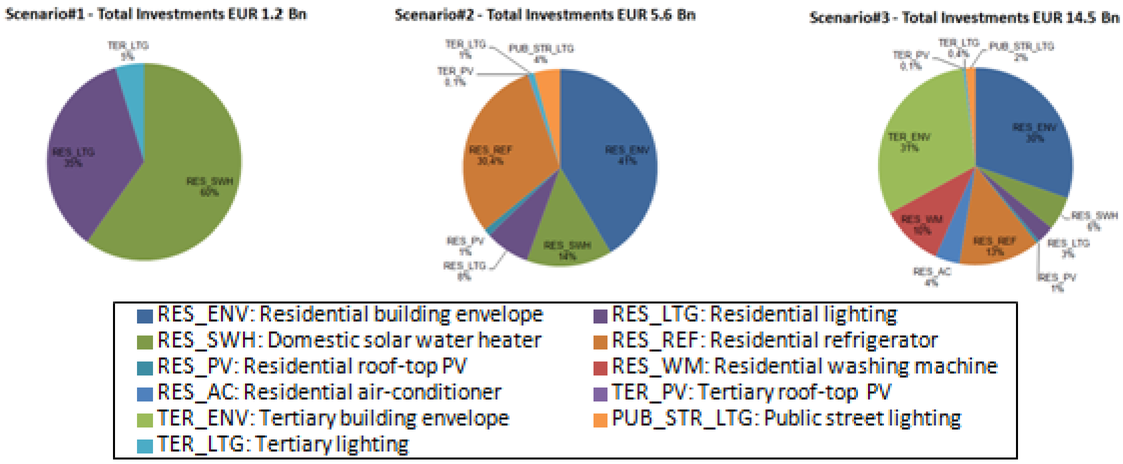


Figure 22: Breakdown of investment costs by technology – Algeria

By investing in technologies which were assessed as economically justified (profitable), Algeria could achieve 2.1 Mtoe of energy savings or 6% of the total final energy consumption by 2020. If all the modelled technologies were deployed, the resulting energy savings would reach 7% of the total final consumption by 2020. Comparing this to the current target of 200 ktoe/year (2010-2014), Algeria could surpass its energy savings targets by focusing on a few profitable technologies.

Results of scenario development using “cost of energy saved” (CES) representation suggest that efficient lighting (residential and tertiary) and domestic solar water heaters are the most cost-effective EE and small-scale RE investments (among the assessed) in Algeria (Figure 23). Roof-top PV projects, though not yet cost effective in Algeria, could present a large cost efficient savings potential towards the second half of the decade.

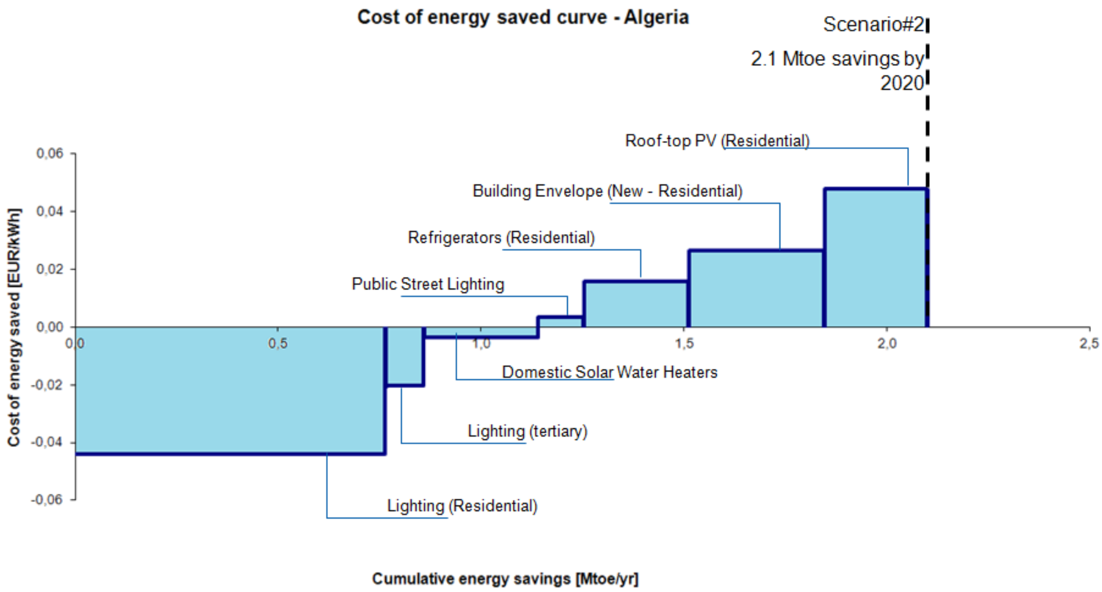


Figure 23: Cost of energy saved curve (scenario#2) – Algeria

In order to fully deploy all the assessed EE and small-scale RE investments (scenario#3), subsidies are needed to ensure sufficient profitability for all projects (as explained in Section 1.5.2). These subsidies were estimated to a total of EUR 3.8 billion, in net present value, and for all the assessed projects to be implemented in Algeria by 2020. Tertiary building envelope projects would require the majority of these estimated subsidies.

2.1.4 BARRIERS TO EE AND SMALL-SCALE RE PROJECTS AND MITIGATION MEASURES

Several barriers to the implementation of EE and small-scale RE investments were identified in Algeria. High energy subsidies (and low energy prices) are a significant barrier to the implementation of the modelled technologies, and these increase their need for financial support (Wuppertal Institute and Adelphi Consult, 2009). Moreover, the Algerian market for EE and small-scale RE technologies appears immature, and there is a need to import technology in the short term.

Several measures were adopted by the Algerian government through the PNME (Hamouda, 2010). These included fiscal tools to reduce or eliminate custom duty taxes and VAT for EE and small-scale RE technologies (e.g. CFLs, High pressure sodium lamps for public lighting, and solar water heaters) and the creation of energy efficiency monitoring bodies to enforce the compliance to building codes and electric appliances standards. Several public awareness campaigns were also organised for households and schools.

2.2 EGYPT

2.2.1 OUTLOOK ON EE AND SMALL-SCALE RE SECTOR IN EGYPT

2.2.1.1 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

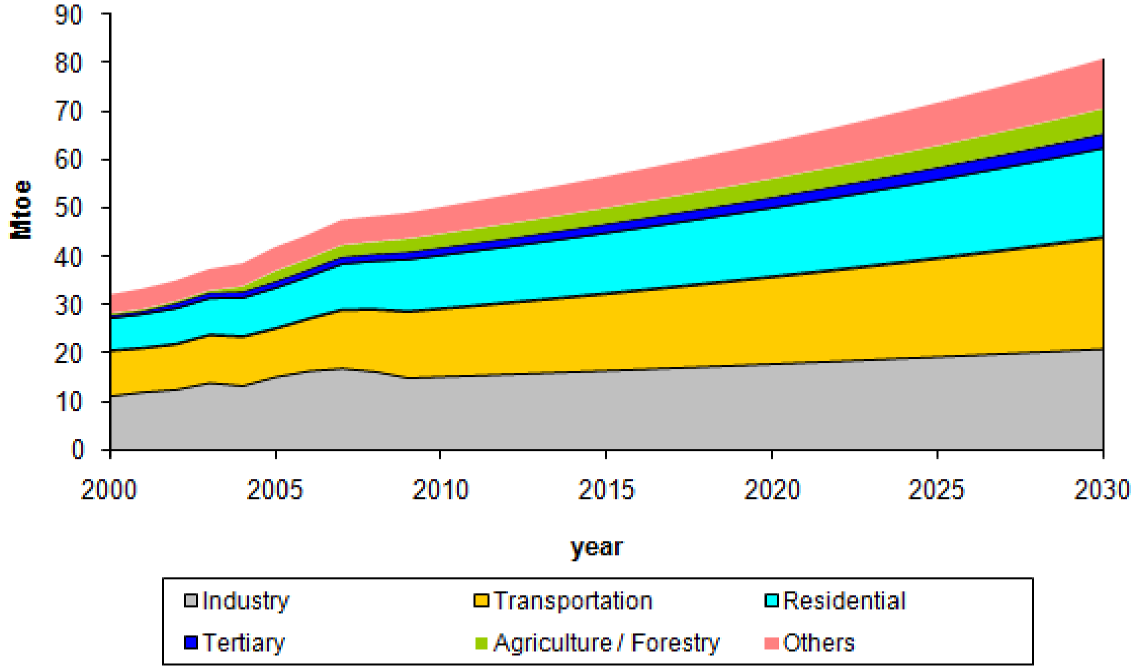


Figure 24: Total final energy consumption in Egypt (2000-2030)

Egypt is an oil and gas producing country. Its economy is heavily dependent on fossil fuels (94%) to meet its growing energy demand. Egypt has experienced an important increase of major energy drivers such as population, economic growth, and motorisation (Jochem et al., 2008).

The total final energy consumption is approximately 50 Mtoe (2010) with the majority of the demand being in the transport and industry sectors (Figure 24). Both sectors, in addition to the residential sector, are expected to witness the largest growth in demand by 2030 (Jochem et al., 2008).

Egypt has a total population of 85 million with 43% only living in urban areas (United Nations, 2010). The lower urbanisation rates in Egypt as compared to other MPCs could explain the relatively high percentage of energy consumption in the agriculture and forestry sector (5%-6% of total final consumption). The total existing residential building stock amounts to 20 million [dwellings] or 46% of the regional residential building stock. A total of 7 million additional dwellings and 4 additional agglomerations (size of 0.5-1 million inhabitants) are expected by 2030 (Plan Bleu, 2011; United Nations, 2010).

2.2.1.2 STAKEHOLDERS DEALING WITH EE AND SMALL-SCALE RE

Currently, there is no single energy efficiency agency in Egypt. The responsibilities of EE and small-scale RE sector are scattered among various departments and institutions (Wuppertal Institute and MVV Decon, 2009a):

- The Energy Supreme Council (ESC) was established in 1979 as the highest policy-making authority in the energy sector and was then reformed in 2007 (Wuppertal Institute and MVV Decon, 2009a; Hassan, 2009). Its objectives are to develop energy strategies in management of energy resources, energy consumption and production patterns, as well as providing guidance to energy reform activities.
- The Energy efficiency unit in the ESC was established by a Prime Minister's decree in May 2009. Its main goal is to coordinate all the efforts related to energy efficiency for the Government. This includes providing technical assistance, drafting policy and market initiatives, and developing energy efficiency implementation roadmap. Ministries, especially of the main energy consumers and producers sectors, are represented within this unit.
- The Energy Efficiency Council (EEC) was created in 2000 as a voluntary consortium of public and private organisations with the aim to create an active framework that would allow a wider adoption of energy efficiency in Egypt (Jochem et al., 2008).
- The New and Renewable Energy Authority (NREA) was established in 1986 to support and develop renewable energy technologies / projects (including small-scale RE such as SWH and roof-top PV) in Egypt together with implementation of related energy conservation programs.

Private sector

There were several attempts to create a self-sustaining market for ESCO activities in Egypt with the support of international organisations. The United Nations Development Program (UNDP) and the Global Environmental Facility (GEF) supported the establishment of several ESCOs in Egypt under the Energy Efficiency Improvement and Greenhouse Gases Reduction (EEIGGR) project (Wuppertal Institute and MVV Decon, 2009a). However, the results were a little disappointing as most of the established ESCOs remained small and under-resourced. The prevailing large energy subsidies reduce the benefits from energy efficiency investments and make it hard to find projects that are attractive to both the ESCO and the client.

2.2.1.3 POLICY, REGULATORY AND FINANCIAL FRAMEWORKS

Policy framework

The National Energy Efficiency Strategy (NEES) was developed in 2000 as part of the Egyptian Environmental Policy Program (EEPP) jointly implemented by the Egyptian Environmental Affairs Agency (EEAA), the Organisation for Energy Planning (OEP), and the Tourism Development Authority (TDA). The NEES consisted of a set of energy policy instruments including the development of a national energy standard and labelling program. However, the lack of a dedicated institution responsible of setting up objectives and targets as well as legislation, incentives and R&D themes for EE and small-scale RE have made it difficult to develop a comprehensive policy (Jochem et al., 2008).

Regulatory framework

There is no energy efficiency law in Egypt at present but rather a draft law (Wuppertal Institute and MVV Decon, 2009a).

Standards and labelling systems for household appliances (refrigerators, washing machines, and air-conditioners) were developed in Egypt (Zahran, 2010; Wuppertal Institute and MVV Decon, 2009a).

Although there has been a Ministerial Decree to implement these standards, compliance is still voluntary at present.

The Ministry of Housing has developed energy efficiency building codes to specify the minimum energy performance standards for residential, commercial and public buildings (Wuppertal Institute and MVV Decon, 2009a).

Financial framework

The committee on energy efficiency in Industry has proposed the establishment of a specific fund to provide financial incentives to investments in EE and small-scale RE. Until now, however, no such fund exists (Wuppertal Institute and MVV Decon, 2009a).

Financial resources for EE and small-scale RE investments have been limited and mainly allocated for technical assistance programmes (Georgy and Soliman, 2007). Neither data about private sector investments nor estimates for future investment needs on the national level have been identified.

2.2.2 NATIONAL TARGETS AND IDENTIFIED PROJECTS PIPELINE

The Egyptian energy strategy is targeting 8.3% reduction[36] in the energy consumption by 2022 through energy efficiency applications collectively at both the supply and demand side (Wuppertal Institute and MVV Decon, 2009a). This would correspond to 20% of 2007 energy consumption by 2022.

Based on the desk review carried out in 2011, only two EE and small-scale RE projects were identified in Egypt (Table 16). The distribution of low consumption light bulbs in the residential sector is the only investment project.

Table 16: Identified EE and small-scale RE projects in Egypt

Project Description	Targeted Sector	Technology	Objectives	Period	Sponsors	Investment Costs [MEUR]	Energy Savings [Ktoe/year]	CO2 Avoided [KtCO2/year]
Investment Projects								
Low consumption light bulbs	Residential	RES_LTG	Distribute 6 million compact fluorescent lamps (CFLs) to residential customers in Cairo	2010	Electricity Distribution Companies	22.6	20.0	109.4
Technical Assisstance								
Industrial energy efficiency (IEE) project	Industry	EE - General & Studies	Facilitate energy efficiency improvements in the industrial sector through the support of ESCOs	2010 - 2014	GEF	15.4	N/A	N/A

2.2.3 MODELLING RESULTS

Results of the profitability assessment carried out suggest that investments in efficient lighting (residential, tertiary and public street lighting) and domestic solar water heaters are financially justified in Egypt. High energy subsidies tend to lower the financial profitability of other assessed investments.

[36] The NEEAP of Egypt (2012-2015) was approved by the prime ministry in July 2012 (resolution no.26/07/12/9) and declared a target of 5% electricity saving in 2105 of baseline consumption equals the average consumption of the last five years (RCREEE, 2012).

Examining the project mix in Egypt, efficient lighting (residential, tertiary and public street lighting), electric appliances and roof-top PV would result in the majority of energy savings in the three scenarios (Figure 25).

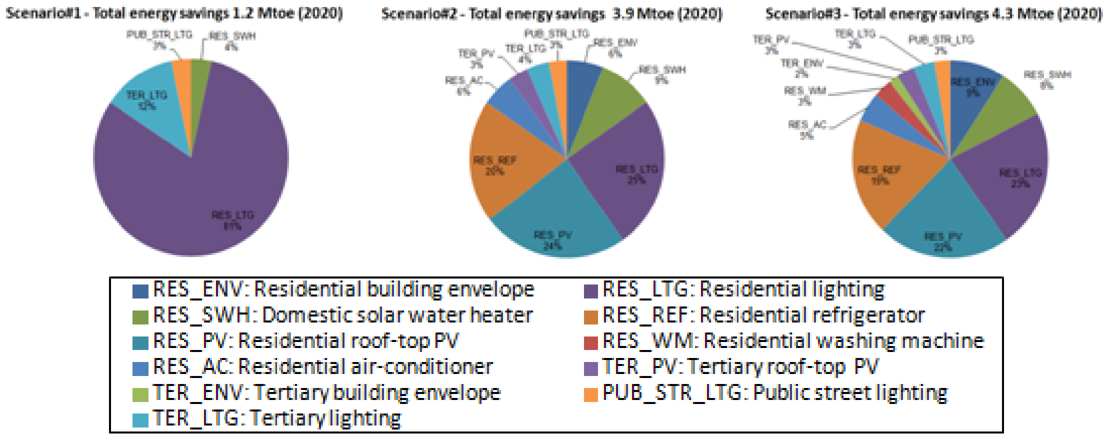


Figure 25: Breakdown of energy savings by technology – Egypt

Figure 26 shows that the majority of investment costs would be associated with building envelope projects (63% of total investment costs under scenario#3).

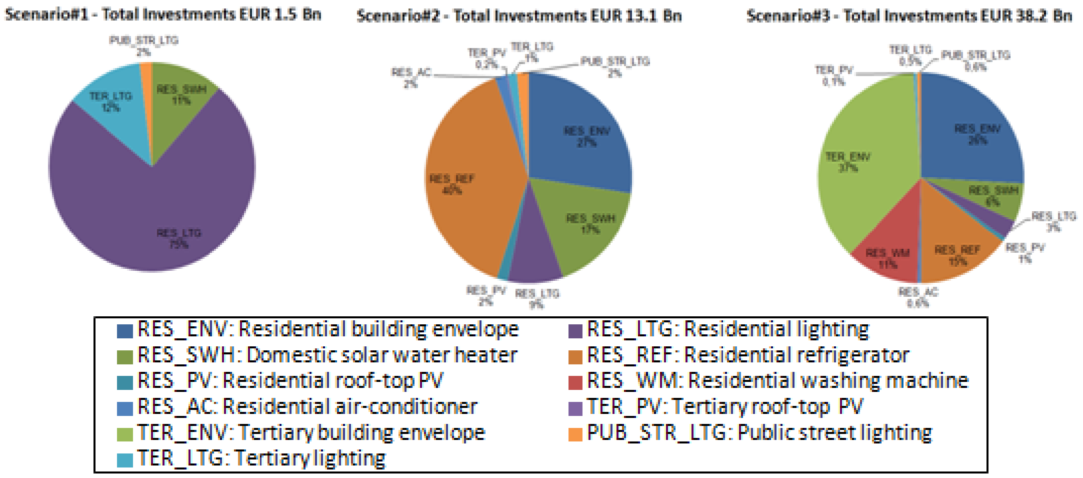


Figure 26: Breakdown of investment costs by technology – Egypt

By investing in technologies which were assessed as economically justified (profitable), Egypt could achieve 3.9 Mtoe of energy savings or 6% of the final energy consumption by 2020. If all the modelled technologies were deployed, the resulting energy savings would reach 6.7% of the total final energy consumption. Comparing this to the current target of 5.8 Mtoe by 2020, Egypt could achieve approximately 75% of its energy savings targets if all the modelled technologies were deployed by 2020.

Results of scenario development using “cost of energy saved” (CES) representation suggest that residential and public street lighting are the most cost-effective EE and small-scale RE investments (among the assessed) in Egypt (Figure 27). Investments in roof-top PV and efficient refrigerators, though not yet cost-effective, appear to present large energy savings potentials.

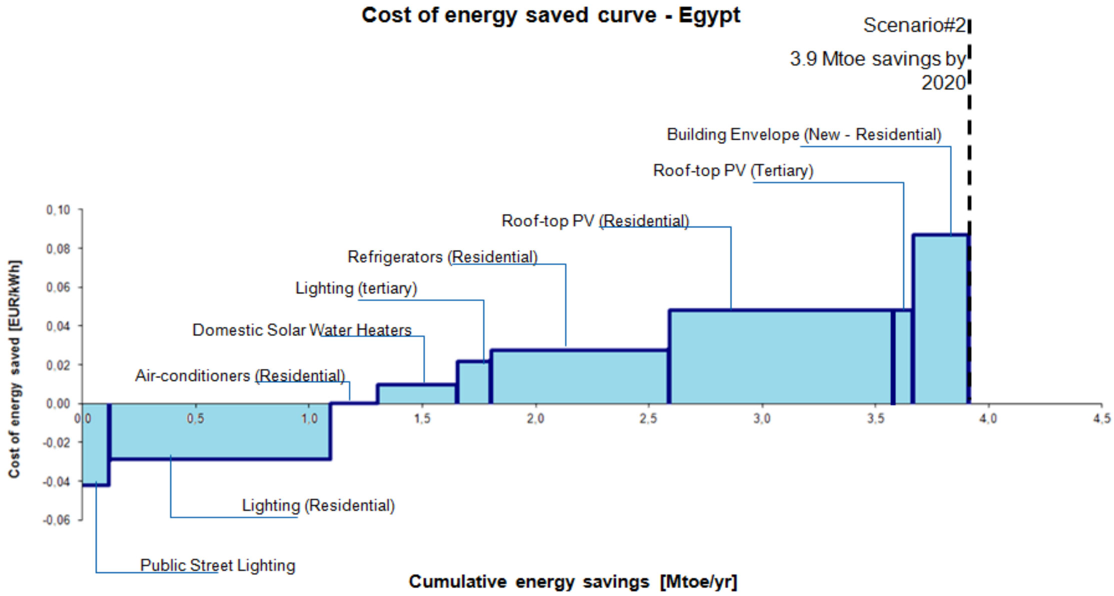


Figure 27: Cost of energy saved (scenario#2) – Egypt

In order to fully deploy all the assessed EE and small-scale RE investments (scenario#3), subsidies are needed to ensure sufficient profitability for all projects (as explained in Section 1.5.2). These subsidies were estimated to a total of EUR 12.8 billion, in net present value, and for all the assessed projects to be implemented in Egypt by 2020. Building envelope projects would require the majority of these estimated subsidies (approximately 82% of the total required subsidies).

2.2.4 BARRIERS TO EE AND SMALL-SCALE RE PROJECTS AND MITIGATION MEASURES

Energy efficiency measures, particularly demand side measures, have not been given much consideration in the past (CTF, 2009). The current electricity tariffs and the heavy conventional energy subsidies are major challenges for an effective energy efficiency policy. The most commonly used primary energy resources in Egypt to cover final demand are oil and gas which have been historically priced at very low levels, a situation that has encouraged high use of energy. All petroleum products and natural gas are subsidised by the Egyptian government with these subsidies reaching up to 18% of total government expenditures in 2009-2010 (Fattouh and El-Katiri, 2012). The same applies to electricity in the residential and agricultural sector (Jochem et al., 2008).

Several mitigation measures have been adopted in Egypt to reform energy subsidies. An annual increase in electricity prices by 5% has been implemented since 2004. An additional 2.5% increase was also considered to count for change in fuel prices in 2007. In the recent years, there have been several discussions by the successive governments in Egypt to phase out energy subsidies especially for private and industrial consumers (Fattouh and El-Katiri, 2012). A more targeted approach to fuel subsidies could possibly reduce subsidy costs and affect less low-income groups. However, and with the current social and political situation in Egypt, such reforms to energy subsidies do appear likely in the short- to medium-term (Fattouh and El-Katiri, 2012).

Moreover, Egypt has already developed and issued three standards (starting 2005) with their corresponding labels for refrigerators, air-conditioners, and washing machines (Jochem et al., 2008). Energy efficiency testing facilities were also established to support the national energy efficiency standards and labelling program (Georgy and Soliman, 2007).

Three energy efficiency building codes (residential, commercial and governmental) were also developed and published (Hanna, 2009). They apply to new buildings or new parts of existing buildings. Despite their existence, the enforcement of these codes is almost negligible (Suding, 2009).

2.3 ISRAEL

2.3.1 OUTLOOK ON EE AND SMALL-SCALE RE SECTOR IN ISRAEL

2.3.1.1 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

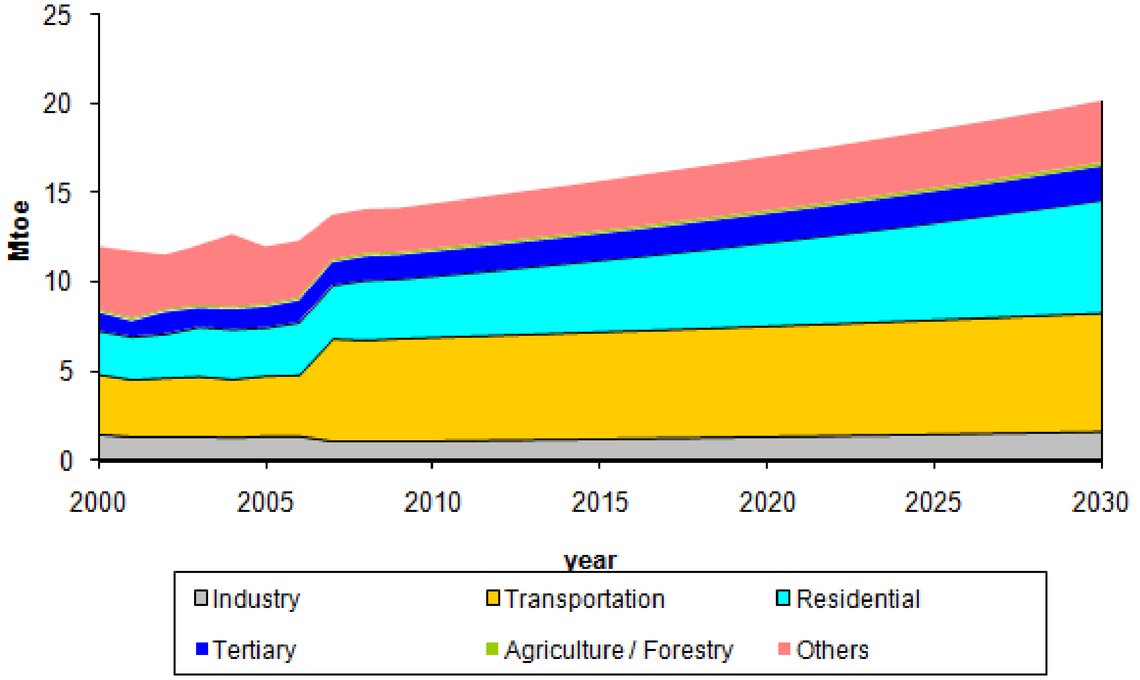


Figure 28: Total final energy consumption in Israel (2000-2030)

The Israeli energy sector is characterised by a steadily increasing energy demand especially in industry and residential sectors mainly due to economic development and high living standards. The government is currently facing this challenge by increasing the electricity supply (establishment of new power stations) and implementing energy conservation measures and actions to reduce energy consumption (Dolev et al., 2009).

Transportation is the largest energy consuming sector in Israel (approximately 40% of the total final energy consumption).The residential sector accounts for 24% of the total final energy consumption and would be expected to witness the largest growth over 2011-2030 (Figure 28).

Israel has a total population of about 7 million with 92% living in urban areas (United Nations, 2010). The total existing residential building stock is 2.2 million dwellings (2010). A total of 0.9 million additional dwellings would be expected by 2030 (Plan Bleu, 2011).

2.3.1.2 STAKEHOLDERS DEALING WITH EE AND SMALL-SCALE RE

Currently, there is no dedicated agency to promote EE and small-scale RE in Israel. The Ministry of Energy and Water Resources (MEW), previously the Ministry of National Infrastructures (MNI), is responsible for the energy sector and national resources in Israel; thus the MEW responsibility covers EE and small-scale RE.

<u>Private sector</u>

The MNI has supported the establishment of ESCOs, especially within the industrial and tertiary sectors, with the support of international experts to promote EE and small-scale RE since 2004 (Mor and Seroussi, 2007). The established ESCOs were successful in implementing the energy performance contract model especially in medium scale industry and business where high energy consumption provide a good opportunity for ESCOs.

2.3.1.3 POLICY, REGULATORY AND FINANCIAL FRAMEWORKS

Policy framework

Several policy plans related to EE and small-scale RE were prepared and published by MNI. The comprehensive master plan for energy sector (2004) and master plan for the electricity sector (2007-2030) are the main policy documents to promote EE and small-scale RE as a strategic goal of the central government policy in energy sector (Dolev et al., 2009).

The National Energy Efficiency Program (2010-2020), prepared by MNI and approved by the Israeli government, provides an implementation roadmap to achieve 20% reduction in electricity consumption by 2020 (MNI, 2010).

Regulatory framework

The Energy Resources Law (1989) included standards and regulations related to energy efficiency (Mor and Seroussi, 2007). Energy efficiency standards include mandatory labelling of domestic electric appliances (refrigerators, freezers, heaters and air-conditioners) and energy audits for large energy consumers. Recently, the MNI has implemented several additional regulations related to EE and small-scale RE especially for water heating, distributed electricity generation and water pumping (Ben-Shalom, 2007). In addition, a voluntary green building standard exists since 2005.

Financial framework

There is currently no energy efficiency fund to promote EE and small-scale RE investments in Israel. The national energy efficiency program requires the establishment of a national fund of approximately NIS 200 million for 2011-2020 if the 20% target were to be met (MNI, 2010). A possible source to finance such fund is to raise electricity tariff by 1% each year (OECD, 2011).

2.3.2 NATIONAL TARGETS AND IDENTIFIED PROJECTS PIPELINE

In 2008, the Israeli government has adopted a national energy efficiency program (2010-2020) to reduce electricity consumption by 20% by 2020 (MNI, 2010). No concrete steps to realise this program have been identified until now (Dolev et al., 2009). For the projects pipeline and based on the desk review carried out in 2011, no EE and small-scale RE investment projects have been identified for implemented in Israel by 2020[37].

2.3.3 MODELLING RESULTS

Results of the profitability assessment carried out suggest that investments in most assessed EE and small-scale RE technologies are financially justified in Israel, mainly due to the high energy pric-

[37] This can appear surprising, especially in the light of the results of the modelling done, as presented in the next sections, which suggest that many of the modelled EE and small-scale RE technologies are already financially or economically profitable in Israel.

es. Profitable investments include efficient lighting (residential, tertiary and street lighting), solar water heaters, efficient envelope for new buildings and roof-top PV (towards the end of the decade). Most of these technologies offer relatively low payback periods which could be attractive for end-users and small business firms. Efficient building envelope investments for new buildings appear to represent another profitable market segment considering that approximately 27% of the building stock by 2030 would be new construction.

Examining the project mix in Israel, efficient lighting would result in the majority of energy savings for the three scenarios (Figure 29).

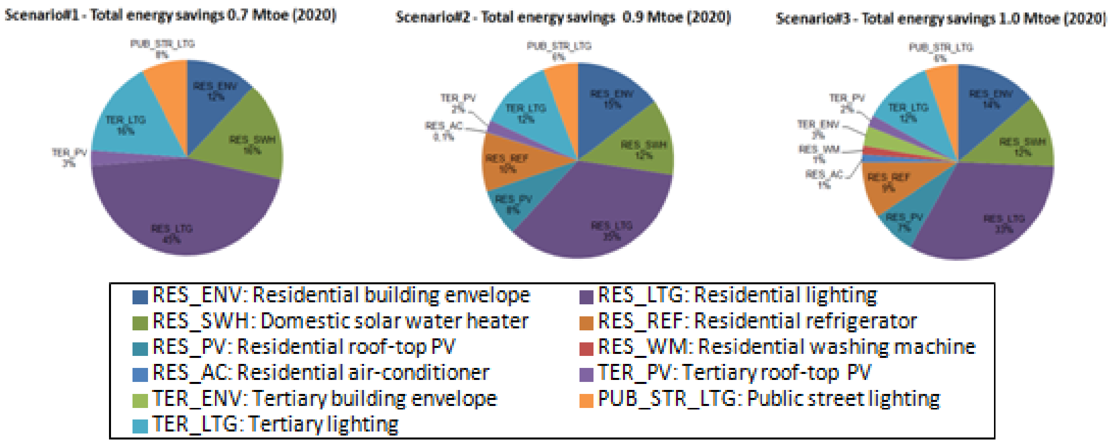


Figure 29: Breakdown of energy savings by technology – Israel

Figure 30 shows that the majority of investment costs would be associated with building envelope projects (between 45% and 68% of total investment costs depending on the scenario).

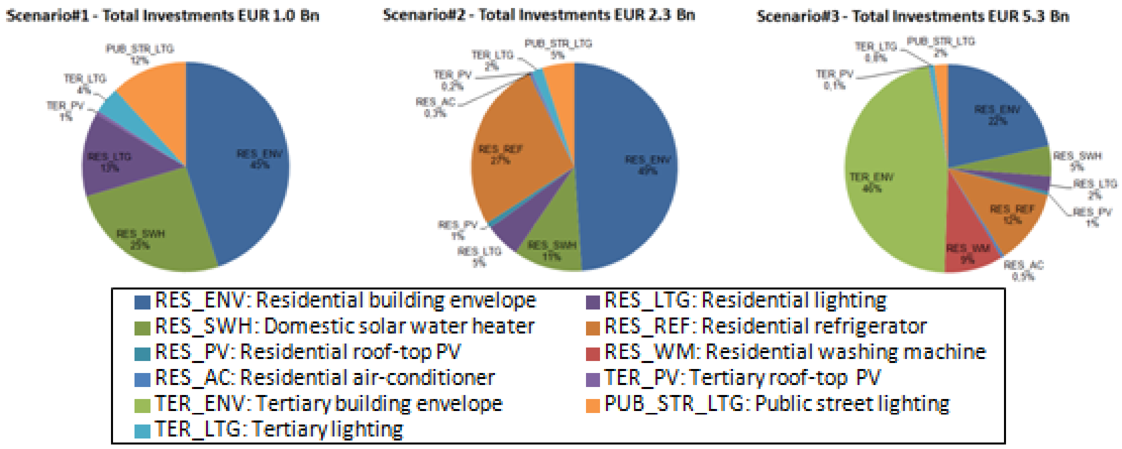


Figure 30: Breakdown of investment costs by technology – Israel

By investing in technologies which were assessed as economically justified (profitable), Israel could achieve 0.9 Mtoe of energy savings by 2020. If all the modelled technologies were deployed, the resulting energy savings would reach 6% of the total final energy consumption by 2020. Comparing this to the current target of 1.2 Mtoe by 2020, Israel could achieve approximately 80% of its energy savings targets by focusing on very few profitable technologies.

Results of scenario development using “cost of energy saved” (CES) representation suggest that efficient lighting (residential, tertiary and street lighting), domestic solar water heaters, building envelope for new built and electric appliances (efficient refrigerators and air-conditioners) are the most cost-effective EE and small-scale RE investments (among the assessed) in Israel (Figure 31).

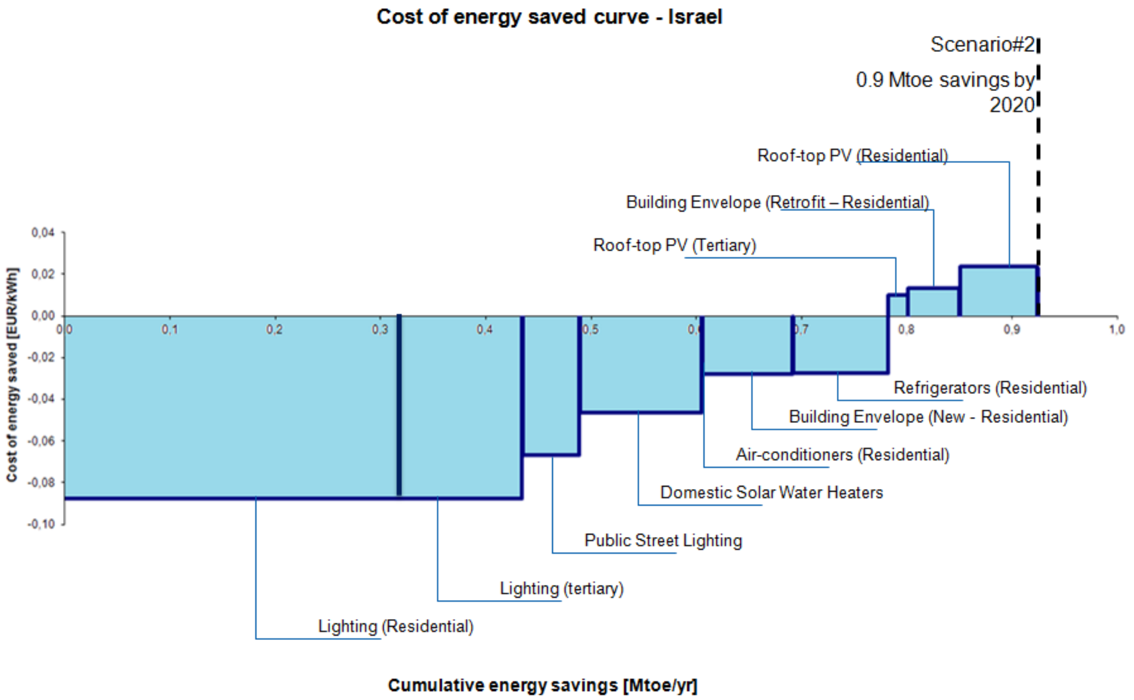


Figure 31: Cost of energy saved (scenario#2) – Israel

In order to fully deploy all the assessed EE and small-scale RE investments (scenario#3), subsidies are needed to ensure sufficient profitability for all projects (as explained in Section 1.5.2). These subsidies were estimated to a total of EUR 1.4 billion, in net present value, and for all the assessed projects to be implemented in Israel by 2020. This would represent a significant addition to the total investment costs required (i.e. EUR 5.3 billion) in scenario#3. Building envelope projects would require the majority of these estimated subsidies.

2.3.4 BARRIERS TO EE AND SMALL-SCALE RE PROJECTS AND MITIGATION MEASURES

The EE and small-scale RE sector in Israel suffers from a lack of a dedicated institution that can promote and coordinate the activities related to EE and small-scale RE (MNI, 2010). This results in lack of enforcement of the current regulations and standards. Moreover, the financial infrastructure that would support EE and small-scale RE investments is absent. To face these barriers, Israel has developed standards for refrigerators, air-conditioners and solar water heaters. Moreover, the national energy efficiency program has proposed the establishment of a national energy efficiency fund to provide incentives and financial support.

2.4 JORDAN

2.4.1 OUTLOOK ON EE AND SMALL-SCALE RE SECTOR IN JORDAN

2.4.1.1 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

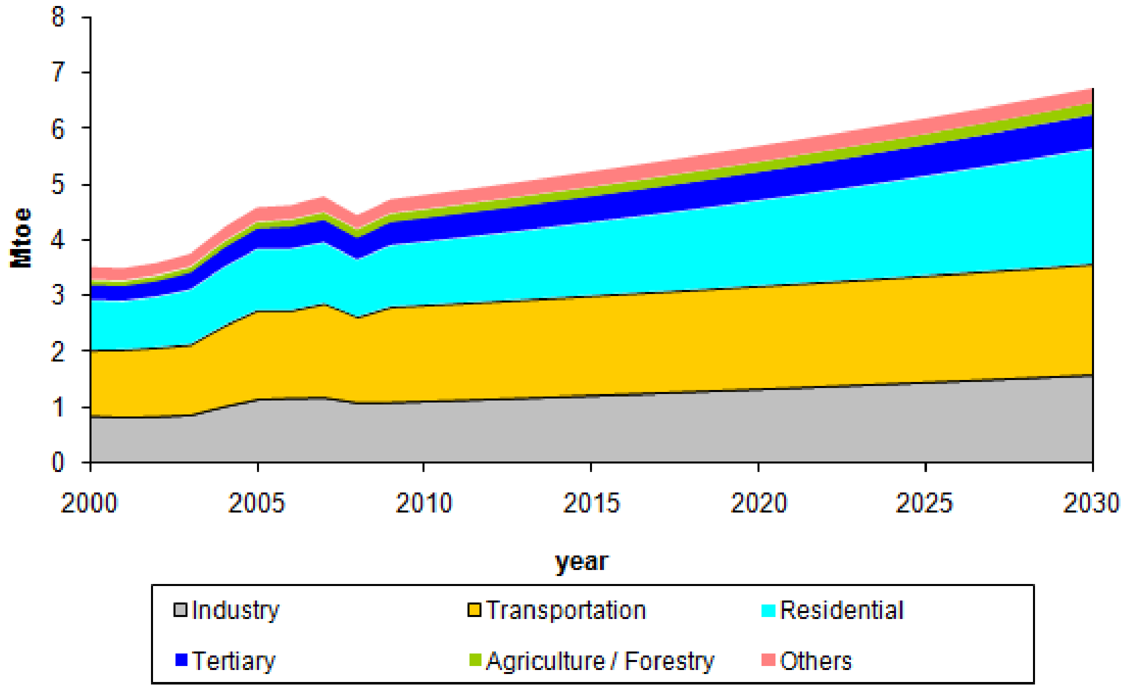


Figure 32: Total final energy consumption in Jordan (2000-2030)

The energy sector in Jordan is facing critical challenges due to increasing demand growth and increased reliance on energy imports. Jordan lacks conventional sources of energy and imports almost all of its fuel needs (MEMR, 2010). Transportation is the largest energy consuming sector (approximately 36% of the total final energy consumption) whereas the residential sector would be expected to witness the largest growth over 2011-2030 (Figure 32).

Jordan has a total population of 6.5 million with 78% living in urban areas (United Nations, 2010). The total existing residential building stock is 1.3 million dwellings. A total of 1.1 million dwellings and one additional agglomeration (size of 0.5-1 million inhabitants) would be expected in Jordan by 2030 (Plan Bleu, 2011; United Nations, 2010).

2.4.1.2 STAKEHOLDERS DEALING WITH EE AND SMALL-SCALE RE

The Ministry of Energy and Mineral Resources (MEMR) is the main responsible body for energy efficiency policy in Jordan. Other Ministries may involve in policy issues related to energy efficiency such as the Ministry of Public Works, Ministry of Environment, Ministry of Transport, Ministry of Trade and Industry, Ministry of Planning and International Cooperation and Chambers of Industry.

The National Energy Research Centre (NERC) was established in 1998 for the purposes of research, development and training in the fields of energy efficiency and renewable energy (Energy Charter, 2010).

Private sector

The majority of companies active in the EE and small-scale RE sector in Jordan are providing services related to energy auditing and energy management especially in the tertiary and industrial sectors. The number as well as the size of these companies currently meets the existing energy efficiency market needs. However, with the demand growth, the ability of these companies to meet the expanding market needs may be challenged (USAID, 2010). Medium-to-large scale energy efficiency projects are not currently properly served in Jordan.

2.4.1.3 POLICY, REGULATORY AND FINANCIAL FRAMEWORKS

Policy framework

MEMR, in cooperation with NERC, has developed an energy efficiency strategy (April 2004) to define energy savings targets and goals (Shahin, 2010). The strategy targets reducing energy consumption without negatively impacting living standards in Jordan. It also identifies several policies related to energy subsidies, taxations and custom duties to achieve the target goals.

Regulatory framework

A draft energy efficiency law was prepared in 2002 with the participation of NERC and was submitted to MEMR. The concepts of the law were partially included into Jordan's national energy efficiency strategy in 2004. A new Renewable Energy and Energy Efficiency Law was approved by the cabinet in 2010 (and adopted by the Parliament in April 2012). The new regulation sets the legal framework to develop procedures and measures for the promotion of EE and small-scale RE investments in the different sectors (Energy Charter, 2010).

Since March 2008, most energy products have been priced close to their cost of service level as a result of new legislations to reduce energy subsidies. Other legislations have been implemented to eliminate or reduce custom duties and sales tax on materials and equipment that contribute to energy savings including thermal insulation materials.

Financial framework

The government of Jordan has established the Renewable Energy and Energy Efficiency Fund (JREEF) to provide the necessary investment needs for the development of renewable energy and energy efficiency projects (Shahin, 2010).

The Fund is designed with five main components, referred to as "windows". Each window provides support to one or more of the various development stages of EE and RE activities. The fund supports technical assistance studies, interest rate subsidies and guarantee facilities to facilitate the deployment of EE and small-scale RE measures.

As per the master strategy of energy sector (2007-2020), the total required investments to improve energy efficiency in Jordan by 2020 has been estimated at USD 80-150 million.

2.4.2 NATIONAL TARGETS AND IDENTIFIED PROJECTS PIPELINE

The national energy strategy (2007-2020) aims to achieve ambitious energy savings targets and increase the contribution of renewable energy sources within the national energy supply (Energy

Charter, 2010). It indicates that EE and small-scale RE projects are to be implemented within the various energy consuming sectors in order to achieve a reduction[38] of 20% of Jordan's energy consumption by 2020 (MEMR, 2007).

Based on the desk review carried out in 2011, only two EE and small-scale RE projects were identified in Jordan; one of which is an investment project for public street lighting (Table 17).The identified projects do not reflect the energy savings targets by 2020.

Table 17: Identified EE and small-scale RE projects in Jordan

Project Description	Targeted Sector	Technology	Objectives	Period	Sponsors	Investment Costs [MEUR]	Energy Savings [Ktoe/year]	CO2 Avoided [KtCO2/year]
Investment Projects								
Street lighting	Tertiary	PUB_STR_LTG	Ensure modernization and maintenance of street lights in the Greater Amman Municipality	N/A	AFD	0.4	0.16	1.1
Technical Assisstance								
Energy audits programme	Multi-sector (Industry / Commercial & Public Services)	EE - General & Studies	Undertake energy audits for commercial (hotels, resorts, banks, etc.) and industrial enterprises	N/A	World Bank; MEMR; NERC	2.8	N/A	N/A

2.4.3 Modelling results

Results of the profitability assessment carried out suggest that investments in many of the assessed EE and small-scale RE technologies are financially justified in Jordan, mainly due to the high energy prices. Profitable investments include efficient lighting (residential, tertiary and street lighting), solar water heaters, roof-top PV (towards the end of the decade) and efficient envelope for new buildings. Most of these projects offer relatively low payback periods which could be attractive for end-users and small business firms. Efficient building envelope investments for new buildings would represent an attractive segment considering that approximately 46% of the building stock by 2030 would be new construction.

Examining the project mix in Jordan, efficient lighting, building envelope and roof-top PV projects would result in the majority of energy savings in the three scenarios (Figure 33).

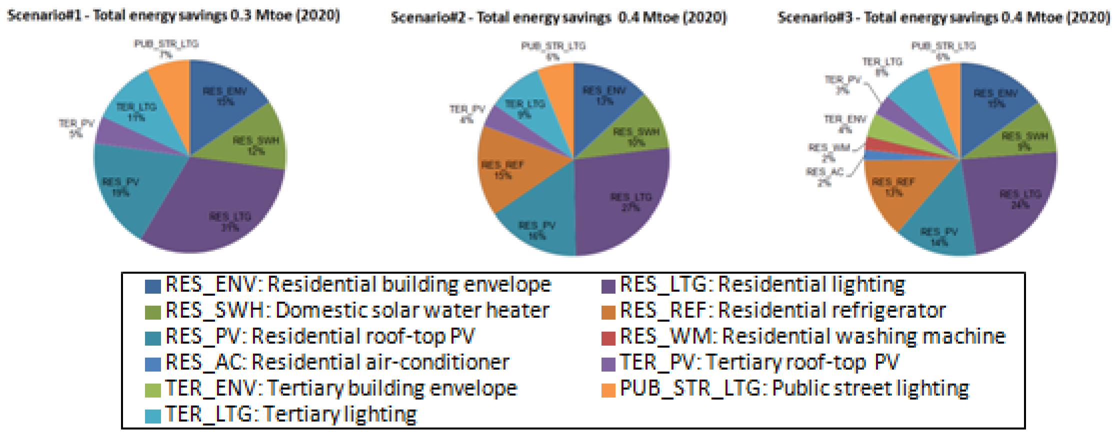


Figure 33: Breakdown of energy savings by technology – Jordan

[38] A draft NEEAP has been prepared and is currently awaiting the approval by the government.

Figure 34 shows that the majority of investment costs would be associated with building envelope projects (up to 74% of total investment costs under the full deployment scenario).

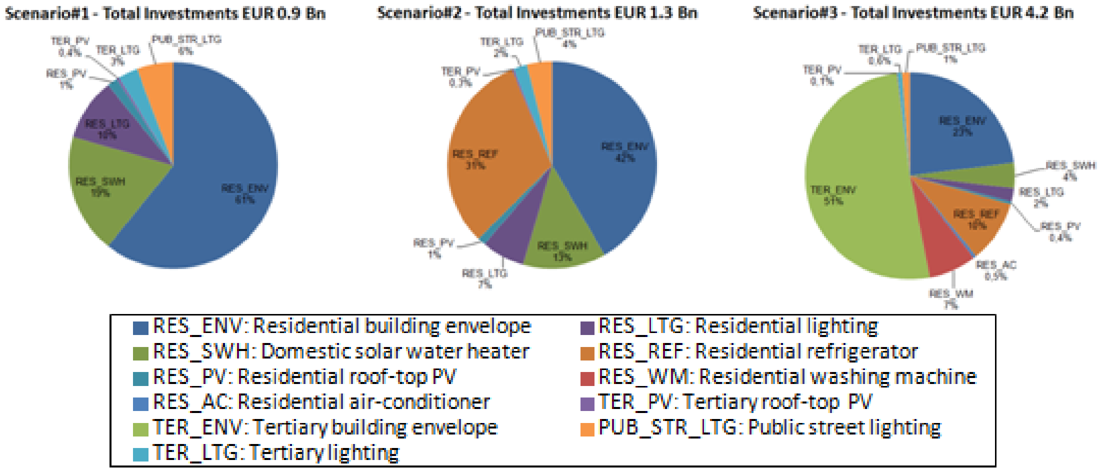


Figure 34: Breakdown of investment costs by technology – Jordan

By investing in technologies which were assessed as economically justified (profitable), Jordan could achieve 0.4 Mtoe of energy savings by 2020. If all the modelled technologies were deployed, the resulting energy savings would reach 7% of the total final energy consumption by 2020. Thus the 20% energy savings target would be achievable if EE and small-scale RE projects were developed in other sectors (e.g. agriculture as water pumping constitutes large share of electricity consumption in Jordan).

Results of scenario development using "cost of energy saved" (CES) representation suggest that efficient lighting (residential, tertiary and streetlighting), domestic solar water heaters, building enevelope for new construction and efficient refrigerators are the most cost-effective EE and small-scale RE investments (among the assessed) in Jordan (Figure 35).

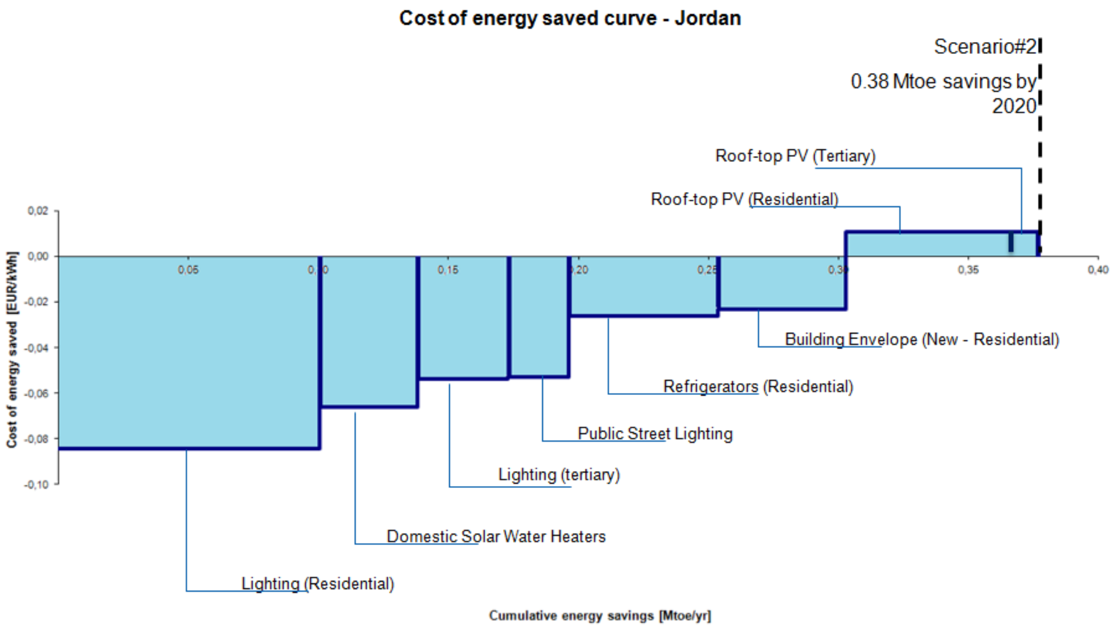


Figure 35: Cost of energy saved (scenario#2) – Jordan

In order to fully deploy all the assessed EE and small-scale RE investments (scenario#3), subsidies are needed to ensure sufficient profitability for all projects (as explained in Section 1.5.2). These subsidies were estimated to a total of EUR 1.4 billion, in net present value, and for all the assessed projects to be implemented in Jordan by 2020. Tertiary building envelope projects would require the majority of these estimated subsidies.

2.4.4 BARRIERS TO EE AND SMALL-SCALE RE PROJECTS AND MITIGATION MEASURES

A few barriers to EE and small-scale RE investments in Jordan were identified. The first barrier is that no directive to implement the renewable energy and energy efficiency law has yet been issued. High capital investment costs required for some EE and small-scale RE technologies are another barrier (Wuppertal Institute and MVV Decon, 2010b).

The Jordanian government recently adopted several measures in order to promote EE and small-scale RE programmes in different sectors and to establish a sustainable market for EE and small-scale RE technologies. First it undertook an economy reform through reducing energy subsidies for gasoline, diesel, fuel oil and kerosene in 2005 (Energy Charter, 2010). Second, importers and manufacturers of energy consuming appliances are now obliged to fix energy efficiency label indicating the annual consumption of the equipment.

2.5 LEBANON

2.5.1 OUTLOOK ON EE AND SMALL-SCALE RE SECTOR IN LEBANON

2.5.1.1 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

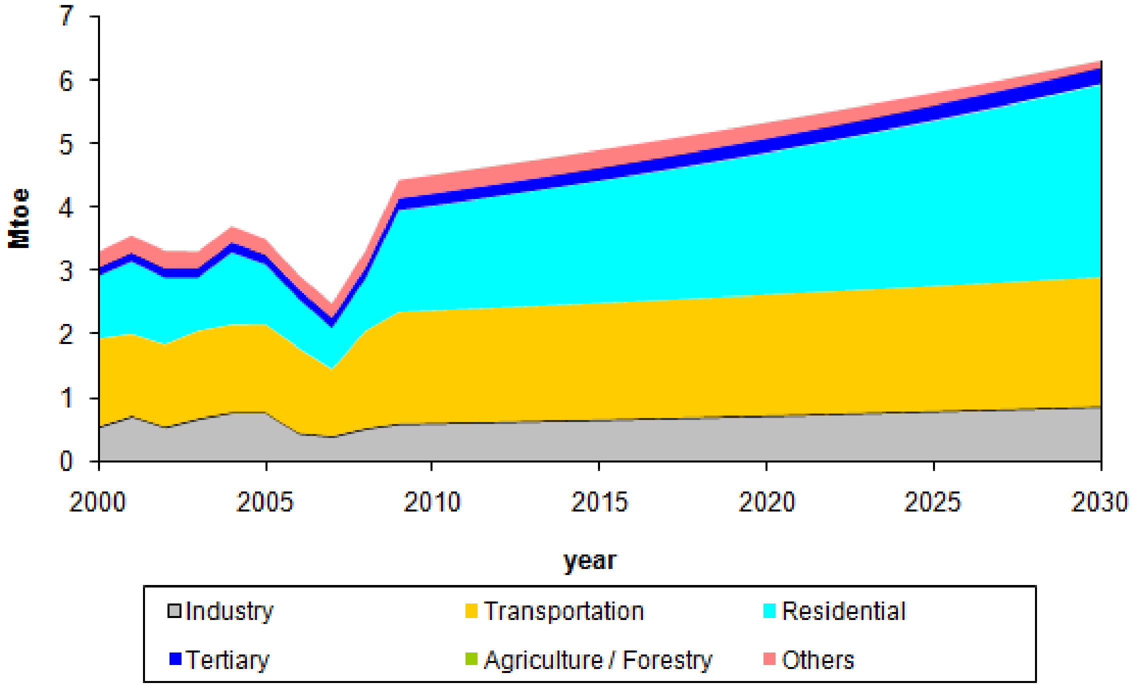


Figure 36: Total final energy consumption in Lebanon (2000-2030)

Lebanon imports more than 95% of its consumed energy which is mainly dominated by fossil fuels (Wuppertal Institute and MVV Decon, 2010c). Both the transport and residential sectors constitute the largest energy consuming sectors in Lebanon (Figure 36). The sudden decrease in the total final energy consumption in 2006-2007 was due to the 2006 summer war.

Lebanon has wide-spread power coverage with 99% electrification. By law, Electricité du Liban (EdL) has the monopoly in Lebanon for power generation, transmission and distribution. The demand for power has been annually rising at 4%-6% in the last decade. However, the sector is unable to supply the reliable electricity needed, being at the same time a considerable drain on government finances, with subsidies for electricity generation reaching 4% of the GDP (Ministry of Environment, 2011). This is mainly due to insufficient new and maintenance investments in power generation and transmission by the Government and the state owned EdL since 1996. Several power plants are beyond their economic lifetime, or are still suffering damages from the civil war. Furthermore, high technical and non-technical losses (up to 44%) worsen the power supply situation.

Lebanon has a total population of 4.3 million (2010) with 87% living in urban areas (United Nations, 2010). The total existing residential building stock is 1 million dwellings. A total of 1.4 million dwellings would be expected in Lebanon by 2030 (Plan Bleu, 2011).

2.5.1.2 STAKEHOLDERS DEALING WITH EE AND SMALL-SCALE RE

The Ministry of Energy and Water (MEW) is the responsible ministry for energy matters in Lebanon. The Lebanese Centre for Energy Conservation (LCEC), currently affiliated with the MEW, was established in cooperation with the UNDP to foster EE and small-scale RE activities in Lebanon (Wuppertal Institute and MVV Decon, 2010c).

The LCEC is responsible to support and perform energy audits in various energy consuming sectors (mainly public buildings, service and industrial sectors), develop markets for energy efficient appliances (solar water heaters, compact fluorescent lamps, street lighting, etc.) and develop financial and legislative frameworks for EE and small-scale RE investments.

Private sector

LCEC helped to create and support ESCOs to provide energy services in the Lebanese market throughout the “Cross sectoral energy efficiency and removal of barriers to ESCO operation” project. The outcome of this project was the creation of six qualified energy audit companies and two ESCOs (LCEC, 2010).

Although LCEC has been successful in stimulating interest among private companies in the energy management business, it does not seem to have created a self-sustaining market for ESCO activities (Wuppertal Institute and MVV Decon, 2010c).

2.5.1.3 POLICY, REGULATORY AND FINANCIAL FRAMEWORKS

Policy framework

An energy efficiency policy paper is currently under preparation in Lebanon (Wuppertal Institute and MVV Decon, 2010c). In June 2010, the MEW launched the policy paper for the electricity sector. The policy paper was approved by the Council of Ministers as the national plan to upgrade the electricity sector in the country. It includes 10 strategic initiatives, 2 of which are dedicated to energy efficiency (El-Hnoud, 2010). The policy aims to develop several demand side management and energy efficiency initiatives (e.g., CFLs, solar water heaters, etc.). Moreover, the policy calls for the adoption of standards and labelling systems and a restructuring of the electricity tariff to decrease the existing heavy subsidies (Bassil, 2010).

Based on this policy paper, LCEC has recently started to develop the National Energy Efficiency Action Plan (NEEAP) by 2015 which includes 15 initiatives, 11 of which are related to energy efficiency. The NEEAP was adopted by the Lebanese Government in November 2011. It calls for the adoption of the energy conservation law and the institutionalisation of the LCEC as a national agency.

Regulatory framework

At present, there is no energy efficiency law in Lebanon (Wuppertal Institute and MVV Decon, 2010c). LCEC has prepared a draft law on energy conservation. However, the law needs to be approved by the Council of Ministers before submitting it to the Parliament. The law would institutionalise LCEC as a national agency and specify its functions and duties. It would also define thresholds for mandatory audits and set out procedures for the promotion of EE and small-scale RE technologies (Shehadeh, 2010).

Financial framework

The Central Bank of Lebanon (CBL) has developed with the support of the LCEC, an energy efficiency and renewable energy fund called the National Energy Efficiency and Renewable Energy Account (NEEREA). It is a national programme aimed at stimulating EE & RE investments through various measures which lower the cost of funding or bank's risk perception vis-à-vis this type of projects. NEEREA consists of four components:

- Incentive loans: which are loans with lower interest rates ("cheaper") that are made possible thanks to the exemption of CBL reserve requirements;
- Cash subsidies: which are funded by the EU and administered by the CBL. The EU has allocated EUR 12 million to CBL to subsidise EE and RE loans. The cash subsidy is equal to 5% of the loan amount (up to USD 1 million) if the loan is to a borrower that falls within the subsidised sectors, and 15% of the loan amount if the loan is not subsidised. LCEC will approve the technical study of the project. The grant will be paid after project completion and verification by LCEC;
- The new "Kafalat Energy" guarantee for SMEs with fewer than 40 employees;
- A technical assistance programme funded by the EU, and aimed at both CBL and Kafalat, to assist both institutions in appraising and validating the technical eligibility of projects as well as training of staff from Kafalat, CBL and commercial banks.

In addition, and although not technically a component of NEEREA, loans to 'subsidised' sectors can benefit from an interest rate reduction of 450 bps granted by the Ministry of Finance via CBL.

Moreover, CBL has permitted commercial banks to use a part of reserve funds at zero percent interest rate for environment beneficial purposes. An example of this scheme was the zero interest rate for solar water heaters (Wuppertal Institute and MVV Decon, 2010c).

The policy paper for electricity sector includes a budget of USD 25 million by the Government of Lebanon for investments in demand side energy efficiency (Bassil, 2010). The investments are distributed as USD 15 million for short term activities and USD 10 million for long term activities.

At the date of publication, the EIB in cooperation with the Agence Française du Développement (AFD) is setting-up a facility (i.e. credit line and technical assistance) which will provide long-term funding and technical assistance necessary for the Lebanese EE & RE market. This facility will complement other existing facilities managed by CBL and supporting energy efficiency, renewable energy and environmental protection. The credit line will allow Lebanese commercial banks to provide long-term funding to individual projects in the eligible sectors with the possibility of fixing interest rates that are currently not available in the Lebanese market. The technical assistance will support the project implementation unit of the credit line, financial intermediaries and final beneficiaries in selecting, structuring and monitoring eligible projects in the EE & RE sectors.

2.5.2 NATIONAL TARGETS AND IDENTIFIED PROJECTS PIPELINE

The Lebanese Government has established the target of 5% energy savings for 2020 stated in the NEEAP[39]. More detailed intermediary steps and measures have been established by the Government. Similarly, the policy paper for the electricity sector commits to the adoption of national programmes focused on demand side management in order to save a minimum of 5% of the total demand (Bassil, 2010).

Based on the desk review carried out in 2011, a total of 7 EE and small-scale RE projects were identified (Table 18), out of which one was classified as investment project. This investment project is related to the distribution of 3 million CFLs to replace the existing incandescent lamps in the residential sector. This project has also been accepted as a Clean Development Mechanism (CDM) project.

Table 18: Identified EE and small-scale RE projects in Lebanon

Project Description	Targeted Sector	Technology	Objectives	Period	Sponsors	Investment Costs [MEUR]	Energy Savings [Ktoe/year]	CO2 Avoided [KtCO2/year]
Investment Projects								
Low consumption light bulbs	Residential	RES_LTG	Replace 3 Million incandescent lamps with 3 Million CFL's at a rate of 3 lamps per house (1 million houses)	2010-2011	Lebanese Government; Greek Government; UNDP/CEDRO	11.3	23.5	190.1
Technical Assisstance								
National strategy for efficient and economic public street lighting in Lebanon	Multi-sectors (Residential / Commercial and Public Services)	Efficient Lighting	Design and implement a national strategy to maintain, replace, and install new photo-sensor devices in the different street lighting sectors (municipalities and residential areas)	2010	Lebanese Government; UNDP/CEDRO	19.2	N/A	N/A
Solar water heating systems	Residential	Solar Thermal Heating	Promote and accelerate the market penetration of SWHs in the residential sector through providing subsidies and long-term, interest-free loans (cooperation with Central Bank of Lebanon)	2008-2013	Central Bank of Lebanon; UNDP; Greek Government	17.3	N/A	N/A
Building codes	Residential	Building Energy Performance	Set thermal standards for new and existing buildings and identify the minimum acceptable energy performance in buildings	2010-2015	GEF; ADEME; World Bank; NEEREA; Amideast	0.2	N/A	N/A
Paving the way for energy audit and ESCOs	Multi-sectors	EE - General & Studies	Promote Energy Service Companies (ESCOs) and energy audit activities mainly in the building and industrial sectors.	Since 2005	MEW; Private sector; Banks	7.5	N/A	N/A
Lebanese Center for Energy Conservation (LCEC)	Multi-sectors	EE - General & Studies	Setup of the Lebanese Center for Energy Conservation (LCEC) as the national energy agency for Lebanon	2013	UNDP; EU; Lebanese Government	2.9	N/A	N/A
Awareness and capacity building	Multi-sectors	EE - General & Studies	Raise awareness about the importance of energy efficiency and introduce energy- efficient technologies, and energy audit concepts	Since 2005	MEW; EU	1.1	N/A	N/A

2.5.3 MODELLING RESULTS

Results of the profitability assessment carried out suggest that investments in efficient lighting (residential, tertiary, and street lighting), domestic solar water heating and new-built thermal insulation projects are financially justified in Lebanon. Most of these projects offer relatively low payback periods which could be attractive for end-users and small business firms. Efficient building envelope investments in new buildings appear to represent another profitable market segment considering that approximately 55% of the building stock by 2030 would be new construction.

[39] The NEEAP of Lebanon (2011-2015) was officially approved by the Lebanese government in November 2011 (resolution no. 26) and includes projects in EE and RE approved by the Lebanese government (RCREEE, 2012).

Examining the project mix in Lebanon, efficient lighting and residential building envelope projects would result in the majority of energy savings in the three scenarios (Figure 37).

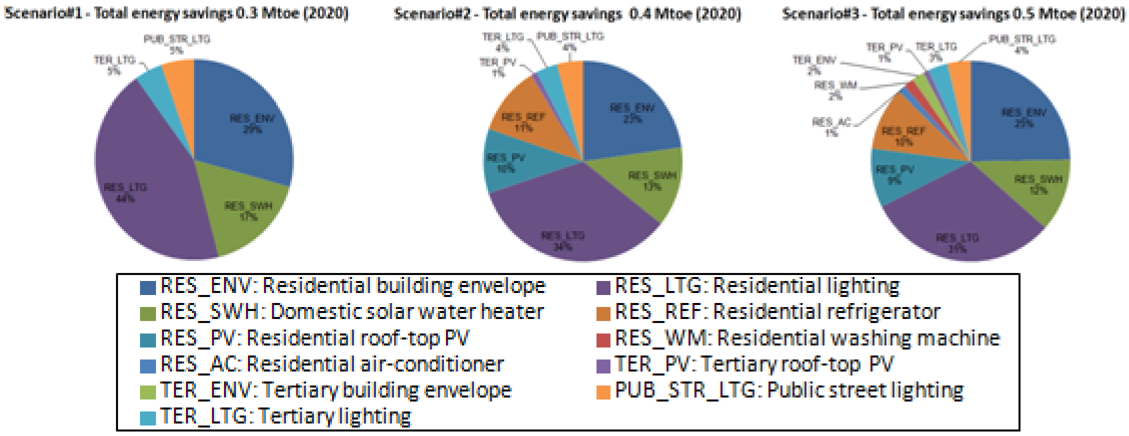


Figure 37: Breakdown of energy savings by technology – Lebanon

Figure 38 shows that the majority of investment costs would be associated with building envelope projects (up to 66% of total investment costs under the full deployment scenario).

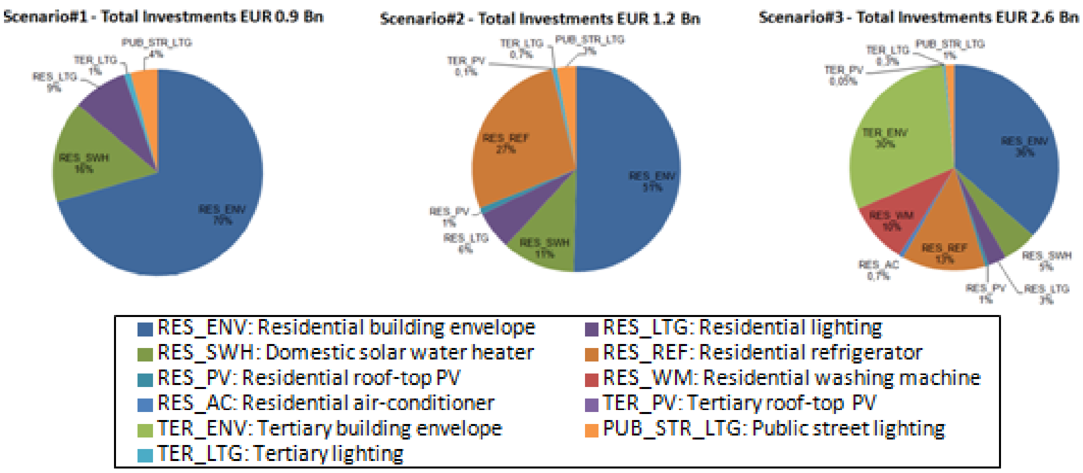


Figure 38: Breakdown of investment costs by technology – Lebanon

By investing in technologies which were assessed as economically justified (profitable), Lebanon could achieve 0.4 Mtoe of energy savings by 2020. If all the assessed technologies were deployed, the resulting energy savings would reach 8.7% of the total final energy consumption by 2020. Thus the 2020 energy savings target (i.e. 5% of final energy consumption) would be achievable with only few profitable modelled technologies.

Results of scenario development using “cost of energy saved” (CES) representation suggest that efficient lighting, domestic solar water heating and building envelope in new built are the most cost-effective EE and small-scale RE investments (among the assessed) in Lebanon(Figure 39).

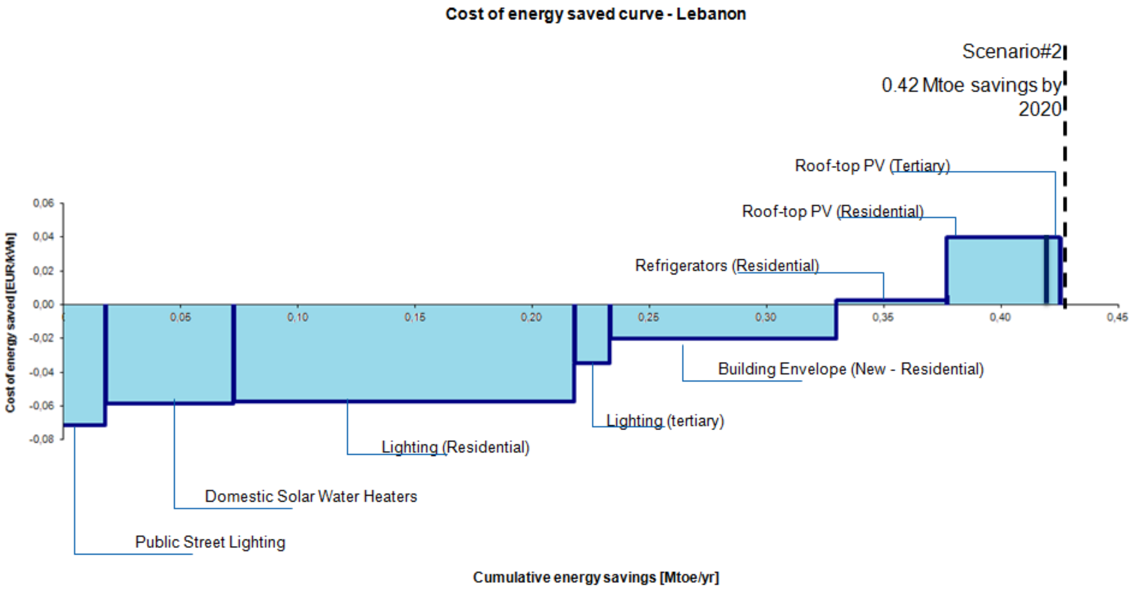


Figure 39: Cost of energy saved (scenario#2) – Lebanon

In order to fully deploy all the assessed EE and small-scale RE investments (scenario#3), subsidies are needed to ensure sufficient profitability for all projects (as explained in Section 1.5.2). These subsidies were estimated to a total of EUR 0.5 billion, in net present value, and for all the assessed projects to be implemented in Lebanon by 2020. Building envelope projects would require the majority of these estimated subsidies (up to 68%).

2.5.4 BARRIERS TO EE AND SMALL-SCALE RE PROJECTS AND MITIGATION MEASURES

Very few barriers to EE and small-scale RE projects specific to Lebanon have been identified. A mentioned barrier was related to reported substantial inefficiencies, poor management and heavy subsidies in the electricity system (El-Fadel et al., 2009). Thus the current status of the electricity sector in Lebanon does not encourage serious demand side management programmes (Wuppertal Institute and MVV Decon, 2010c).

Electricity sector price reform is an essential part of any strategy which intends to provide an enabling environment for EE and small-scale RE investments in Lebanon (Wuppertal Institute and MVV Decon, 2010c). The policy paper for the electricity sector aims to gradually restructure and increase the electricity tariff to decrease the annual subsidies and eliminate the financial deficit in the electricity sector.

Several other measures have been adopted in Lebanon to implement and promote EE and small-scale RE investments in the various end-use sectors. These included standards and labelling programs where the LCEC proposed label prototypes for refrigerators, air conditioners and CFLs based on the Tunisian labelling system. The standards governing the three categories of appliances were accepted by the Lebanese Norm Institute (LIBNOR) and were implemented on a voluntary basis in November 2007 (Wuppertal Institute and MVV Decon, 2010c). The standard for CFLs was adopted by the Council of Ministers as mandatory in September 2010 (El-Hnoud, 2010).

The UNDP/GEF project (2002-2007), “Capacity building for the adoption and application of thermal standards for buildings”, developed thermal standards in order to improve the poor thermal performance of buildings in Lebanon. These standards have, however, not been fully incorporated and have remained voluntary (Wuppertal Institute and MVV Decon, 2010c). Several institutions have played significant roles in the implementation of the thermal building code standards. This includes the Directorate General of Urban Planning which is responsible of the advancement of building laws and municipalities which are responsible of issuing construction permits.

Moreover, the LCEC has launched an energy audit support program resulting in more than 120 energy audits with the majority of them taking place after 2005. About 20% of the performed audits have led to new investments in EE and small-scale RE (Wuppertal Institute and MVV Decon, 2010c).

2.6 MOROCCO

2.6.1 OUTLOOK ON EE AND SMALL-SCALE RE SECTOR IN MOROCCO

2.6.1.1 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

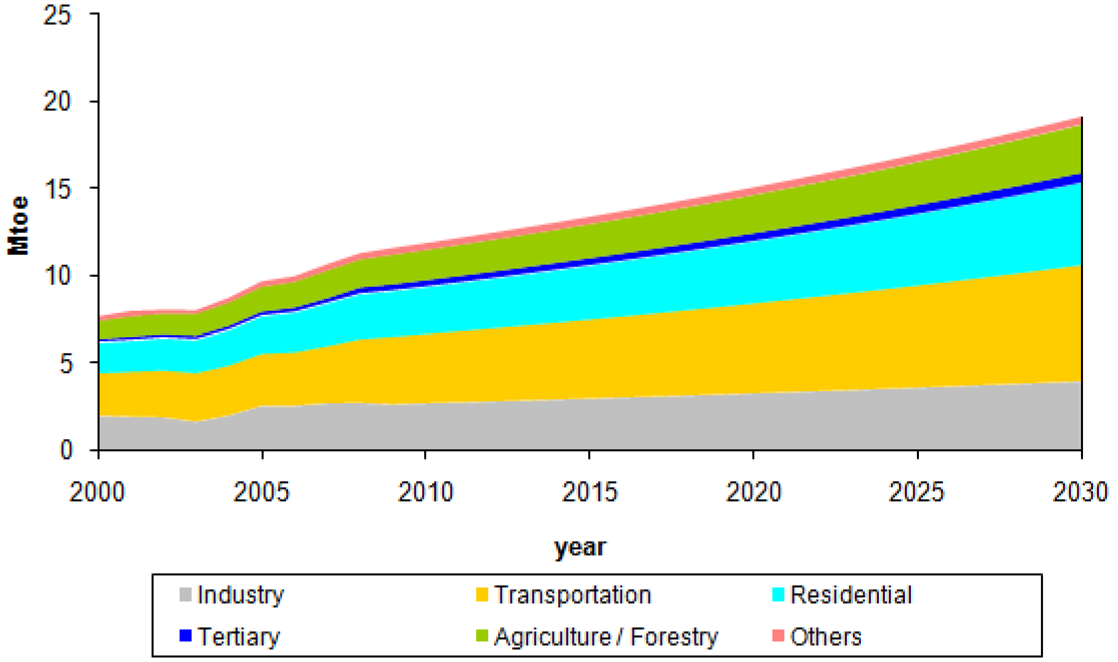


Figure 40: Total final energy consumption in Morocco (2000-2030)

Morocco is a net importer of energy. The country possesses virtually no fossil fuel resources and therefore imports most of its fuel supply. In 2009, it imported about 95% of its primary energy supply to satisfy its total energy consumption (Al-Abdawi, 2010).

Energy demand in Morocco is rising steadily mainly due to economic and demographic growth, industrialisation, and greater prosperity among Moroccans. Transportation is the largest energy consuming sector in Morocco (approximately 33% of the total final energy consumption) whereas the residential sector would be expected to witness the largest growth by 2030 (Figure 40).

Morocco has a total population of 32.4 million with 58% living in urban areas (United Nations, 2010). The total existing residential building stock is 5 million dwellings. A total of 2.8 million dwellings and three additional agglomerations (size of 1-5 million inhabitants) would be expected by 2030 (Plan Bleu, 2011; United Nations, 2010).

2.6.1.2 STAKEHOLDERS DEALING WITH EE AND SMALL-SCALE RE

The Centre for Renewable Energy Development (CDER), created in 1982 and attached to the Ministry of Energy, Mining, Water and Environment (MEMEE), was the public institution responsible to promote the development of renewable energy in Morocco. In January 2010, Morocco has adopted Law 16.09 which stipulates the transformation of CDER into an Agency for Development of Renewable Energy and Energy Efficiency (ADEREE).

Under the new Law, ADEREE is responsible to promote both renewable energy and energy efficiency in Morocco (Wuppertal Institute and MVV Decone, 2010d). This includes the preparation of the national plan, the performing of energy audits, and the development of regulatory and financial frameworks.

Private sector

There has been some experience[40] with energy audits in Morocco in different end-use sectors. These energy audits suggested energy savings potential of 5-20% depending on the sectors. EE measures recommended included the improving efficiency of heat generation, the insulation of heat pipes and devices, the installation of variable speed drivers, the improving of the efficiency of drivers, the improving of the efficiency of lighting systems, and the implementation of energy management systems.

2.6.1.3 POLICY, REGULATORY AND FINANCIAL FRAMEWORKS

Policy framework

The National Plan for Priority Actions (PNAP) established the short-term priorities and measures (2008-2012) as well as the required legal and structural reforms to promote EE and small-scale RE investments. The plan includes 10 measures and 20 actions for demand-side energy efficiency (El-Hafidi, 2010).

Regulatory framework

MEMEE defines and implements the national policies for the energy sector and supervises the activities of ADEREE. The draft law on renewable energy and energy efficiency (law 16.09 approved by the Parliament on January 2010) provides the legal basis for defining and imposing EE and small-scale RE measures such as mandatory energy performance standards for buildings, mandatory energy audits for industries, and mandatory energy impact analysis of all new large projects (MEMEE, 2010).

Financial framework

The Guarantee Fund for Renewable Energy and Energy Efficiency (FOGEER), currently under development, aims to foster sustainable funding structure, set-up incentive schemes and attract local and foreign investments.

The Fund for Energy Development (FDE), a USD 1 billion fund, was established to support the energy sector (Cherkaoui, 2010; Ben Khadra, 2009). The application of the FDE in EE and small-scale RE includes subsidies and studies for technical assistance. Much of the PNAP action plans would be supported from this resource.

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[40] Under the Audits Optima study financed by the FEMIP Trust Fund, the consultant hired by the EIB delivered 8 energy audits for a sample of 8 companies covering the following sectors: food industry, ceramics, university, paper industry, textile industry, and petrochemical industry. The companies expressed the willingness to implement only the most effective of the proposed measures with the simple payback time of up to 4 years and 5% energy savings on the average. The investments were estimated at EUR 5 million with 75% external financing requested.

2.6.2 NATIONAL TARGETS AND IDENTIFIED PROJECTS PIPELINE

The long-term energy strategy of the Moroccan government sets energy efficiency targets to reduce energy use by 12% by 2020 and 15% by 2030. These percentages are related to a reference scenario based on the projected energy demand without energy efficiency measures (Ben Khadra, 2009; Al-Abdawi, 2010).

Based on the desk review carried out in 2011, a total of 4 EE and small-scale RE projects were identified in Morocco (Table 19), out of which 3 were classified as investment projects. These projects cover efficient residential lighting, solar water heating and efficient building envelope projects.

Table 19: Identified EE and small-scale RE projects in Morocco

Project Description	Targeted Sector	Technology	Objectives	Period	Sponsors	Investment Costs [MEUR]	Energy Savings [Ktoe/year]	CO_2 Avoided [KtCO2/year]
Investment Projects								
Low consumption light bulbs	Residential	RES_LTG	Deploy 22.7 million low consumption light bulbs	2008-2012	ADEREE; ONE; Municipalities	83.0	68.2	561.6
PROMASOL (Moroccan Program for Promoting Solar Energy)	Residential	RES_SWH	Install 100,000m² of SWH by 2012	2008-2012	ADEREE; FOGEER; Private sector	30.0	3.1	11.3
Energy efficiency investments in public and private sectos	Tertiary	TER_ENV	Integrate EE standards in the social housing programme, rehabilitation plan for public hospitals, new construction and renovation of existing hotels and university buildings	2009-2013	GEF; Moroccan Government; Italian Government	10.1	82.7	233.3
Technical Assisstance								
Building codes	Multi-Sectors (Residential / Commerce and Public Services)	Building Energy Performance	Develop EE building code and provide technical assistance to improve EE in commercial and hospital buildings	2009-2013	GEF; Moroccan Government; Italian Government	4.3	N/A	N/A

2.6.3 MODELLING RESULTS

Results of the profitability assessment carried out suggest that investments in efficient lighting, solar water heating, roof-top PV (towards the end of the decade) and efficient refrigerators (in the second half of the decade) are financially justified in Morocco.

Examining the project mix in Morocco, efficient lighting, efficient refrigerators and residential roof-top PV projects would result in the majority of energy savings as per the three scenarios (Figure 41).

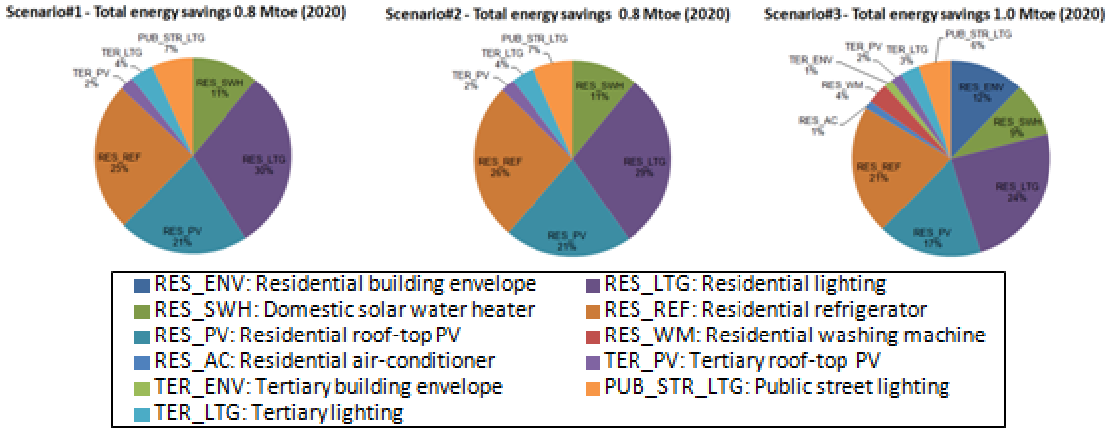

Figure 41: Breakdown of energy savings by technology – Morocco

Figure 42 shows that the majority of investment costs would be associated with building envelope and residential refrigerators.

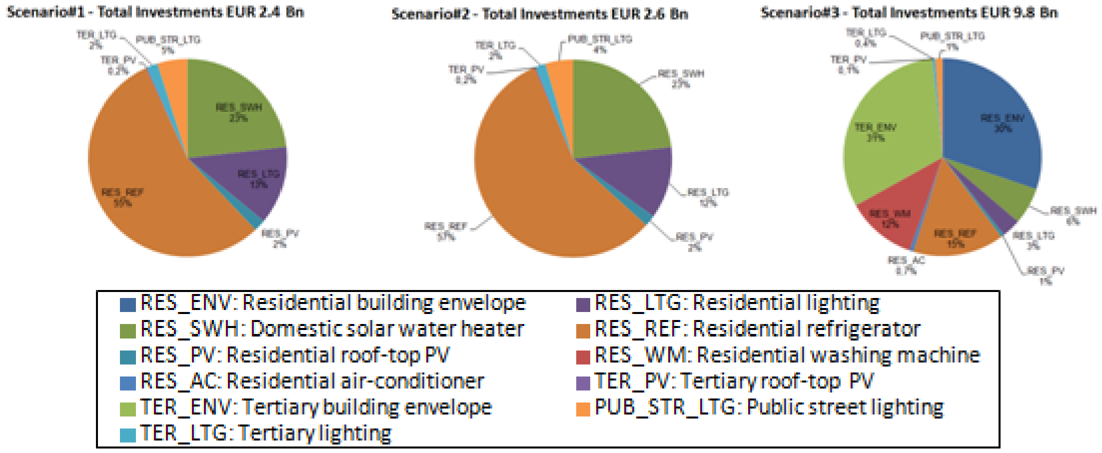

Figure 42: Breakdown of investment costs by technology – Morocco

By investing in technologies which were assessed as economically justified (profitable), Morocco could achieve 0.8 Mtoe of energy savings or 5.4% of the final energy consumption by 2020. If all assessed investments were deployed, the resulting energy savings would reach 6.6% of the total final energy consumption by 2020. Thus more EE and small-scale RE projects should be identified within all energy consuming sectors if the 2020 energy savings targets were to be met.

Results of scenario development using "cost of energy saved" (CES) representation suggest that Residential efficient lighting, domestic solar water heaters and refrigerators are the most cost-effective EE and small-scale RE investments (among the assessed) in Morocco (Figure 43).

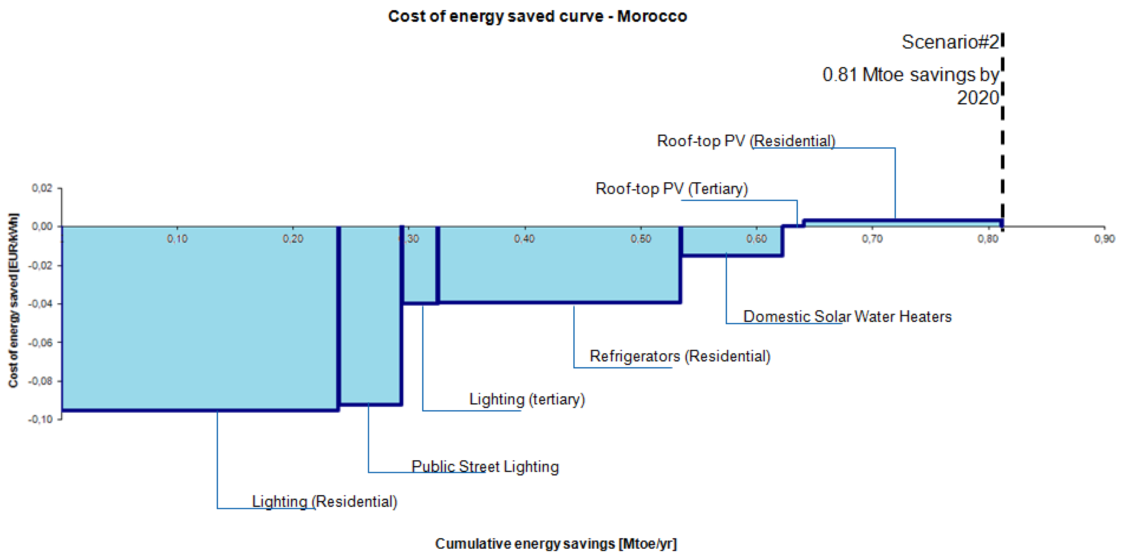

Figure 43: Cost of energy saved (scenario#2) – Morocco

In order to fully deploy all the assessed EE and small-scale RE investments (scenario#3), subsidies are needed to ensure sufficient profitability for all projects (as explained in Section 1.5.2). These subsidies were estimated to a total of EUR 3.3 billion, in net present value, and for all the assessed projects to be implemented in Morocco by 2020. Building envelope projects (mainly building retrofits) would require the majority of these estimated subsidies.

2.6.4 BARRIERS TO EE AND SMALL-SCALE RE PROJECTS AND MITIGATION MEASURES

Several barriers to the implementation of EE and small-scale RE investments were identified for Morocco. These cover the lack of a coordinated regulatory framework, of suitable institutional infrastructure, of defined implementation roadmaps and of adequately qualified experts.

The PNAP has specified 10 measures and 20 actions for EE and small-scale RE in order to tackle some of the identified barriers. These include re-structuring electricity tariff by providing 20% electricity bill reduction for residential customers and local communities whose consumption is 20% less than identified targets, implementing load shifting schemes for high voltage customers, and adopting the daylight saving hour (GMT+1) during the summer months (El-Hafidi, 2010; Ben Khadra, 2009).

2.7 SYRIA

2.7.1 OUTLOOK ON EE AND SMALL-SCALE RE SECTOR IN SYRIA

2.7.1.1 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

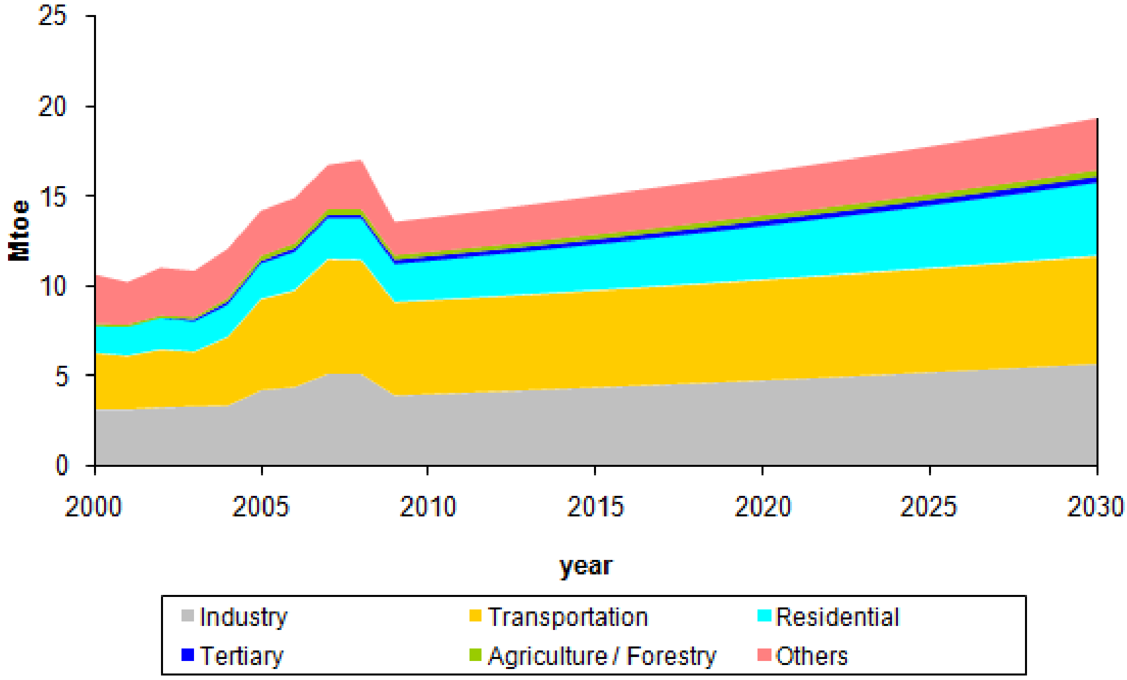

Figure 44: Total final energy consumption in Syria (2000-2030)

Syria has a significant domestic crude oil and natural gas reservoirs (Wuppertal Institute and MVV Decon, 2009b). Transportation and industry are the largest energy consuming sectors in Syria accounting together for approximately 66% of total final energy consumption whereas the residential sector is expected to witness the largest growth by 2030 (Figure 44).

Syria has a total population of 22.5 million with 56% living in urban areas (United Nations, 2010). The total existing residential building stock is 4.4 million dwellings. A total of 3.4 million dwellings and one additional agglomeration (size of 1-5 million inhabitants) would be expected by 2030 (Plan Bleu, 2011; United Nations, 2010).

2.7.1.2 STAKEHOLDERS DEALING WITH EE AND SMALL-SCALE RE

The National Energy Research Centre (NERC), a government owned institution fully financed by the State and chaired by the Minister of Electricity, was created in 2003 (Wuppertal Institute and MVV Decon, 2009b). The main responsibilities of NERC include developing energy efficiency policy and strategies, preparing draft law and regulations, and administering labelling and standards programmes for electric appliances. Moreover, the NERC is responsible to coordinate proposals for financial incentives, tax and customs exemptions, and banking mechanisms.

2.7.1.3 POLICY, REGULATORY AND FINANCIAL FRAMEWORKS

Policy framework

Syria has adopted a central planning system based on a five year plan. (Wuppertal Institute and MVV Decon, 2009b).

The five year plan 2006-2010 included long term procedures for decreasing energy demand through adopting energy efficiency measures, implementing energy price reform and developing standards and labelling systems (Kraidy, 2007).

The next five year plan was expected to run from 2011 till 2015. The government had also started to develop a master plan for energy efficiency and renewable energy which will run until 2030[41] (Kasparek and Dimashki, 2009).

Regulatory framework

The energy conservation Law nb. 3 was issued in February 2009 to promote energy conservation and execute energy efficiency procedures in all sectors (Kassem, 2010). This law is the regulatory basis to adapt EE and small-scale RE technologies and measures in the various sectors.

Law 18 (issued in 2008) deals with energy efficiency for home appliances in the residential and commercial sectors (Adrah, 2010).

The thermal insulation code for buildings was issued by NERC in November 2007. Although this code is in force since January 2009, it is not mandatory (Wuppertal Institute and MVV Decon, 2009b).

Financial framework

Financing EE and small-scale RE investments in Syria is shared between the government, donor assistance and private sector with the government having the largest share (Kraidy, 2007). However, there is a governmental interest to encourage the participation of private investors to attract additional funds for EE and small-scale RE investments.

2.7.2 NATIONAL TARGETS AND IDENTIFIED PROJECTS PIPELINE

The Syrian strategy for EE and small-scale RE in the government's five-year plan (2006-2010) contained no specific energy savings targets but rather a package of various objectives and measures (Kraidy, 2007). An unofficial target to reduce energy consumption by 1.8% by 2011 was indicated by the Supply-Side and Energy Conservation and Planning Project (SSEECP) (Wuppertal Institute and MVV Decon, 2009b).

Based on the desk review carried out in 2011, only one technical assistance project to implement building codes in the residential sector has been identified in Syria (Table 20).

[41] The NERC has also prepared draft NEEAP with a target to decrease energy consumption by 10% by 2020. The plan is still awaiting the approval of the Syrian government (RCREEE, 2012).

Table 20: Identified EE and small-scale RE projects in Syria

Project Description	Targeted Sector	Technology	Objectives	Period	Sponsors	Investment Costs [MEUR]	Energy Savings [Ktoe/year]	CO_2 Avoided [KtCO2/year]
Technical Assistance								
Building codes	Residential	Building Energy Performance	Provide technical assistance to implement new performance-based energy efficiency code and 15 pilot projects throughout Syria	2011-2015	UNDP; GEF	11.5	N/A	N/A

2.7.3 MODELLING RESULTS

Results of the profitability assessment carried out suggest that investments in efficient lighting and solar water heaters (starting 2015) are financially justified in Syria. Most of the assessed investments apart from tertiary building envelope, washing machines and building envelope retrofit would also be economically justified in Syria.

Examining the project mix in Syria, efficient lighting (residential, tertiary and public street lighting), residential refrigerators and residential roof-top PV would result in the majority of energy savings (Figure 45).

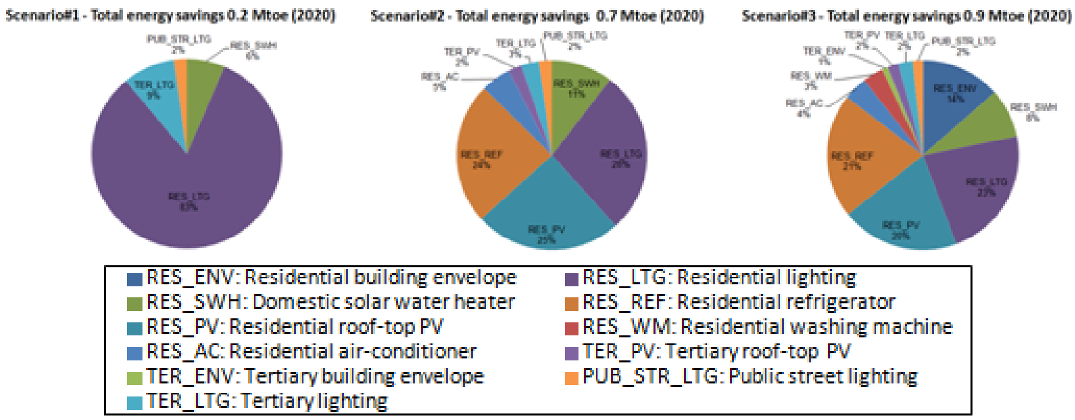

Figure 45: Breakdown of energy savings by technology – Syria

Figure 46 shows that the majority of investment costs would be associated with building envelope, electric appliances and solar water heating projects.

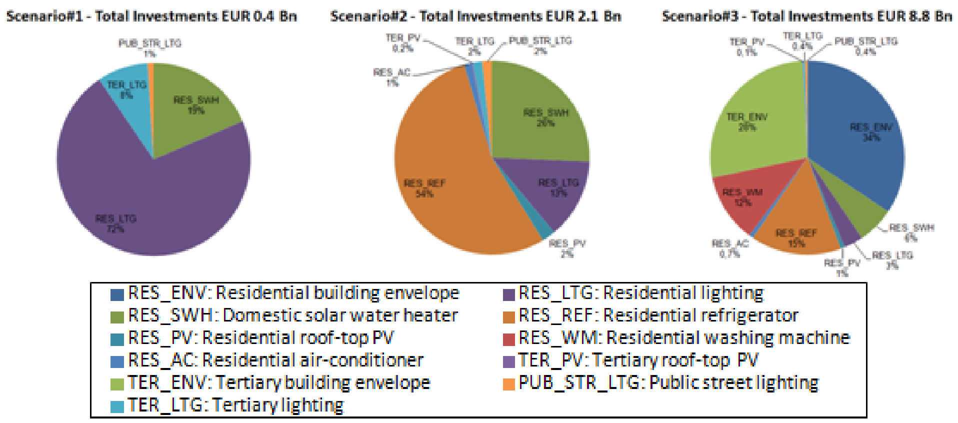

Figure 46: Breakdown of investment costs by technology – Syria

By investing in technologies which were assessed as economically justified (profitable), Syria could achieve 0.7 Mtoe of energy savings or 4.3% of the final energy consumption by 2020. If all assessed investments were deployed, the resulting energy savings would reach 5.4% of the total final consumption by 2020. Comparing this to the current target of 0.2 Mtoe by 2020, Syria could surpass its energy savings targets by focusing on a few economically justified investments.

Results of scenario development using "cost of energy saved" (CES) representation suggest that residential and public street lighting are the most cost-effective EE and small-scale RE investments (among the assessed) in Lebanon (Figure 47). Though not yet cost-effective, residential refrigerators and roof-top PV appear to both present significant potential for cost effective energy savings.

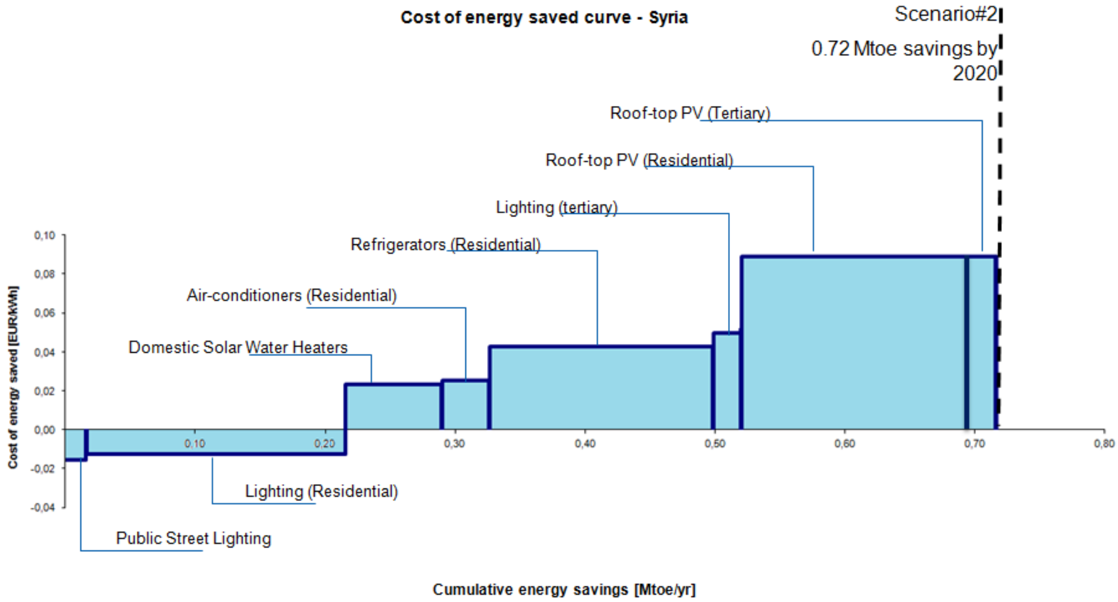

Figure 47: Cost of energy saved (scenario#2) – Syria

In order to fully deploy all the assessed EE and small-scale RE investments (scenario#3), subsidies are needed to ensure sufficient profitability for all projects (as explained in Section 1.5.2). These subsidies were estimated to a total of EUR 2.6 billion, in net present value, and for all the assessed projects to be implemented in Syria by 2020. This would represent a significant addition to the total investment costs required (i.e. EUR 8.8 billion) in scenario#3. Residential and tertiary building envelope projects would require the majority of these estimated subsidies (81%).

2.7.4 Barriers to EE and small-scale RE projects and mitigation measures

Several barriers to the implementation of the assessed EE and small-scale RE investments were identified for Syria. Identified financial and economic barriers are the high energy subsidies, the lack of favourable incentive schemes, and the limited availability of cheap, efficient appliances in the local market (Yahia, 2005). Some regulatory and organisational barriers were also identified, in particular the dominance of the public sector, the inadequate governmental assistance, and more generally the lack of a favourable policy framework (Kasparek and Dimashki, 2009).

To address the identified barriers, the energy conservation law provides a comprehensive set of measures covering mandatory audits, consumption monitoring, incentive schemes and financial investments (Wuppertal Institute and MVV Decon, 2009b).

Standards and labelling programmes were adopted by the Syrian government to improve energy efficiency for home appliances starting with refrigeration systems (2003), cooling systems (2007), washing machines (2010) and lighting sets (2010) (Kraidy, 2007). Testing facilities for solar water heaters and insulation materials were also established (Al-Ali, 2007).

The Syrian government has also adopted several incentive methods such as tax exemption for imported materials used in building insulation, exemptions on imported energy efficient equipment and appliances and grants for researchers and organisations undertaking activities in the EE and small-scale RE sector (Kraidy, 2007).

2.8 TUNISIA

2.8.1 OUTLOOK ON EE AND SMALL-SCALE RE SECTOR IN TUNISIA

2.8.1.1 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

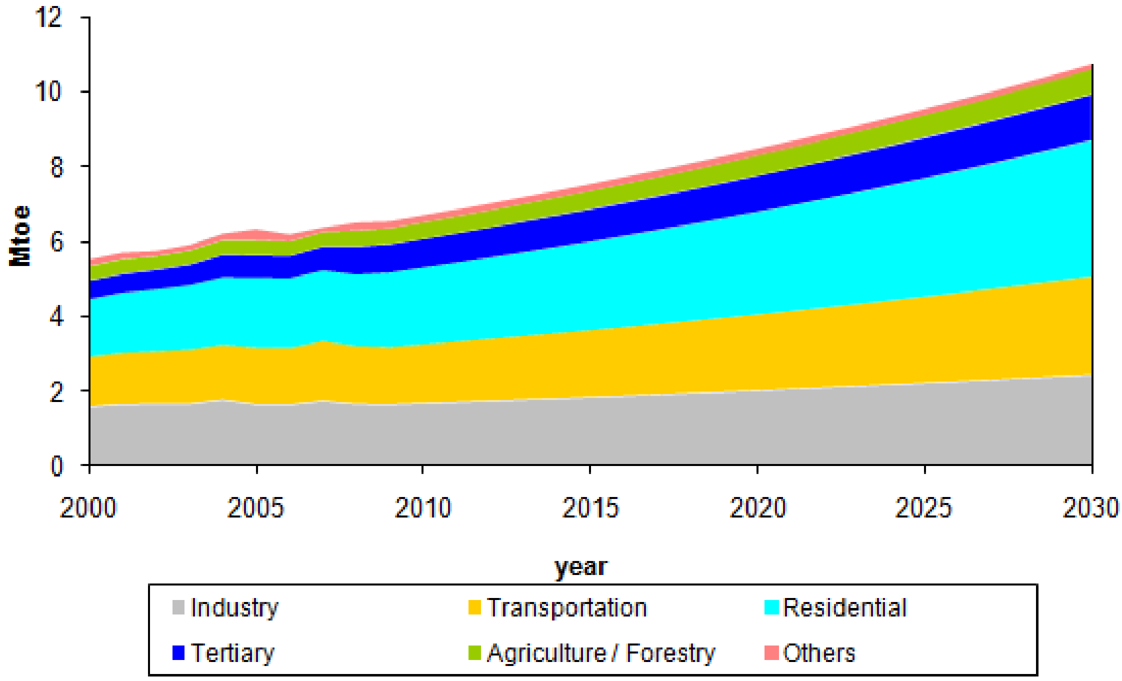

Figure 48: Total final energy consumption in Tunisia (2000-2030)

Tunisia has evolved from being a net exporter of oil and gas in 1980s into a net importer by the late 1990s (Ayadi, 2010). The residential sector is the largest energy consuming sector and accounts for approximately 31% of the total final energy consumption (Figure 48).

Tunisia has a total population of 10.4 million with 67% living in urban areas (United Nations, 2010). The total existing residential building stock is 2.6 million dwellings. A total of 0.6 million dwellings would be expected in Tunisia by 2030 (Plan Bleu, 2011).

2.8.1.2 STAKEHOLDERS DEALING WITH EE AND SMALL-SCALE RE

The institutional framework for the support of renewable energy and energy efficiency in Tunisia is well developed. An Agency for Energy Conservation (AME) was created in 1985. In 2004, the National Agency for Energy Management (ANME) was created as a financially autonomous legal entity (law 2004-72). The line ministry is the Ministry of Industry and Technology (MIT).

ANME plays a key role in both energy efficiency and renewable energy. It implements the action plans, manages the national energy fund and provides technical assistance. Additionally, ANME manages the programme of mandatory audits, proposes financial incentives to EE and small-scale RE, and promotes educational and training programmes.

Private sector

Many companies have developed skills in energy auditing and feasibility studies for investments in EE and small-scale RE. However, there is very little activity in the classic ESCO model whereby the ESCO supplies funds and the profits are shared through an energy performance contract. ESCO development in Tunisia was the main objective of a substantial grant from the World Bank for an activity called the energy efficiency program and industrial sector project (2004-2009). The aim of the project was to overcome institutional and capacity-related barriers and to establish ESCOs as the main vehicle to guarantee a sustainable energy efficiency market.

2.8.1.3 POLICY, REGULATORY AND FINANCIAL FRAMEWORKS

Policy framework

An important stimulus to energy efficiency policy in Tunisia was the transition of the country from energy surplus to net importer by late 1990s. Tunisia had already an agency for energy conservation (since 1985) and a policy in place to manage energy (Figuiri, 2009). The policy measures for both energy efficiency and renewable energy have been conceived against a long-term strategy document extending up to 2020 and 2030. Within this strategy (Ayadi, 2010; Bahri, 2010), the Tunisian government has set four action plans (Table 21).

Table 21: Energy efficiency programmes in Tunisia

Action Plan	Period	Objective
Triennial	2005-2008	Achieve energy savings of 700 ktoe in 2007 (8% of annual national consumption)
Quadrennial	2008-2011	Reduce energy demand by 20% by 2011
Presidential	2009-2014	Improve energy intensity indicator
Tunisian Solar Plan (TSP)	2010-2016	Implement 40 projects with the objective to reduce primary energy demand by 24% by 2016

Regulatory framework

The EE and small-scale RE sector in Tunisia is regulated by a series of laws and decrees. The law 2004-72 (August 2004) and its later modification, law 2009-7 (February 2009) has established energy efficiency as a national priority (Ayadi, 2010; Amaimia, 2010). These laws define priorities and reinforce the position of ANME by placing special emphasis on mandatory periodical audits, labelling and standards, building codes and the promotion of ESCOs.

Financial framework

Financial incentives for EE and small-scale RE have been in place since 1994 but the present structure and scope of incentives were defined in 2005 and 2009. Financial incentives include grants for energy audits, preliminary consultancy, and demonstration projects as well as grants for the substitution of natural gas in industry and tertiary sectors (Amaimia, 2010).

In December 2005, the national government set up a National Fund for Energy Conservation (FNME) for financing EE and small-scale RE measures. FNME can subsidise 20% of energy efficiency investments undertaken by corporations, 50% of energy audit costs, 20% of solar energy investments and 50% of investments in demonstration initiatives (Amaimia, 2010).

2.8.2 NATIONAL TARGETS AND IDENTIFIED PROJECTS PIPELINE

The Government of Tunisia has initiated a policy to improve energy efficiency and reduce energy intensity of the Tunisian economy by 3% per year in order to ensure significant energy savings by 2016. Currently, the Tunisian Solar Plan aims to achieve 24% reduction in the primary energy demand by 2016 (Ayadi, 2010; Amaimia, 2010).

Based on the desk review carried out in 2011, a total of 14 EE and small-scale RE investment projects were identified in Tunisia (Table 22), mainly as part of the Tunisian Solar Plan. The majority of the identified projects included solar thermal space and water heating (29%), efficient building envelope (26%), PV systems (21%) and household electric appliances (20%). Efficient building envelope projects in the residential sector are expected to yield the largest share of energy savings (28%).

Table 22: Identified EE and small-scale RE projects in Tunisia

Project Description	Targeted Sector	Technology	Objectives	Period	Sponsors	Investment Costs [MEUR]	Energy Savings [Ktoe/year]	CO_2 Avoided [KtCO2/year]
Investment Projects								
Thermal insulation	Residential	RES_ENV	Install 11 million sqm of roof thermal insulation	2011-2016	ANME	110.0	50.0	117.5
PROSOL	Residential	RES_SWH	Develp SWH market to reach a total installation of 1 million sqm by 2014	2010-2014	ANME	80.0	20.3	53.0
PROSOL	Industry	Solar Thermal Heating	Promote collective solar thermal systems through the installation of 60,000sqm solar	2010-2014	ANME	25.0	N/A	11.0
PROSOL	Residential	RES_SWH	Promote the use of SWH in residential communities through the installation of 10,000sqm solar collectors for 200 buildings	2010-2014	ANME	4.3	0.7	1.8
Solar heating for indoor municipal	Tertiary	Solar Thermal Heating	Install 5700sqm of solar collectors for heating swimming pools	2010-2014	ANME	2.4	2.5	6.8
Solar refrigeration in food industry	Industry	Efficient Heating and Cooling	Develop concepts for producing cold energy through solar thermal (10 pilot projects)	2009-2014	ANME	9.0	0.2	N/A
Low consumption light bulbs	Residential	RES_LTG	Distribute 5 million energy efficient lamps	2009-2011	ANME	8.0	70.0	164.4
Energy efficient refrigerators	Residential	RES_REF	Replace 400,000 old refrigerators (over 10 years) by energy efficient refrigerators (Class 1	2009-2016	ANME	85	24	56.4
Energy efficient buildings	Tertiary	TER_ENV	Construct 15,000sqm of energy efficient buildings (public areas)	2010-2016	ANME	0.30	0.00	0.01
PV public lighting	Tertiary	PV Systems	Achieve 500KW of PV installations for public	2010-2015	ANME	5.5	0.2	N/A
PV - service stations	Tertiary	PV Systems	Equip 200 service stations with PV systems	2010-2014	ANME	2.5	0.2	N/A
Decentralized PV systems	Residential	PV Systems	Provide 6000 PV systems for 600 residential buildings and public houses (total installed power = 15MW)	2010-2011	ANME; STEG	75.0	5.6	13.2
Solar pumping for irrigation	Agriculture / Forestry	Solar Pumping	Provide 200 PV solar pumping systems for irrigation	2009-2011	ANME	5.0	0.4	0.9
Monitoring systems for vehicles	Transportation	ICTs	Promote ICTs in the monitoring of fleet vehicles	2009-2014	ANME	8.0	4.0	11.6

2.8.3 MODELLING RESULTS

Results of the profitability assessment carried out suggest that investments in efficient lighting (residential, tertiary and street lighting), domestic solar water heating, efficient refrigerators and roof-top PV (towards the end of the decade) are financially justified in Tunisia. It can therefore appear surprising that a large share of the projects earlier identified in section 2.8.2 correspond to efficient building envelope projects, which do not seem appear yet financially or economically justified.

Examining the project mix in Tunisia, efficient lighting (residential, tertiary and public street lighting), residential refrigerators and roof-top PV would result in the majority of energy savings in the three scenarios (Figure 49).

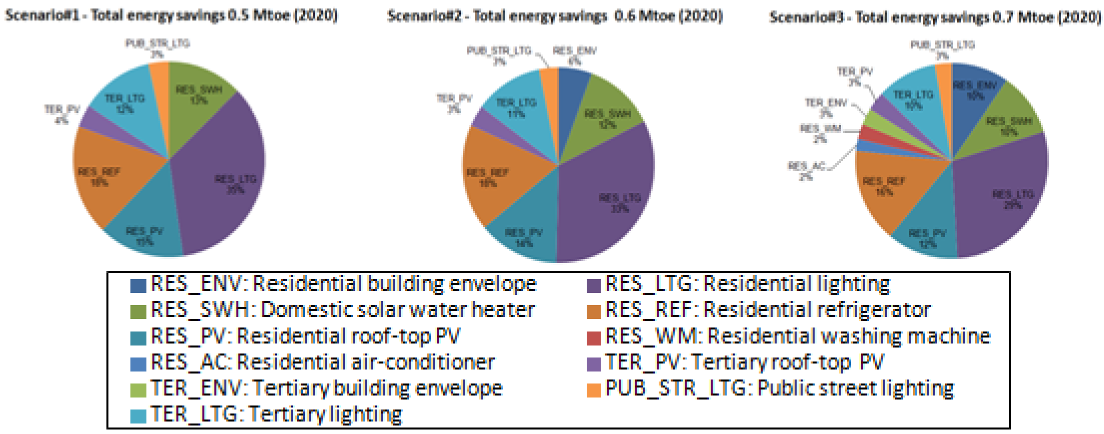

Figure 49: Breakdown of energy savings by technology – Tunisia

Figure 50 shows that the majority of investment costs would be associated with residential refrigerators and building envelope projects (between 21% and 68% depending on the scenario).

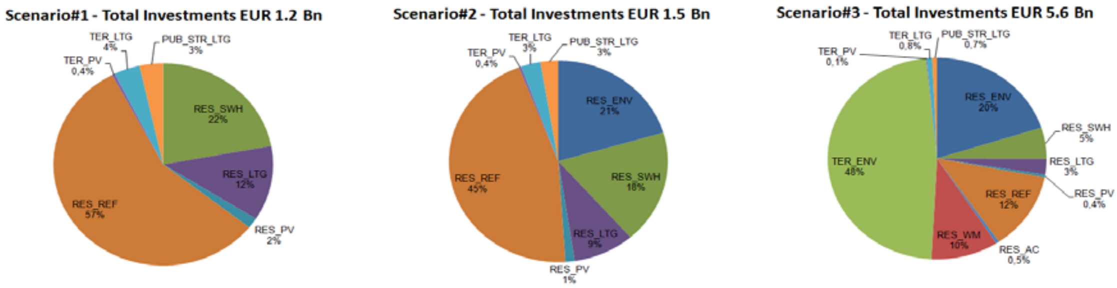

Figure 50: Breakdown of investment costs by technology – Tunisia

By investing in technologies which were assessed as economically justified (profitable), Tunisia could achieve 0.6 Mtoe of energy savings or 6.8% of the final energy consumption by 2020. If all assessed investments were deployed, the resulting energy savings would reach 7.8% of the total final consumption by 2020. Comparing this to the current envisaged 2020 energy savings target, Tunisia would require to identify and develop more EE and small-scale RE projects in all energy consuming sectors if its 2020 savings target were to be met.

Results of scenario development using "cost of energy saved" (CES) representation suggest that efficient lighting, efficient refrigerators and domestic solar water heaters are the most cost-effective EE and small-scale RE investments (among the assessed) in Tunisia (Figure 51).

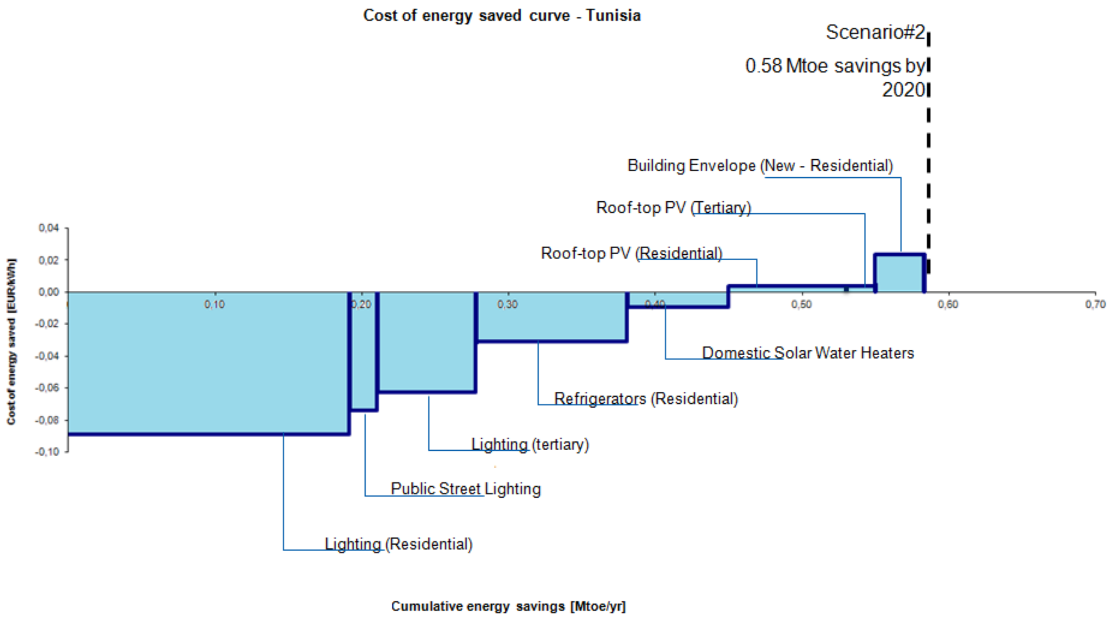

Figure 51: Cost of energy saved (scenario#2) – Tunisia

In order to fully deploy all the assessed EE and small-scale RE investments (scenario#3), subsidies are needed to ensure sufficient profitability for all projects (as explained in Section 1.5.2). These subsidies were estimated to a total of EUR 2.1 billion, in net present value, and for all the assessed projects to be implemented in Tunisia by 2020. This would represent a significant addition to the total investment costs required (i.e. EUR 5.6 billion) in scenario#3. Tertiary building envelope projects would require the majority of these estimated subsidies.

2.8.4 Barriers to EE and small-scale RE projects and mitigation measures

The main barrier to the implementation of EE and small-scale RE investments identified for Tunisia is the high energy subsidies (10% of the total national budget and 3% of the GDP in 2007). These subsidies lead to high energy invoice and negative effects on national economic competitiveness in Tunisia (Wuppertal Institute and MVV Decon, 2010e; Figuiri, 2009).

The Tunisian government has taken several measures to address barriers to EE and small-scale RE sector. It has supported the establishment of energy performance standards for buildings and household appliances (e.g. refrigerators and air-conditioners) (Bahri, 2010). Moreover, the government is now mandating large energy consumers in the transportation, tertiary and residential sectors (more than 500 toe/year) and industrial companies (more than 800 toe/year) to conduct periodic energy audits (every 5 years) (Figuiri, 2009). Financial support for this purpose is provided through the FNME. For the period 2007-2011, the government's objective was to realise 200 energy audits and 300 performance contracts in order to achieve energy savings of 943 ktoe (Bahri, 2010; Abdessalem & Labidi, 2008).

The PROSOL programme was developed to promote solar water heaters. It led to a major recovery of the national solar water heaters market and attracted new industrial operators and networks' installers.

Furthermore, the government aims to set up an energy information system, including the definition of relevant energy and GHG emissions indicators. Capacity building initiatives in the public and private sector have been also conducted to raise awareness on the benefits of EE and small-scale RE.

2.9 WEST BANK/GAZA

2.9.1 OUTLOOK ON EE AND SMALL-SCALE RE SECTOR IN WEST BANK/GAZA

2.9.1.1 ENERGY CONSUMPTION PATTERNS AND URBAN DEVELOPMENT

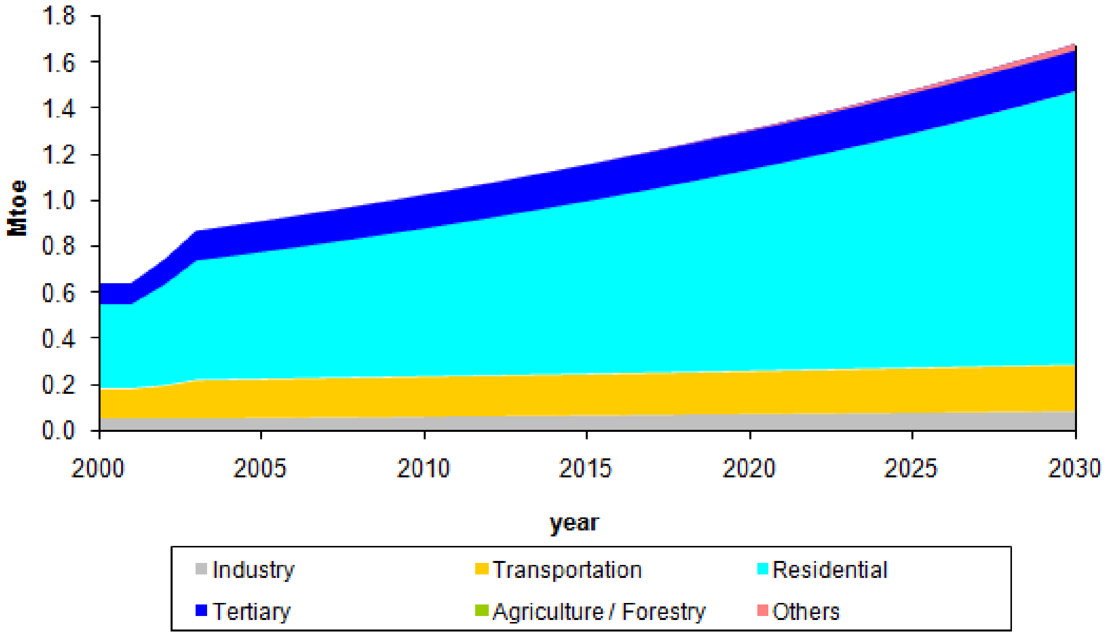

Figure 52: Total final energy consumption in West Bank/Gaza (2000-2030)

West Bank/Gaza is almost entirely dependent on imported energy supplies. The high energy prices and insufficient grid capacity are the main reasons for increased awareness related to energy conservation programmes.

Total energy consumption in West Bank/Gaza is small compared to regional and international standards (World Bank, 2007). Most of the energy is provided by electricity and petroleum products purchased from Israel. The residential sector is the largest energy consuming sector in West Bank/Gaza (more than 60% of the total final energy consumption) and is expected to witness the largest growth by 2030 (Figure 52).

West Bank/Gaza has a total population of 4.4 million with 74% living in urban areas (United Nations, 2010). The total existing residential building stock is 0.5 million dwellings. A total of 0.6 million dwellings would be expected in West Bank/Gaza over 2011-2030 (Plan Bleu, 2011).

2.9.1.2 STAKEHOLDERS DEALING WITH EE AND SMALL-SCALE RE

The Palestine Energy Authority (PEA) is the sole agency responsible for the development and implementation of energy policy. PEA was established in 1995 to address energy challenges in West Bank/Gaza.

There is no public agency dedicated for EE and small-scale RE in West Bank/Gaza. The Palestinian Energy and Environment Research Centre (PEC), a R&D institution which was established under the Ministry of Economy, is responsible of the development of EE and small-scale RE programmes and policies (Wuppertal Institute and MVV Decon, 2009c).

2.9.1.3 POLICY, REGULATORY AND FINANCIAL FRAMEWORKS

Policy framework

The “letter of sector policy”, published by the Palestine National Authority (PNA) and PEA, sets a national strategy for the development of the power sector. PEC was authorised to coordinate policies for energy efficiency and conservation as part of its main role as a policy making body for the energy sector.

The Ministry of Planning, the Ministry of Finance and the PEA work together on the preparation of 3 years plans. A priority item is to finalise the preparation of the National Energy Efficiency Action Plan (NEEAP) to promote energy conservation and rational use of energy[42]. The plan should provide proposals and pilot projects for EE and small-scale RE. Preparation activities for the NEEAP would cover the drafting of the energy efficiency law, the establishment of an EE and RE accreditation department, and the establishment of solar water heaters and electric appliances testing facilities (Amel and Yasin, 2010).

Regulatory framework

At present, there is no specific law for EE and small-scale RE sector. PEC has been charged to develop proposals for a renewable energy and energy efficiency law. Afterwards, the proposal should get the approval of PEA, the Council of Ministers and the Legislative Council before getting the approval of the President of the Palestinian Authority (Wuppertal Institute and MVV Decon, 2009c).

Financial framework

Currently, there are no financial incentives for EE and small-scale RE in West Bank/Gaza (Wuppertal Institute and MVV Decon, 2009c). A revolving fund to provide incentives for industry and some small pilot projects has been under discussion.

2.9.2 NATIONAL TARGETS AND IDENTIFIED PROJECTS PIPELINE

No explicit national energy savings target has been specified. An unofficial target exists to achieve 5% savings in end-use energy consumption by 2020 (Amleh and Yasin, 2010).

Based on the desk review carried out in 2011, only one technical assistance EE and small-scale RE project has been identified in West Bank/Gaza (Table 23).

[42] NEEAP of West Bank/Gaza was approved by the Palestinian Council of Ministers in March 2012 (resolution no. A.P.M.W. /2012/387) and aims at saving electricity at least 5% of the total electricity demand in various sectors by 2020 (RCREEE, 2012).

Table 23: Identified EE and small-scale RE projects in West Bank/Gaza

Project Description	Targeted Sector	Technology	Objectives	Period	Sponsors	Investment Costs [MEUR]	Energy Savings [Ktoe/year]	CO_2 Avoided [KtCO2/year]
Technical Assistance								
Energy efficiency study for municipal development program (MDP)	Commerce and Public Services	EE - General & Studies	Perform energy audits for 4 municipalities from West Bank	2010	World Bank	0.5	N/A	N/A

2.9.3 MODELLING RESULTS

Results of the profitability assessment carried out suggest that investments in efficient lighting (residential, tertiary and street lighting), domestic solar water heating, efficient refrigerators and building integrated PV (towards the end of the decade) are financially justified in West Bank/Gaza by 2020. This could be mainly attributed to the high current energy prices in West Bank/Gaza. Investments in efficient building envelope in new residential buildings are also currently economically justified.

Examining the project mix in West Bank/Gaza, efficient lighting would result in the majority of energy savings in the three scenarios (Figure 53).

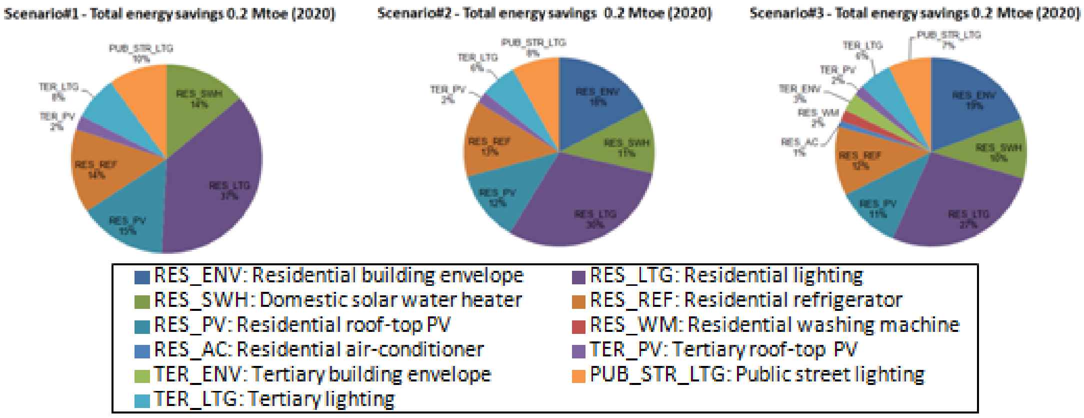

Figure 53: Breakdown of energy savings by technology – West Bank/Gaza

Figure 54 shows that the majority of investment costs would be associated with building envelope and residential refrigerators projects.

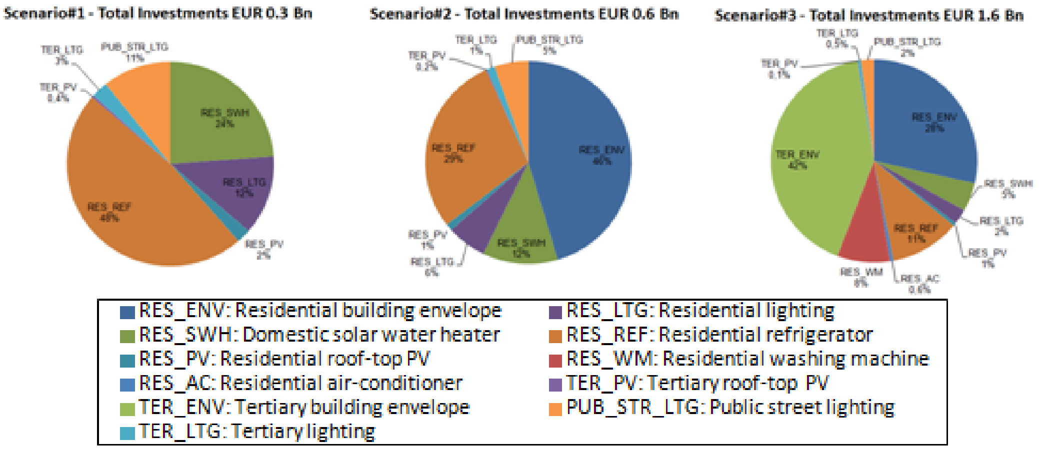

Figure 54: Breakdown of investment costs by technology – West Bank/Gaza

By investing in technologies which were assessed as economically justified (profitable), West Bank/Gaza could achieve 0.2 Mtoe of energy savings by 2020. If all assessed investments were deployed, the resulting energy savings would reach 16% of the total final energy consumption by 2020. Comparing this to the current target of 5% by 2020, West Bank/Gaza could surpass its energy savings target by focusing on a few economically justified investments.

Results of scenario development using "cost of energy saved" (CES) representation suggest that efficient lighting is the most cost-effective EE and small-scale RE investments (among the assessed) in West Bank/Gaza (Figure 55). Domestic solar water heaters, efficient refrigerators and building envelope for new construction are cost-effective as well.

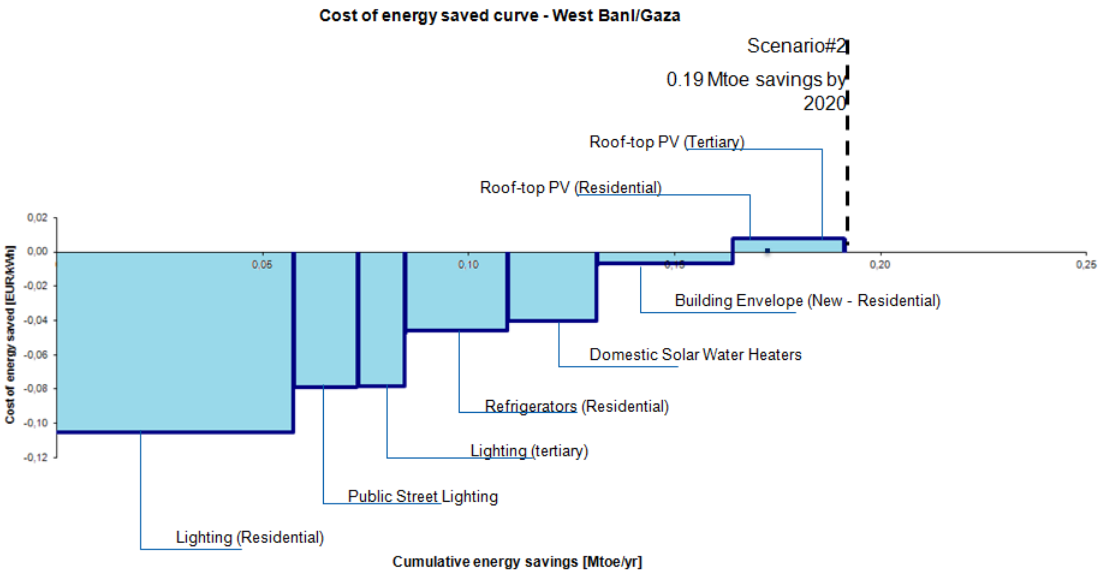

Figure 55: Cost of energy saved (scenario#2) – West Bank/Gaza

In order to fully deploy all the assessed EE and small-scale RE investments (scenario#3), subsidies are needed to ensure sufficient profitability for all projects (as explained in Section 1.5.2). These subsidies were estimated to a total of EUR 0.5 billion, in net present value, and for all the assessed projects to be implemented in West Bank/Gaza by 2020. This would represent a significant addition to the total investment costs required (i.e. EUR 1.6 billion) in scenario#3. Tertiary building envelope projects would require the majority of these estimated subsidies (up to 75%).

2.9.4 BARRIERS TO EE AND SMALL-SCALE RE PROJECTS AND MITIGATION MEASURES

West Bank/Gaza faces significant financial constraints to the implementation of EE and small-scale RE investments. As donor funds are the main source of finance in many sectors, accessing the necessary funds to allow the development of EE and small-scale RE projects is a main barrier. Another significant barrier is the lack of fiscal revenues to provide financial incentives and grants to EE and small-scale RE investments. Like in other countries in the region, such financial incentives are a critical aspect for the feasibility of EE and small-scale RE investments in West Bank/Gaza. The current institutional framework (absence of a dedicated agency) is rather weak and West Bank/Gaza presents low capacity levels to undertake EE and small-scale RE planning and project implementation.

The Energy Efficiency Improvement and Greenhouse Gas Reduction (EIGR) project (1998-2004) developed several measures and instruments to address barriers to EE and small-scale RE (GEF and UNDP, 2008). This included the development of standards and labelling systems for electric appliances and performing energy audits (over 180 energy audits) for large users including hospitals, factories, government offices, universities and commercial premises (Wuppertal Institute and MVV Decon, 2009c). Moreover, the project drafted building code guidelines which were adopted by the Ministry of Local Government in 2004. They are, however, not mandatory.

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APPENDICES

Appendix 1 – MAIN MODELLING ASSUMPTIONS FOR SELECTED EE AND SMALL-SCALE RE TECHNOLOGIES

A- Technology-specific assumptions as defined by the authors (various sources as specified in the table)

Assumption	Description, value and / or source
Efficient Building Envelope (RES_ENV and TER_ENV)	
Energy efficient technology	Use of building thermal insulation and efficient windows (with films and sunscreen)
Conventional alternative	Conventional heating (electric or gas heaters) and cooling (air-conditioners) is used instead of building insulation
Energy consuming sector(s)	Households and buildings in the residential and tertiary sectors
Energy end-use	Space heating and air-conditioning
Lifetime	20 years
Potential energy saving	Heating and cooling energy demand was assumed to be reduced (1) by 30%-50% (compared to current average consumption levels) in existing buildings through building retrofit; and (2) by 90%-95% in new buildings. Assumptions based on data from (XCO_2, 2003)
Material and installation costs (2011 prices) – Energy efficient technology	Thermal insulation cost was estimated at 7.3 EUR/m^2 and energy efficient window with films and sunscreen estimated at 180 EUR/unit. Cost assumptions were based on cost data from Power and Conservation Council (2009)
Material and installation costs (2011 prices) – Conventional alternative	Conventional heating and cooling cost was estimated at 2.7 EUR/m^2 assuming the use of 1 LPG portable heater and 1 split air-conditioner for a 100m^2 dwelling and conventional window cost was estimated at 145.3 EUR/unit. Cost assumptions were based on cost data from Power and Conservation Council (2009)
Domestic Solar Water Heaters (RES_SWH)	
Energy efficient technology	Domestic solar water heater
Conventional alternative	Conventional water heating system (electric or gas)
Energy consuming sector(s)	Households in the residential sector
Energy end-use	Water heating
Lifetime	15 years
Potential energy savings	Water heating energy demand could be reduced by 70%-90% compared to minimum standards (Energy Star, 2007)

Assumption	Description, value and / or source
Material and installation costs (2011 prices) – Energy efficient technology	SWH cost was estimated at 600 EUR/unit assuming average cost of 300 EUR/m^2 and system collector area of 2 m^2 (WEC, 2011)
Material and installation costs (2011 prices) – Conventional alternative	Electric water heater (efficiency = 0.88) cost was estimated at 192 EUR/unit and gas water heater (efficiency = 0.6) cost was estimated at 312 EUR/unit. Cost assumptions were based on cost data from Power and Conservation Council (2009)
Learning rate (investment cost decrease)	An annual cost decrease of 4% was considered based on the assumption that (1) SWH prices fall between 20%-30% each time the quantity of SWH in the market doubles (Du Toit, 2010); and (b) penetration increases from 7% in 2010 till 20% in 2020 (Plan Bleu, 2011)
Efficient Lighting (RES_LTG and TER_LTG)	
Energy efficient technology	Compact fluorescent lamp (CFL)
Conventional alternative	Incandescent lamp
Energy consuming sector(s)	Households and buildings in the residential and tertiary sectors
Energy end-use	Lighting
Lifetime	8 years
Potential energy saving	Electricity consumption was assumed to be reduced by 75% when replacing a 60W incandescent lamp by 15W compact fluorescent lamp
Material and installation costs (2011 prices) – Energy efficient technology	CFL cost was estimated at 3.8 EUR/unit based on data from Power and Conservation Council (2009)
Material and installation costs (2011 prices) – Conventional alternative	Incandescent lamp cost was estimated at 0.4 EUR/unit, based on data from Power and Conservation Council (2009)
Light bulb main technical parameters	The following assumptions were based on data available via Energy Star website (www.energystar.gov): • Incandescent lamp power rating = 60W and lifetime = 1000hrs; • Equivalent CFL power rating = 15W and lifetime = 8000hrs; Annual operation hours = 1825 hrs (5 hrs/day)
Efficient Refrigerator (RES_REF)	
Energy efficient technology	Refrigerator with A++ energy performance classification

Assumption	Description, value and / or source
Conventional alternative	Refrigerator with B energy performance classification
Energy consuming sector(s)	Households in the residential sector
Energy end-use	Electric appliances
Lifetime	10 years
Material and installation costs (2011 prices) – Energy efficient technology	Average cost of A++ refrigerator was estimated at 506 EUR/unit, based on market prices in France, Greece, Spain, Italy, Portugal, Germany, United Kingdom and Netherlands as found in ECORYS (2011)
Material and installation costs (2011 prices) – Conventional alternative	Average cost of a B refrigerator was estimated at 246 EUR/unit, based on market prices in France, Greece, Spain, Italy, Portugal, Germany, United Kingdom and Netherlands as found in ECORYS (2011)
Refrigerator main technical parameters	Annual unit energy consumption was assumed in line with Atalli et al. (2009) (1) at 170 kWh/year for an energy efficient model (A++); and (2) at 425 kWh/year for a conventional model (B type). For old refrigerators, annual energy consumption was estimated at 1063 kWh/year (calculated as *(Consumption of B type)*(Consumption of B type/Consumption of A++)*)
Efficient Washing Machine (RES_WM)	
Energy efficient technology	Washing machine with A+ energy performance classification
Conventional alternative	Washing machine with B energy performance classification
Energy consuming sector(s)	Households in the residential sector
Energy end-use	Electric appliances
Lifetime	10 years
Material and installation costs (2011 prices) – Energy efficient technology	Average cost of A+ washing machine was estimated at 412 EUR/unit, based on market prices in France, Greece, Spain, Italy, Portugal, Germany, United Kingdom and Netherlands as found in ECORYS (2011)
Material and installation costs (2011 prices) – Conventional alternative	Average cost of a B washing machine was estimated at 296 EUR/unit, based on market prices in France, Greece, Spain, Italy, Portugal, Germany, United Kingdom and Netherlands as found in ECORYS (2011)

Assumption	Description, value and / or source
Washing machine main technical parameters	Annual unit energy consumption was assumed in line with Atalli et al. (2009) (1) at 170 kWh/year for an energy efficient model (A+); and (2) at 230 kWh/year for a conventional model (B type). For old washing machines, annual energy consumption was estimated at 311 kWh/year (calculated as *(Consumption of B type)*(Consumption of B type/Consumption of A++)*)
Public Street Lighting (PUB_STR_LTG)	
Energy efficient technology	High pressure sodium (HPS) lamps
Conventional alternative	High pressure mercury vapour lamps
Energy consuming sector(s)	Public sector
Energy end-use	Street lighting
Lifetime	8 years
Material and installation costs (2011 prices) – Energy efficient technology	High pressure sodium lamp cost was estimated at 214 EUR/unit based on Tyler (2004)
Material and installation costs (2011 prices) – Conventional alternative	High pressure mercury vapour lamp cost was estimated at 247 EUR/unit based on Tyler (2004)
Maintenance costs (2011 prices)	Maintenance cost was estimated at 26.8 EUR/unit/year (Tyler, 2004)
Street lighting main technical parameters	The following assumptions were based on data available from (inter alia) Clinton Foundation (2010): • HP mercury vapour lamp power rating 400W and lifetime of 24000hr; • HP mercury vapour typical net efficacy (lamp and fixture) = 10-17 lm/W; • HPS lamp power rating 150W and lifetime of 24000hr; • HPS typical net efficacy (lamp and fixture) = 32-68 lm/W; • Annual operation of 4000hrs

Roof-top Photovoltaic (RES_PV and TER_PV)	
Efficient technology	Roof-top Photovoltaic
Conventional technology	Electricity from national electric grid
Energy consuming sector(s)	Households and buildings in the residential and tertiary sectors
Energy end-use	Electricity generation
Lifetime	20 years

Assumption	Description, value and / or source
Energy produced (saved)	Efficiency of C-Si PV modules was estimated at 14.5% based on James et al. (2011)
Material and installation costs (2011 prices) – Efficient technology	Average unitary cost was estimated at 2 EUR/W_p based on Bazilian et al. (2012)
Material and installation costs (2011 prices) – Conventional technology	N/A
Learning rate (cost reduction) of PV	An annual cost decrease of 5% was considered by the authors. Based on Commission of the European Communities (2009)
Efficient Air-conditioner (RES_AC)	
Efficient technology	Efficient air-conditioner
Conventional technology	Conventional less efficient air-conditioner with lower Energy Efficiency Ratio (EER)
Energy consuming sector(s)	Households in the residential sector
Energy end-use	Electric appliances
Lifetime	10 years
Material and installation costs (2011 prices) – Efficient technology	Efficient air-conditioner cost was estimated at 198 EUR/unit. Cost assumptions were based on cost data from Power and Conservation Council (2009)
Material and installation costs (2011 prices) – Conventional technology	Conventional air-conditioner cost was estimated at 160 EUR/unit. Cost assumptions were based on cost data from Power and Conservation Council (2009)
Air-conditioner main technical parameters	Cooling capacity of air-conditioner = 10000 Btu/hr; EER rating of air-conditioner: • Energy efficient = 10.8; • Conventional = 9.8; • Old = 8.

B- Solar irradiations for building integrated PV (UNEP and ROWA, 2007)

Country	Global Horizontal Irradiance [kWh/m^2/year]	Capacity factor [%]
Algeria	1970	20.5%
Egypt	2450	23.3%
Israel	2320	17.1%

Country	Global Horizontal Irradiance [kWh/m²/year]	Capacity factor [%]
Jordan	2310	19.5%
Lebanon	1920	18.5%
Morocco	2000	18.9%
Syria	2360	17.8%
Tunisia	1980	20.0%
West Bank/Gaza	2320	16.6%

C- Average heating and cooling hours per year (BizzEE, 2011)

Country	Base Temperature [C]		Total degree days per year [days]		Average number of hours per year [hrs]	
	HDD	CDD	Heating - HDD	Cooling - CDD	Heating	Cooling
Algeria	18	25	1090	235	1453	226
Egypt	18	25	334	721	445	692
Israel	18	25	510	413	680	396
Jordan	18	25	1153	368	1537	353
Lebanon	18	25	378	347	504	333
Morocco	18	25	894	176	1192	169
Syria	18	25	1534	552	2045	530
Tunisia	18	25	774	362	1032	348
West Bank/Gaza	18	25	1153	253	1537	243

Appendix 2 – METHODOLOGY, INPUT DATA AND CALCULATIONS FOR THE MODELLING OF THE ECONOMIC COSTS AND RETAIL PRICES OF ENERGY

OVERALL METHODOLOGY

The economic cost of energy fuels was calculated and used to perform the economic profitability analysis. Firstly, the IEA fossil fuel import prices were used to estimate the cost of crude oil and natural gas imports (Figure 56) at the EU borders (Step 1). Then shipment costs were accounted for by assuming that all the MPCs are at the same distance from the EU. Shipment costs were estimated at +/-5% of fuel costs based on whether the MPC is an oil/gas importer or oil/gas exporter (Step 2). Then fuel transportation costs within each country were added to calculate the total economic cost of energy fuels (Step 3).

For the financial analysis, retail energy prices were calculated. First, the rate of subsidization or taxation of energy fuels, represented by a coefficient factor (CF), was calculated as retail fuel price (2009) divided by economic fuel cost in 2009. This CF was assumed constant by fuel type and by country over 2011-2020. Then the CF was applied to the projected fuel economic costs to calculate the retail fuel prices over 2010-2020.

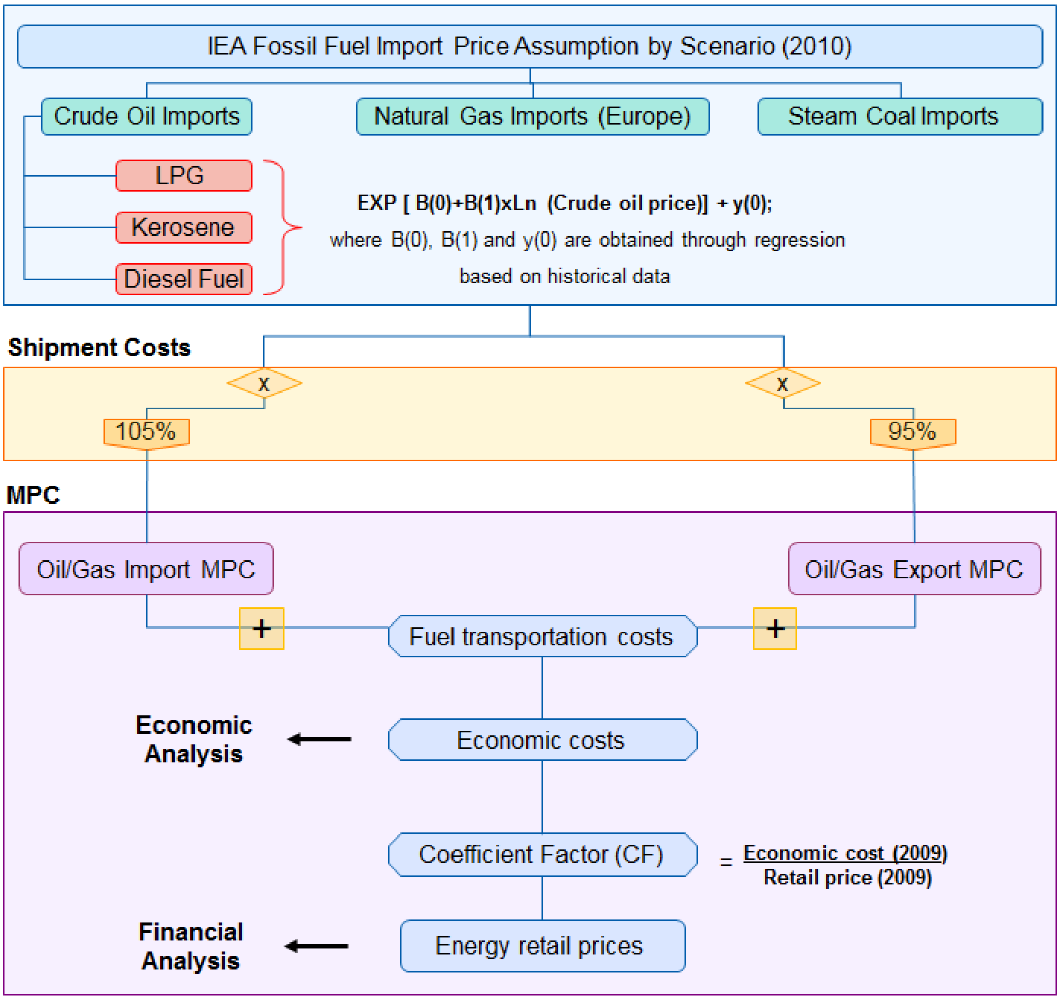

Figure 56: Overall methodology for the calculation of economic costs and retail prices of energy

INPUT DATA FOR THE CALCULATION OF ECONOMIC COSTS OF ENERGY FUELS (ECONOMIC ANALYSIS)

Step 1: the IEA energy price scenarios were used to calculate the average cost of fuel products (butane, kerosene, diesel and natural gas) at the borders of EU. A conversion factor for each of the petroleum product was multiplied by the average price of IEA crude oil imports to obtain the average cost of petroleum products at the EU borders.

IEA energy price scenarios (IEA, 2010a)

	2009	2015	2020	2025	2030
IEA Crude oil imports [USD/bbl]					
Current Policies	60.4	94.0	110.0	120.0	130.0
New Policies	60.4	90.4	99.0	105.0	110.0
450 Scenario	60.4	87.9	90.0	90.0	90.0
IEA Natural Gas imports - Europe [USD/MBtu]					
Current Policies	7.4	10.7	12.1	12.9	13.9
New Policies	7.4	10.6	11.6	12.3	12.9
450 Scenario	7.4	10.4	10.6	10.7	10.9

Conversion factors for petroleum products based on historical data (EIB, 2010)

Petroleum products	B(0)	B(1)	Intercept
Butane	2.308	0.984	13
Kerosene	2.551	0.931	10
Diesel Fuel	2.551	0.931	10

Step 2: the calculated costs of petroleum products (butane, kerosene and diesel) and natural gas were multiplied by 95% or 105% to account for shipment costs based on whether the MPC is oil/gas exporter or oil/gas importer respectively.

Step 3: Fuel transportation costs within each of the MPCs were added to calculate the total economic fuel costs. Average values for fuel transportation costs were used for all the MPCs based on data from European market for the transportation of fuel from refinery to final consumer.

Fuel transportation costs

Fuel	Transportation costs [EUR/kWh]	Assumptions
LPG	0.043	Author's assumptions based on average transportation costs for fuels in EU available via: www.energy.eu (2012)
Gasoil	0.020	
Natural Gas	0.014	

INPUT DATA FOR THE CALCULATION OF RETAIL PRICES OF ENERGY FUELS (FINANCIAL ANALYSIS)

The calculated economic costs of fuels were then multiplied by the corresponding coefficient factor (of each fuel) in order to obtain the retail prices.

Coefficient factor (calculated as retail price divided by economic cost in 2009)

Country	LPG	Kerosene	Diesel	Natural Gas
Algeria	0.27	N.A*	0.23	0.10
Egypt	0.13	0.40	0.29	0.31
Israel	0.47	1.41	0.63	N.A*
Jordan	0.79	1.42	1.41	N.A*
Lebanon	0.96	N.A*	0.80	N.A*
Morocco	0.38	N.A*	0.81	N.A*
Syria	0.03	0.70	0.97	N.A*
Tunisia	0.44	0.86	0.56	0.64
West Bank/Gaza	0.47	1.41	1.30	N.A*

Notes:

* N/A indicates the CF was not calculated because the corresponding fuel is not present within the end-use fuel mix in the country.

Retail fuel prices (2008)

Country	LPG [EUR/kWh] (Plan Bleu, 2011)	Kerosene [EUR/kWh] (Kojima, 2009)	Diesel [EUR/kWh] (GTZ, 2009)	Natural Gas [EUR/kWh] (GTZ, 2009)
Algeria	0.021	0.0	0.016	0.003
Egypt	0.010	0.022	0.020	0.010
Israel	0.037*	0.084**	0.047	N/A
Jordan	0.062	0.084	0.106	N/A
Lebanon	0.075	N/A	0.060	N/A
Morocco	0.030	N/A	0.061	N/A
Syria	0.002	0.039	0.067	N/A
Tunisia	0.035	0.051	0.042	0.022
West Bank/Gaza	0.037*	0.084**	0.097	N/A

Notes:

* Source (World Bank, 2007)

** For Israel and West Bank/Gaza, data for kerosene retail prices was not identified in both countries so the data of Jordan was used instead.

Electricity tariffs and electricity production costs calculations

Electricity tariffs for the residential, commercial and street lighting consumers were obtained from published tariffs in each of the MPCs. These tariffs were used to perform the financial profitability analysis.

Electricity tariffs in [EUR/kWh] (AUPTDE, 2008)

Country	Residential 750kWh/month	Commercial 500kWh/month	Street Lighting
Algeria	0.05	0.05	0.00
Egypt	0.04	0.04	0.05
Israel	0.09	0.10	0.07
Jordan	0.09	0.09	0.06
Lebanon	0.06	0.06	0.07
Morocco	0.10	0.10	0.10
Syria	0.02	0.02	0.02
Tunisia	0.09	0.09	0.08
West Bank/Gaza	0.11	0.11	0.08

The economic costs of electricity generation were calculated for a 10% discount rate and accounting for the cost of CO_2 and other environmental externalities.

Economic cost of power generation in [EUR/MWh] – at power generation plant

EUR/MWh	*Country type*	
	*Oil/Gas **Importer** (Israel, Jordan, Lebanon. Morocco, Tunisia, West Bank/Gaza)*	*Oil/Gas **Exporter** (Algeria, Egypt, Syria)*
2010		
Base load	84	75
Peak load	99	87
2015		
Base load	90	80
Peak load	107	95
2020		
Base load	95	85
Peak load	113	101
2025		
Base load	99	89
Peak load	120	113
2030		
Base load	103	94
Peak load	126	119

In order to estimate the economic cost of electricity consumed by the end-user (residential), additional assumptions were used on (i) avoided transmission and distribution costs; and (ii) avoided transmission and distribution losses.

Avoided transmission and distribution costs were estimated at 66.7% of the electricity generation cost. This assumption was based on experience from EU electricity market.

Avoided electricity transmission and distribution losses were estimated at 11.7% of the electricity generation cost. This assumption was based on data obtained for transmission and distribution losses in some MPCs (World Bank, 2009).

The calculated economic cost of electricity production was used to perform the economic profitability analysis of all the modelled EE and small-scale RE technologies

Economic cost of electricity consumed by end-users (residential) (with savings on transmission and distribution costs and losses) in [EUR/MWh]

EUR/MWh	*Country type*	
	*Oil/Gas **Importer** (Israel, Jordan, Lebanon. Morocco, Tunisia, West Bank/Gaza)*	*Oil/Gas **Exporter** (Algeria, Egypt, Syria)*
2010		
Base load	151	133
Peak load	177	154
2015		
Base load	161	143
Peak load	191	169
2020		
Base load	169	151
Peak load	202	181
2025		
Base load	177	159
Peak load	213	201
2030		
Base load	185	167
Peak load	224	212

Note:

For the economic assessment of PV investments, the electricity production cost did not account for transmission and distribution savings.

Appendix 3 - Assumptions on maximum penetration levels by 2020

Sources: Author's assumptions based on Plan Bleu (2011) rupture scenarios and some specific assumptions for street lighting (see Appendix 6).

Technology	Hypothesis	
	Existing	**New**
Building envelope	Thermal renovation (shell insulation) of existing buildings (roofs, walls, and windows). Gradual implementation from 1% to 30% was assumed between 2010 and 2030.	Strict implementation of thermal regulation (current and in-progress) for new housing constructions. Gradual dissemination from 13% to 80% was assumed between 2010 and 2030.
Solar water heater	Accelerated pace of dissemination of solar panels in the existing housing stock from 7% in 2010 to reach a penetration rate of 20% in 2020.	Accelerated pace of dissemination of solar panels in the new built from 5% in 2010 to reach a penetration rate of 25% in 2020.
Efficient indoor lighting	Gradual elimination of incandescent lamps and large-scale dissemination of efficient lighting bulbs. Gradual dissemination from 20% to 100% was assumed between 2010 and 2020.	
Street lighting	Penetration at 100% by 2020 in high density MPCs and at 50% penetration levels in low density MPCs (see Appendix 6).	
Household electric appliances (refrigerator, air conditioner, washing machine)	Enhancement of the energy performance of electric household appliances (refrigerators, air-conditioners and washing machines) through gradual elimination of less efficient classes and gradual dissemination of more efficient classes from 10% in 2010 to 50% in 2020 (Plan Bleu, 2011).	
Roof-top PV	Penetration levels similar to that of solar water heater (i.e. 20% by 2020) were used to estimate the total number of applied roof-top PV installations by 2020.	Penetration levels similar to that of solar water heater (i.e. 25% by 2020) were used to estimate the total number of applied roof-top PV installations by 2020.

Appendix 4 – COST OF ENERGY SAVED CALCULATIONS

For each of the modelled EE and small-scale RE technologies, the cost of energy saved was calculated as (Durand, 2010):

$$CCE = \frac{A(\Delta I) + \overline{CF}}{kWh_{saved}}$$

Where:

$A(\Delta I)$: is the annuity of the incremental investment cost of an energy efficient technology as compared to a conventional technology;

$\overline{CF}$: is the average annual net saving benefits;

kWh_{saved} : is the average annual energy savings.

Appendix 5 – ASSUMPTIONS FOR FINAL ENERGY CONSUMPTION BY END-USE IN THE RESIDENTIAL SECTOR

The final energy consumption by end-use (kWh/m^2/year) was calculated based on the projected final energy consumption (by sector), the estimated building stock (both existing and new building) and the percentage of energy end-use within the residential and tertiary sectors. The energy end-use for the residential sector was based on Plan Bleu (2011). As no data could be identified for the tertiary building stock, it was estimated as proportional to the energy consumption within the tertiary sector.

Energy end-use	2000	2005	2010	2015	2020	2025	2030
Space heating	16%	19%	23%	26%	30%	33%	36%
Air-conditioning	3%	5%	6%	9%	12%	12%	12%
Water heating	22%	21%	20%	18%	16%	15%	13%
Lighting	16%	14%	13%	11%	10%	8%	7%
Cooking	14%	13%	12%	12%	11%	10%	9%
Electric appliances	29%	28%	26%	25%	22%	23%	23%
Total [Mtoe]	57.7	63.7	71.2	81.1	94	113.1	137

Appendix 6 – ASSUMPTIONS ON STREET LIGHTING IN MPCS

METHODOLOGY FOR ESTIMATION OF STREET LIGHTS IN MPCS

The total lengths of road network in each of the MPCs were identified (Eurostat, 2010). Figure 57 was used to identify the percentages of the paved road network from the total lengths of road network in each of the MPCs:

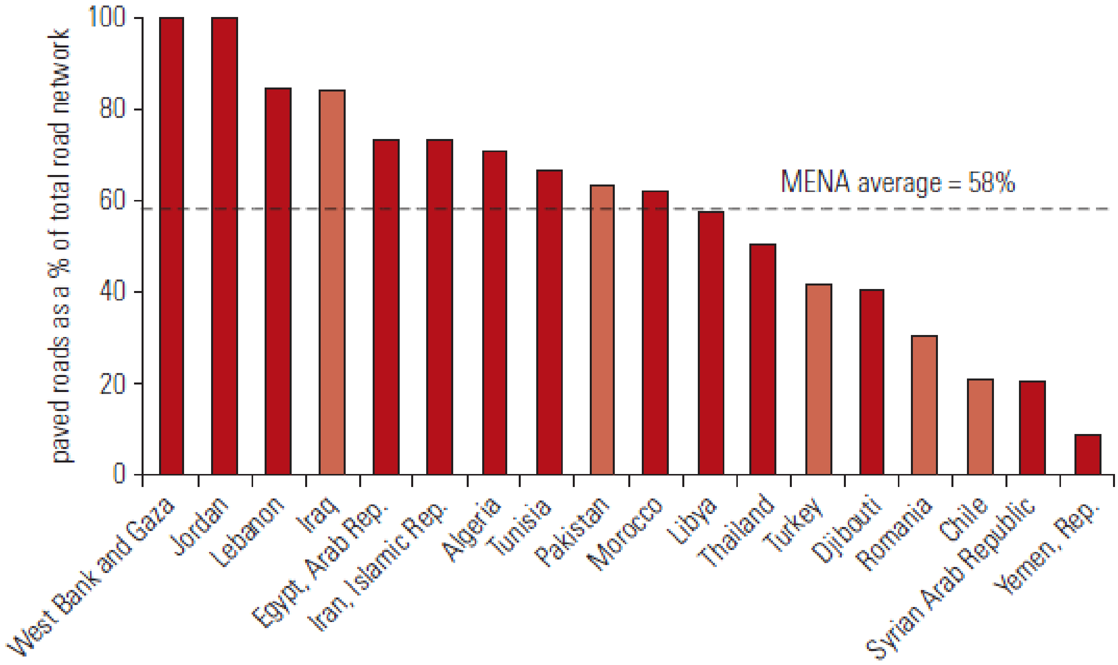

Figure 57: Paved roads as a percentage of total roads network (World Bank, 2011)

The MPCs were then divided in two categories: MPCs with high road density and MPCs with low road density (World Bank, 2011). High road density was identified in Israel, Jordan, Lebanon and West Bank/Gaza. The remaining MPCs were identified to have low road density. It was assumed that street lights would penetrate at 100% penetration levels by 2020 in high density MPCs and at 50% penetration levels in low density MPCs.

The required lighting levels for main roads in urban areas are 10-20 lux (Institution of Light Engineers, 1990). Assuming a road width of 8m, the spacing between two high pressure mercury street lights (the conventional alternative considered in the economic and financial modelling) would be 44m (Institution of Light Engineers, 1990). This will correspond to a total of 23 street lights per km of paved road network.

RESULTS FOR ESTIMATION OF STREET LIGHTS IN MPCS

Country	Road network [Km]	% of paved roads in total road network	Paved roads [Km]	Road density	Max. penetration levels	Total number of street lights [Million]
Algeria	109,452	69%	75,522	Low	50%	0.87
Egypt	106,854	72%	76,935	Low	50%	0.88
Israel	18,096	100%	18,096	High	100%	0.42
Jordan	7,786	100%	7,786	High	100%	0.18
Lebanon	6,970	84%	5,855	High	100%	0.13
Morocco	57,852	62%	35,868	Low	50%	0.41
Syria	51,967	20%	10,393	Low	50%	0.12
Tunisia	19,371	65%	12,591	Low	50%	0.14
West Bank/ Gaza	5,147	100%	5,147	High	100%	0.12

Appendix 7 – Definition of identified barriers to EE and small-scale RE

Economic and Financial Barriers

Identified barriers	Description and reference
PRICE DISTORTION	
Price distortion	Heavily subsidised energy prices (i.e. energy prices do not reflect the true marginal cost of energy use) can distort the markets and prevent consumers from appraising the true value of energy efficiency. Moreover, accurate energy pricing would require externalities (environmental, health and other societal costs) to be included in the final energy price (IEA, 2010b; 2008).
LACK OF ACCESS TO (AFFORDABLE) CAPITAL	
Limited access to capital	Low-income borrowers and small business owners can have difficulties in obtaining additional capital in order to invest in EE and small-scale RE technologies due to restrictions on lending money or self-imposed restrictions (Thollander, 2010).
High initial costs	High initial costs of EE and small-scale RE technologies, as compared to their less-efficient alternatives, can represent a barrier for customers especially within the lower income sections of the community, who then tend to opt for low initial cost technology even if the more expensive would be more financially profitable from a life-cycle cost view (IEA, 2008).
DISCOUNT RATE & FINANCIAL RISK PERCEPTION	
Risk exposure	There can be uncertainty about the long term savings in operating costs of investments in EE and small-scale RE, as these costs depend mainly on future economic conditions and energy prices (Thollander, 2010). Uncertainty about fuel prices can be a barrier to investments in both the manufacture and purchase of EE and small-scale RE technologies.
Discount rate	High discount rates are applied to EE and small-scale RE investments due to their risk level (IEA, 2008).
OTHER ECONOMIC & FINANCIAL RISK PERCEPTION	
Uncertainty with energy savings	The currently used methods to evaluate and quantify potential energy savings for EE and small-scale RE projects maintain a certain level of uncertainty and pose the challenges of hidden risks. Systematic ex-post project evaluation would be costly (IEA, 2008).
Hidden costs	Economic models do not always account for some “hidden costs” (e.g. overhead costs, cost of collecting and analysing information, production disruptions, inconvenience, etc.) in the full cost of EE and small-scale RE technology. Such costs could inhibit investments especially in small, non-energy intensive firms (Thollander, 2010).
Heterogeneity	Using some economic models may lead to identifying technologies which are cost-effective on average but not for all population (Thollander, 2010).

ORGANISATIONAL BARRIERS

Identified barriers	Description and reference
SPLIT INCENTIVES	
Split incentives	The principal-agent problem, specific to the building context, can occur when the owner and the tenant are different persons/entities. It is usually in the interest of the landlord to decrease capital costs by providing least initial cost technology which is usually less efficient and thus result in increased energy bills for the tenant (IEA, 2010b).
Low priority of energy issues	Consumers can ignore energy costs if these are small relative to other costs (IEA, 2010b; 2008). This might lead to constraints for implementing EE and small-scale RE technologies and measures (Thollander, 2010).
INADEQUATE INSTITUTIONAL AND REGULATORY FRAMEWORKS	
Lack of en-forcement	The lack of enforcement of existing regulations related to EE and small-scale RE (e.g. building codes) can be a significant barrier to compliance to energy efficiency laws and standards.
Centralisation	Highly centralised institutional frameworks can result in slow decision making pro-cess regarding the needs and allocated budgets for EE and small-scale RE invest-ments.
Lack of inter-sector coordina-tion	Low coordination levels among the different stakeholders usually lead to slow pro-cesses and duplicate efforts in developing and implementing EE and small-scale RE investments.
Incentive struc-ture	There can be an institutional bias towards supply-side investments, in that incentive structures are developed to encourage energy providers to sell energy rather than invest in cost-effective energy efficiency technologies and measures (IEA, 2010b).
LACK OF INFORMATION / AWARENESS	
Imperfect infor-mation	The lack of adequate information and understanding, on the part of consumers, about market conditions, technology characteristics, energy consumption patterns and financing options inhibits investments in EE and small-scale RE technologies and measures (IEA, 2010b; Thollander, 2010). Moreover, information related to EE and small-scale RE can be difficult or costly to obtain, and/or can turn out to be inaccurate (Thoallander, 2010; IEA, 2008).
Information complexity	Information related to EE and small-scale RE technologies can be too technical and/or complex for an average consumer to fully grasp (IEA, 2008). The existence of low quality technologies side by side with high quality technologies without the consumer being able to differentiate between both might lead to the deployment of low quality, low performance technologies that can then affect consumers' future in-vestment decisions.
Asymmetric in-formation and adverse selec-tion	Producers/sellers of EE and small-scale RE technologies can be more informed about the characteristics and performance of the technology than potential us-ers/buyers. This asymmetric access to information can result in purchasers select-ing goods on the basis of visible aspects only such as price (Thollander, 2010).

Identified barriers	Description and reference
LACK OF QUALIFIED CAPACITY	
Lack of adequate training	There can be a lack of adequate skills and proper training related to EE and small-scale RE for suppliers, manufacturers, promoters, and financiers. Energy expertise, to identify and finance EE and small-scale RE projects, can be rare in some financial institutions and commercial banks (IEA, 2008).
Lack of local capacity	The lack of sufficient local qualified capacities for identifying, developing, implementing and maintaining EE and small-scale RE projects can be a barrier for such investments (IEA, 2010b).

TECHNICAL BARRIERS

Identified barriers	Description and reference
Technology unavailability	The lack of EE and small-scale RE technologies which are suitable to local conditions can be a barrier to the uptake of energy saving technologies in some markets.
Poor power quality	Poor power quality due to electric grid inefficiencies can in some cases affect the performance of some EE and small-scale RE technologies.

Appendix 8 – Conversion factors

1 USD = 0.71 EUR; Average yearly exchange rate from 1/1/2011 till 11/2011 (OANDA, 2011);

1 GBP =1.15 EUR; Average yearly exchange rate from 1/1/2011 till 11/2011 (OANDA, 2011);

1 Mtoe = 11630000000 kWh;

1 kWh = 3600 kJ;

Lower Heating Value (LHV) of Diesel = 36.4 MJ/L;

Lower Heating Value (LHV) of LPG = 46.1 MJ/Kg;

Lower Heating Value (LHV) of Kerosene = 43.1 MJ/Kg;

Lower Heating Value (LHV) of NG = 34.2 MJ/m3;

Density of Diesel = 0.85 kg/L;

Density of LPG = 0.54 kg/L;

Density of Kerosene = 0.78 kg/L.

European Investment Bank

Facility for Euro-Mediterranean Investment and Partnership

Improving energy efficiency (EE) and developing small-scale renewable energy (RE) projects in the urban environment of the Mediterranean Partner Countries (MPCs) can contribute to meeting the challenge of increasing energy demand and to reducing pollution, in particular greenhouse gas emissions, in the region. Investments in EE and RE could also lead to heightened economic competitiveness and local employment opportunities. Ultimately such investments would support the objectives of the Mediterranean Solar Plan, which is a priority initiative of the Union for the Mediterranean.

This study, prepared by a consultant under the supervision of the European Investment Bank (EIB), analyses a range of EE and small-scale RE projects in the urban environment, as identified in the MPCs' own national plans from 2011- 12. Accordingly, this study covers EE and small-scale RE technologies in the residential and tertiary sectors, but does not cover the industry, transportation or rural sectors.

The analysis presented in this report (i) assesses the energy savings (RE production) and the required investment costs resulting from the total or partial implementation of the identified projects in the relevant national plans; (ii) gives a simplified estimate of the economic and financial profitability of these projects; and (iii) considers the main barriers to the implementation of these projects.

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