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Energy, Climate change and the Building sector in the Mediterranean: Regional Prospects

Report

El Habib El Andaloussi, Rafik Missaoui, Adel Mourtada, Stéphane Pouffary and Ariane Rozo

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Report carried out under the direction of Henri-Luc Thibault, director of Plan Bleu (2006-2011) and coordinated by Pierre Icard, head of the thematic unit of Plan Bleu.
The regional and national studies on the « Energy, Climate change and the Building sector in the Mediterranean » was coordinated by El Habib El Andaloussi (Plan Bleu) and Stéphane Pouffary (ADEME).

Authors

The authors of the part "Regional prospects" are El Habib El Andaloussi (Plan Bleu), Stéphane Pouffary (ADEME), Ariane Rozo (Trans Energie), Rafik Missaoui (Alcor, Tunisia) and Adel Mourtada (Ecotech, Lebanon).
The National studies were respectively written by national experts, Adel Mourtada for Lebanon, Rafik Missaoui for Tunisia, Mohamed Berdai and Naim Lahlou for Morocco.

Review

Stéphane Pouffary, Ariane Rozo, Prof. Fatiha Bourbia and El habib El Andaloussi.

Experts that contributed and/or added comments

Pascal Augareils (ADEME), Mohamed Berdai (CDER, Maroc), Charlotte Colleu (ADEME), El habib El Andaloussi (Plan Bleu), Sylvain Houpin (Plan Bleu), Pierre Icard (Plan Bleu), Julien Le Tellier (Plan Bleu), Naim Lahlou (Citech, Maroc), Rafik Missaoui (Alcor, Tunisie), Adel Mourtada (Ecotech, Liban), Stéphane Pouffary (ADEME), Ariane Rozo (Trans Energie), Nathalie Rousset (Plan Bleu) and Noémie Zambeaux (ADEME).

Comments collected during the first Energy Steering committee on the study project held in 2010, from Eugène Howard (EIB, Luxembourg), Arthur Honoré (AFD/Environment and Equipment Division, France), Mladen Borsic (Croatian Energy Agency), Walid Al Deghaili (UN-ESCWA/Head of the Energy Section, Lebanon), Abdenour Keramane (Director of the magazine Revue Medenergie, Algeria), Lisa Guarerra (OME, France) et Klaus Wenzel (Med-Enec, Beyrut/Tunis). Other comments were also collected in a second steering committee held 17 June 2011 which included additionally: Agnès MOREL et Mohamad TARHINI (BEI/Energy Efficiency & RE Division, Luxembourg), Thierry LATREILLE (AFD, France), Florentine VISSER (Med-Enec, Cairo), Rafik MISSAOUI (ALCOR, Expert Energy & Environment Expert, Tunisia) and Adel MOURTADA (Ecotech, Expert on Energy & Buildings, Lebanon).

Realization

Cartography: Jean-Pierre Giraud, Benoit Briquetti
Layout: Sandra Dulbecco

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Abstract

Faced with growing concerns due to possible consequences of climate change, mitigation issues but adjustment as well must be now at the heart of our societies' concerns. There are many issues and challenges, therefore actions must be implemented on a very tight timetable, given the warnings issued by the international scientific community, while anticipating the best countries development prospects in a spirit of solidarity between rich and most vulnerable countries. That said, we must not minimize the human and economic interests and national policy so the challenges are both collective and individual.

Strategies and action plans that must be put in place need to be enrolled in the long term and to take into account the most energy consuming sectors while relying on existing technological solutions and leverage or to invent for developing viable projects in terms of energy savings and therefore reduce greenhouse gas emissions.

Mediterranean countries, which include the countries of the northern Mediterranean (NMCs1) and the Southern and Eastern Mediterranean (SEMCs2), located in an area considered as a "hot spot" of climate change, are especially concerned when considering the high population growth expected that could reach a population of 360 million inhabitants by 2030, coupled with an increase in primary energy demand that should be multiplied by 1.5 by 2030. In addition, the rapid increase of the energy dependence of SEMCs makes it necessary to anticipate the heavy investments coming from the supply side (production, particularly by encouraging renewable energy) but especially to establish meaningful action on the demand side (energy consumption reduction).

It must be added to this situation that the southern countries of the Mediterranean are experiencing rapid urbanization (over three quarters of the population in SEMCs will be urban in 2030) accompanied by a massive housing demand. By 2030, experts predict a nearly 42 million need in additional housing units compared to today.

The building sector, which represents the first electricity consumer sector and the second for fossil fuels (after transportation), is a sector with high stakes because it can act both on demand (energy efficiency) and supply (renewables integration). Globally, it is estimated that the potential energy savings in this sector is around 40% and this largely through action that are now economically viable.

The present study provides an overview of the construction sector in SEMCs and analyzes what could or should be its place in the context of ambitious policies for the control of energy demand. While the recommendations may apply to all the construction sector, this report focuses on the residential sector (70% of CO_2 emissions and 27% of energy consumption in the housing sector) and especially on the new residential housing in the formal sector. It is understood that regulatory actions, technical and financial resources for the "existing" buildings and for the informal sector should be further investigated.

Today, it is clear that the opportunities in energy savings in the construction sector have not been exploited at fair value and that recent constructions, modeled on international models are inadequate in most cases to SEMCs' climate conditions. This has caused the rise of particularly energy-intensive buildings, not counting the abandonment of very powerful urban organizations. Therefore, in many cases, to get a decent thermal comfort, occupants must invest in equipment such as heaters and air conditioners. This has a strong impact on the cost of use of the consumers, not to mention the precarious energy situations that are increasingly growing.

Understanding the current situation is a pre-requisite to being able to develop relevant scenarios as realistic as possible. Many initiatives have already been implemented at national level and, in many cases, through bilateral or international cooperation. The report reviews the various initiatives to address the questions of

[1] NMCs inlcudes : Albania, Bosnia-Herzegovina, Cyprus, Spain, France, Greece, Croatia, Italy, Monaco, Montenegro, Malta & Slovenia.
[2] SEMCs includes : Morocco, Algeria, Libya, Tunisia, Egypt, Israël, Jordan, Gaza & Cisjordanie, Jordan, Lebanon, Syria and Turkey.

"who finance" or "who should pay" and "where to initiate" the establishment of an ambitious policy of controlling energy demand in the residential sector.

Beyond the specificities of the SEMCs, the barriers but also the opportunities for action in terms of organization, availability of technologies as well as the economic and financial issues are quite similar to what we can look at European or international level. Therefore the transfer of skills and the North-South as well as the South-South partnerships should be encouraged in all its forms. The best practices adopted by Mediterranean countries were studied and the mechanisms that might allow generalization to all SEMCs were analyzed.

On this basis two scenarios have been established. The first scenario called "trend or reference" scenario and the second called "rupture scenario" that takes into account the implementation of proactive policies to control energy demand and renewable energy integration. Based on the accepted assumptions, the difference is significant with nearly 42 Mtoe in the rupture scenario by taking into account a final energy consumption of 130 Mtoe by 2030 in the reference scenario.

The study also offers recommendations for action to be used to implement the rupture scenario at the organizational, economic and informational levels that will have to result in legal and institutional aspects. This implies implementation of incentives and support mechanisms in time and perennial by strengthening the capacity of stakeholders to support the transformation of the sector.

National dynamics as a background of the establishment of a regional strategy, subject to the mobilization of all stakeholders, develop a "win-win" scenario on the southern and eastern Mediterranean in a process similar to that which was implemented in Europe.

I. Introduction

The responsibility of human activity in climate change is no longer in doubt. But beyond this recognition more or less shared, it is necessary to establish real action because time and worse, he plays against us if we rely on the observation made by scientists Group Intergovernmental Panel on Climate Change (IPCC).

In view of the challenges and the vital need for solidarity between rich countries and most vulnerable countries, the conclusions of the Copenhagen Summit of December 2009 are inevitably disappointing even if the political will at the highest level is in itself a encouraging sign. However, it is clear the difficulty of integrating a vision for the long term associated with defending national economic interests.

Considering the challenges ahead and the vital need for solidarity between the rich countries and the more vulnerable ones, the conclusions of the "Copenhagen Summit" of December 2009 are admittedly disappointing, even though the political will at highest level remains in itself an encouraging sign. And yet, one can but admit the difficulty of accommodating a long-term vision with the defence of national economic interests.

In view of this admission, it is essential that international bodies rally efforts in order to pre-empt an international legal framework likely to help take up the challenges arising from the climate issue and respond to the stakes attached thereto.

Identifying the particularly vulnerable geographic zones, specifying the highly energy-consuming sectors, and inventorying the dedicated technological solutions, as well as the existing economic drivers or those that need to be created, constitute the preliminary steps necessary to put forward viable projects in terms of energy saving and, hence, of reduction of greenhouse gas (GHG).

When it comes to the Mediterranean countries—comprising the Northern Mediterranean Countries (NMCs3) and the Southern and Eastern Mediterranean Countries (SEMCs)4, all located in an area considered as a veritable climate change "hot spot", the necessary action is all the more urgent.

This zone is subject to a rapid increase in demand on primary energy, likely to multiply by 1.5 by 2030. This demand is set to increase by 4 to 5 times more rapidly in the SEMCs than in the NMCs, thus accounting, in 2030, for over 42% of the energy demand of the Mediterranean Basin, as against 30% in 20075. Besides, the energy dependence of the SEMCs is steadily on the increase, with the attendant prospect of inevitable tensions in the future. In this regard, meeting this increasing demand will constitute a veritable challenge for the SEMCs in the years to come and incur huge investments, especially if solutions are to be sought exclusively on the supply side (production), neglecting action on the demand side (consumption).

Alongside with this, the SEMCs experience accelerated urbanisation (over 3/4 of the population of the SEMCs will be urban by 2030) which gives rise in its wake to a massive demand on housing. Experts foresee the need for around 42 million additional housing units by 2030, with respect to the present.

The building sector, being the largest electricity user and the second fossil energy consumer (after transport), has a major stake attached to it; indeed, it offers room to act not only on demand (energy efficiency measures) but also on supply (introduction of renewable energies). Thus, for the sake of illustration, it is estimated that the energy saving potential in this sector, on global level, is in the order of 40%, and this, based for the major part on measures that are already economically viable.

This study present an overview of the situation of the building sector in the SEMCs and to assess what place it could hold, or should hold, within the framework of ambitious energy demand management policies.

[3] The NMCs comprise: Albania, Bosnia-Herzegovina, Croatia, Cyprus, France, Greece, Italy, Malta, Monaco, Montenegro, Slovenia and Spain.

[4] The SEMCs comprise: Morocco, Algeria, Tunisia, Libya, Egypt, Israel, Jordan, the Gaza Strip and the West Bank, Lebanon, Syria and Turkey. While Jordan is not a Mediterranean riparian country, it belongs to the Union for the Mediterranean (UfM) and is therefore included, in this capacity, in the present study.

[5] Source: Plan Bleu 2009, Infrastructures and Sustainable Energy Development in the Mediterranean: Outlook 2025.

Indeed, one can but admit that the energy saving potential has not been tapped as it should have been over the past. More problematic still, recent constructions—copied on international models, and unsuitable in most cases to the weather conditions of the SEMCs—have led to a surge of particularly high energy-consuming buildings. Besides, the forsaking of urban organization patterns—even though they are quite efficient—would need to be drastically reconsidered. That is why, in many cases, in order to obtain a decent heating and cooling comfort, this poorly insulated construction—designed the rules of bio-climatic architecture—incurs its inhabitants' investment in heating and air-conditioning equipment. From a purely economic perspective, disregarding this situation is not viable in the long term: indeed, owing to their high electricity consumption, these equipments are extremely costly for the occupants…Finally, and even though we are only stating the obvious, it would not be amiss to remind here that, in the energy sector, the cost of "inaction" will exceed by far that of "action": investing in energy efficiency today means saving tomorrow.

Among the various types of constructions in the Mediterranean (residential, administrative, commercial, etc…), the "residential" alone accounts for 70% of the emissions due to the building sector. As the data concerning the other types of construction are extremely difficult to obtain, it was decided that this study would focus on the prospects offered by the residential sector in terms of reduction of energy use. Besides, in view of the scope of the construction objectives in matter of new housing units in the SEMCs, this study will focus more particularly on the "new" residential of the formal sector. It goes without saying that the legal, technical and financial actions regarding the "existing" residential should form the subject of a complementary study.

In view of all these considerations, it is easy to appreciate the extent to which energy efficiency in the residential is a strategic stake with regard to energy demand management in the SEMCs. While the lag with respect to the other Mediterranean rim is wide, pre-emption and a reversal of the various scenarios are still possible.

After recalling, in Part 1, the energy situation in the Mediterranean and the special place held by the construction sector, this study will examine in detail, in Part 2 and Part 3, a trend energy scenario and a rupture energy scenario for the time frame 2030 for the residential sector.

Part 4 will address not only the barriers, but also the opportunities, for action, with a particularly closer focus on economic and financial issues. This will comprise an attempt to answer such questions as "who finances", and "where to start", an ambitious policy of control over energy demand in the residential sector. It will also comprise a close look at best practices, together with an overview of mechanisms likely to allow replication throughout the SEMCs.

The conclusion will recall the need for a regional approach in support of the national dynamics to be implemented or strengthened. Such a dynamics would be justified largely with a mobilization of all stakeholders, a veritable "win-win" scenario could be established on the Southern and Eastern Mediterranean rim, similar to the one implemented in Europe.

II. Energy and the Building sector: State of the art in the Mediterranean

1. Energy in the Mediterranean: A markedly contrasted picture

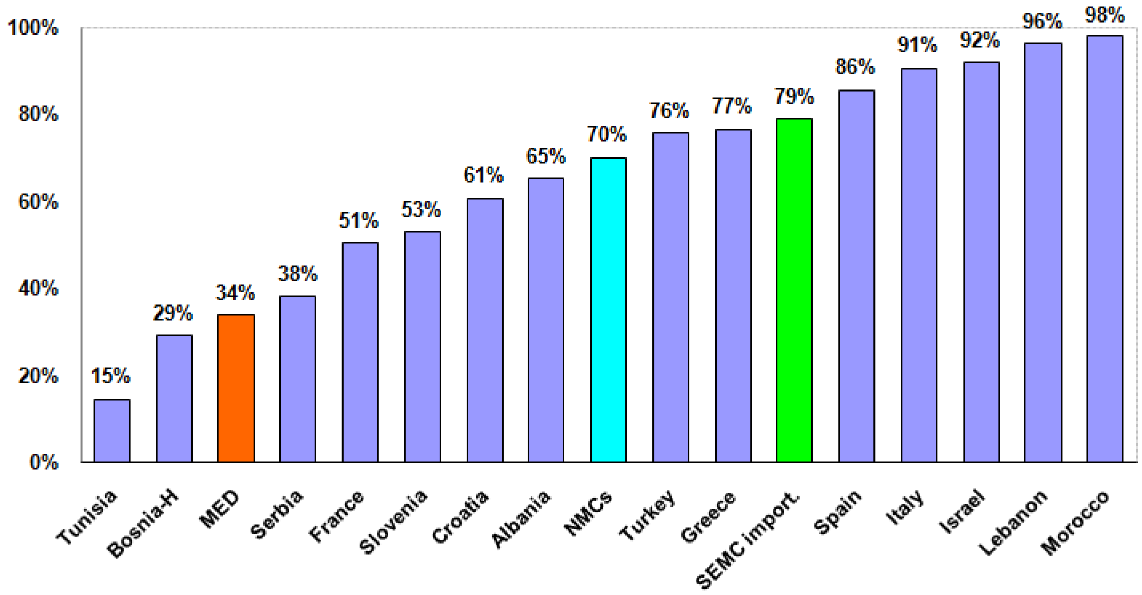
Mediterranean countries present extremely contrasted energy profiles: fossil energies exporting countries alongside with wholly importation dependent countries, as well as countries that are aware about and advanced in terms of development of renewable energies and energy efficiency alongside with others where everything needs to start from scratch... For all that, and irrespective of the national contexts, an observation is due: energy and power demand in the Mediterranean has been constantly on the increase over the past few years, and this trend is unlikely to be reversed in the coming years...

1.1. An energy dependency to be monitored

In the Mediterranean region, the SEMCs have the specificity of grouping at once hydrocarbon exporting countries (Algeria, Egypt, Libya, Syria) and ones that are dependent on imports for their supply.6

Energy dependence, all energies considered, currently stands at around 35% in the Mediterranean. The riparian countries imported 267 Mtoe in 1971, of which 10 Mtoe by the importing SEMCs, and, in 2007, the volume of imports amounted to 589 Mtoe, of which 123 by the SEMCs, that is, a rise by 7.2% per year.

Figure 1 - Energy dependence of Mediterranean importing countries in 2007



Source: Plan Bleu (calculations based on IEA-Energy Balance statistics, 2009 edition)
*N. B.: In the graph above, "MED" stands for the mean between Mediterranean importing countries (importing "NMCs" and "SEMCs") and Mediterranean exporting countries. The average ("MED") of the Mediterranean importing countries both in the North and in the South (importing "NMCs" and "SEMCs") stood at 72 % in 2007.

Considering this unequal distribution of resources, and in order to most promptly anticipate an inexorable amplification of energy tensions, it is essential for the SEMCs to introduce the notions of energy efficiency and of control over consumption while continuing to develop the various renewable energies.

[6] Tunisia became a net importer as from 2001.

1.2. Rapidly increasing energy and electricity demand

Around 453 million people live in the Mediterranean basin and consume around 1000 million toe (Mtoe) of energy, that is, around 8.2% of the global energy demand. It is worth recalling that annual per capita primary energy consumption is 3.3 times lower in the SEMCs (1.1 toe) than in the NMCs (3.6 toe).

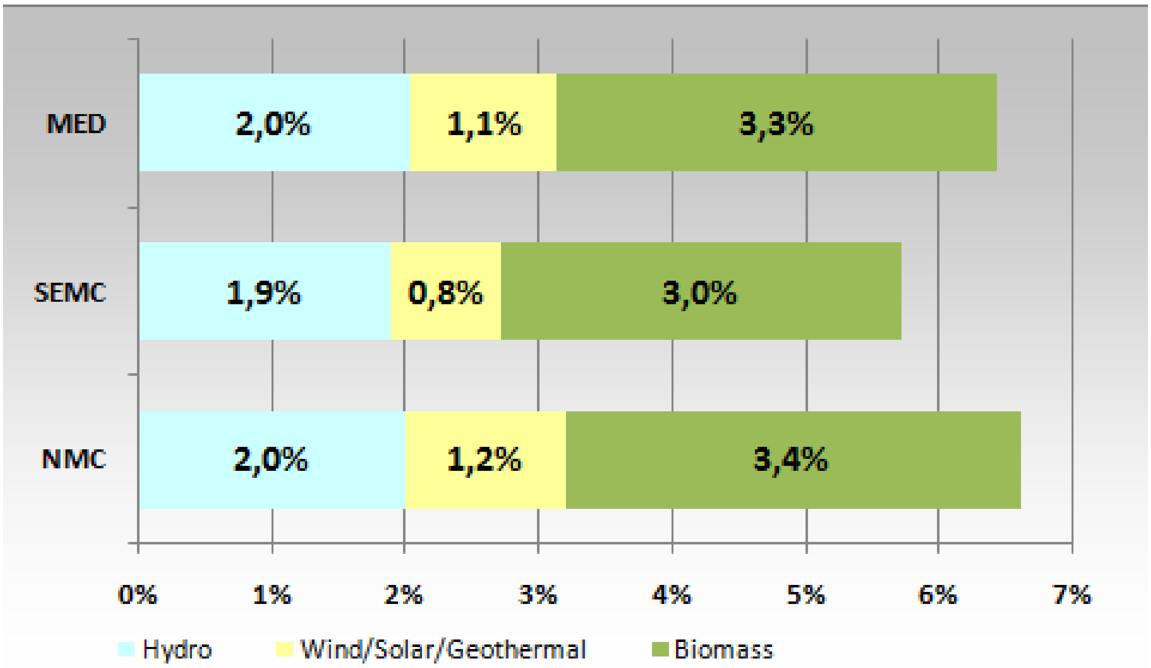
Total energy demand in the Mediterranean has more than doubled over the period 1971-2007 (from around 400 to around 1000 Mtoe), which represents a 2.7% increase per year, on average. Over this period, the major portion of the increase was due to the SEMCs. Energy demand has been characterized by an increase in electricity demand that is more rapid than the increase in primary energy demand or population growth. It is worth pointing out that subsidizing electricity tariffs, as in Egypt, Syria, Lebanon and Algeria, encourages the use of electricity for the heating of water or of premises at the expense of other energy sources, thus inducing a high increase in electricity consumption.

1.3. Under-tapped renewable resources

The Mediterranean holds a significant potential of renewable energies, especially solar and wind. On the whole, this potential remains under-tapped, and this, despite a doubling up in volume between 1971 and 2007. At present, renewable energies (RE) account for less than 7% (inclusive of biomass) of the region-wide energy balance.

Yet, it must be mentioned that, fostered by incentives, policies and technological advances, renewable energies in the Mediterranean have reported exceptional growth in the power production sector (mainly wind-energy based), with over 9.1%[7] increase per year, on average, over the period 1980-2006 (though it must be recalled that the capacity installed was low back in the late 1980s).

Figure 2 - Share of renewable sources in primary energy demand in 2006 (%)



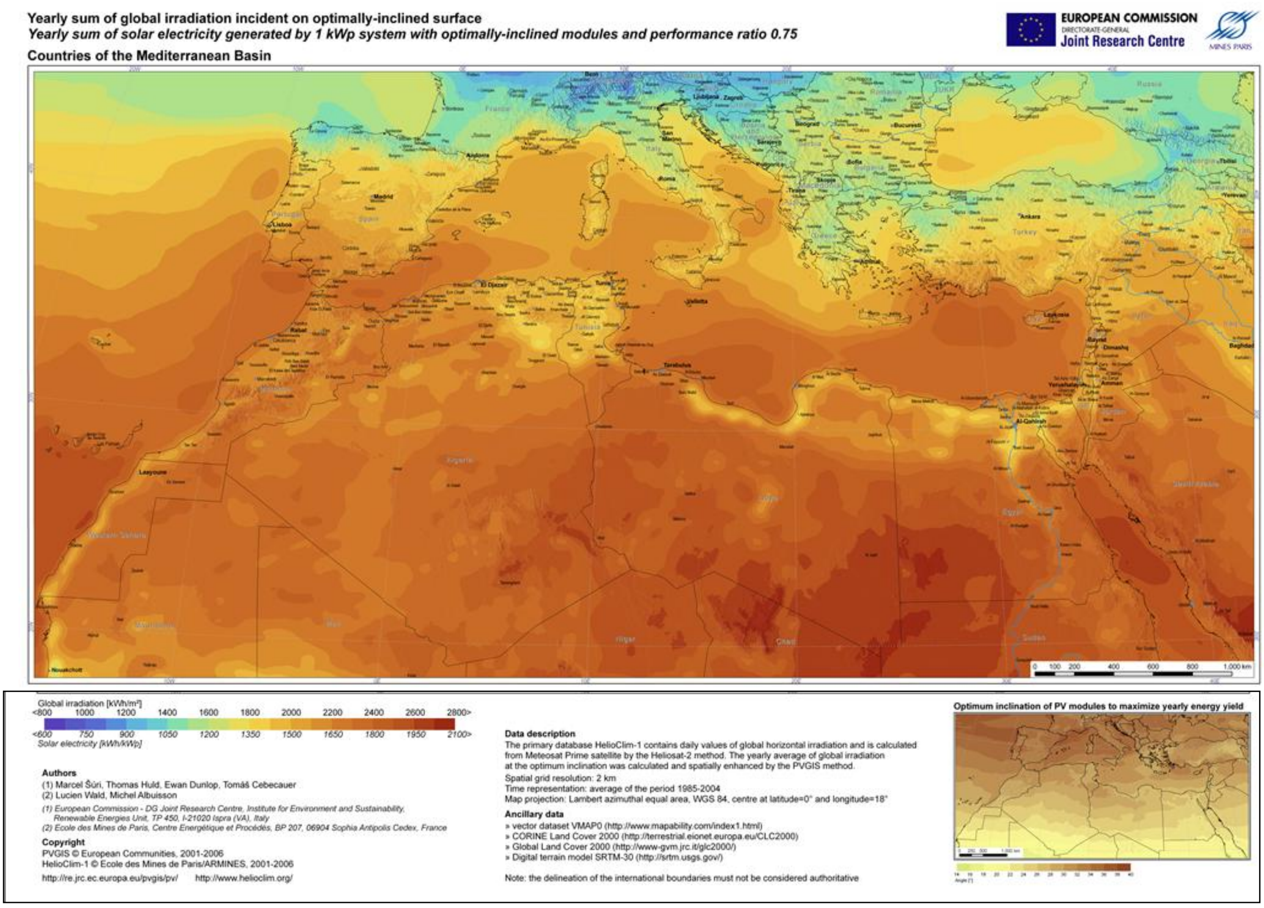
Source: Plan Bleu (State of the Environment and Development in the Mediterranean - 2009, p. 48)

[7] Global growth has been of 10.5% per year over the same period 1980-2006 (from 31 to 414 TWh).

Finally, though the quantity of renewable energies (RE) produced is on the increase in absolute value, simultaneous increase in demand is such that the relative share of RE in primary energy supply reports a very slow increase: they account for a mere 2.7% of the energy demand in the SEMCs (5.7%, biomass included), which remains short of the 7% primary energy target recommended by the MCSD8.

And yet, the potential is definitely there! While vaunting favourable conditions for wind energy, the SEMCs are characterised by a significant sunshine, as attested by the map below, thus offering several opportunities for a valorisation of solar energy, both passive and active, via heat and power applications.

Figure 3 - Solar radiation and potential for the solar – photovoltaic in the Mediterranean



Source: PVGIS © European Communities, 2001-2008 (Photovoltaic Geographical Information System)
http://re.jrc.ec.europa.eu/pvgis/cmaps/eu_opt/PVGIS_Mediterranean_globrad_opt_angle.png

For the sake of illustration, one may mention the example of Israel, which ranks 5th worldwide in terms of area of solar panels installed and 2nd in terms of installed area/inhabitant ratio (just before the Palestinian Territories, with 420 and 350 m² per 1 000 inhabitants, respectively, in 2007[9]).

But it would be too risky to count exclusively on the development of renewable energies to meet the increasing energy demand and address energy dependence. In fact, many experts agree that, even at the cost of massive investments, this sector cannot by itself address the problems specific to this region. Here again, rational energy use and energy efficiency emerge as indispensable components of the solution.

[8] The Mediterranean Commission on Sustainable Development (CMDD/ MCSD) is a forum for dialogue towards setting out a Mediterranean sustainable development strategy. The MCSD has developed a Mediterranean Strategy for Sustainable Development (MSSD), coordinated by Plan Bleu and setting objectives and indicators to be achieved in order to engage the region in a sustainable development process and promote peace, stability and prosperity.

[9] Source: ESTIF.

1.4. High energy intensity, a sign of inefficient energy use

Apart from the challenges pertaining to the production of renewable energies, an optimal energy use must be in all cases a priority. The total or primary "energy intensity (EI)[10]" indicator is a good tool to appreciate the economy's overall energy efficiency, even though it may not allow an evaluation of energy efficiency from a purely technical perspective.

This indicator—which is denominated in toe per unit of GDP—qualifies the extent of "energy conservancy" of a country or of a development pattern: it measures the quantity of energy consumed for the same comfort or production level. Energy intensity (EI) depends, quite obviously, on factors such as the weather (the colder it is, the more energy one consumes for heating, at equal economic level) and economy structure (the more heavy industries a country has—which are high energy-consuming—, the higher its EI is likely to be). However, when comparing countries of similar economic structures, the key factor is the efficiency with which energy is produced and consumed: roughly speaking, the lower the intensity, the greater the efficiency[11].

There is increasing awareness worldwide about the importance of energy efficiency. On the Northern rim of the Mediterranean, in the European Union, this is attested by the adoption of drastic measures for the promotion of energy efficiency, the development of renewable energies and the reduction of GHG emissions (historically speaking, energy efficiency policies were first implemented in the wake of the first oil crisis of 1973).

These energy efficiency gains correspond to energy savings garnered every year and which may be denominated in "negawatts" or "negajoules", calculated based on the improvement of energy intensity of 1980. The Figure 4 shows the evolution of primary energy consumption over the period 1980-2006. The lower curve shows the actual primary energy consumption and the upper curve shows how this consumption would be if the energy intensity for the whole NMCs had stood at its value for 1980. The upper part of the graph (negawatts) represents the savings made with regard to primary energy consumption as a result of the reduction of total energy intensity[12]. In 2006, the quantity of negawatts for the NMCs stood at around 114 Mtoe, that is, 16% of the reported primary energy consumption of 690 Mtoe (volume equivalent to 1.5 times the consumption of oil products in the NMCs). Accordingly, the NMCs have achieved, thanks to improving their EI over the period 1980-2006, aggregate savings in the order of 1300 Mtoe, that is, the equivalent of about 2 years of consumption (level of 2006).

The information on the SEMCs is based on the data available for evaluating the non-saved, hence non-realised, energy quantities (presented in the right-hand side graph of Figure 4) in order to show the correspondence with the negawatts of NMCs which are actually realised.

The slight decrease in energy intensity in the SEMCs (-0.7% since 2000) is far from being sufficient with regard to the challenges that the region is confronted with due to a great surge in energy demand. While the NMCs have implemented the process, it is crucial that the SEMCs follow suit by engaging energy conservancy actions and investing in energy efficiency technologies.

In view of the energy situation of the SEMCs, where energy supply is already clearly short of the needs, it seems essential to promptly act on the energy demand side. Indeed, in the face of limited resources and production means, of rapidly increasing energy and power needs, and of as yet insufficiently developed renewable energy sectors, it seems essential to concentrate on the very source of the problem, that is, energy consumption.

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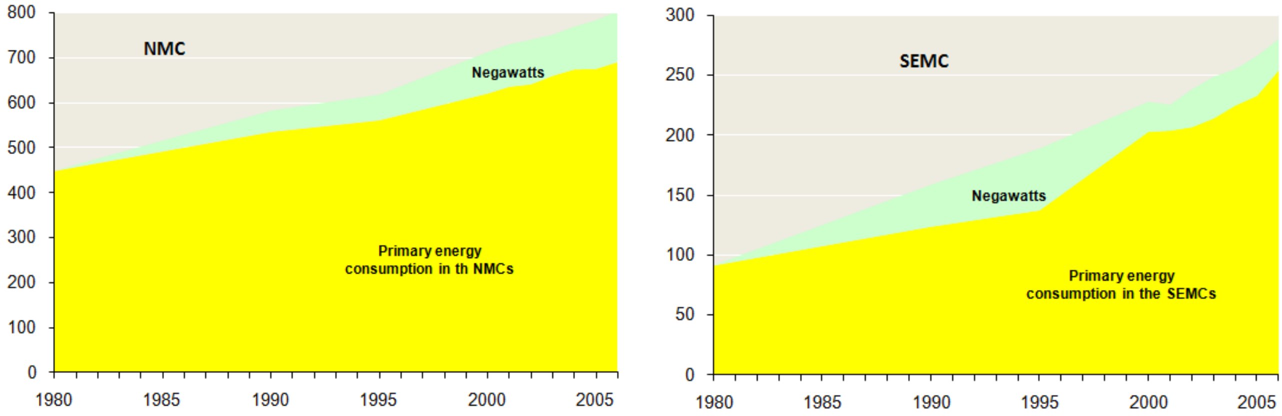
[10] Energy Intensity (EI) is the energy consumption/GDP ratio; the latter is reckoned in purchasing power parity (PPP) in order to take into consideration differences in standards of living.

[11] If one were to take the inverse of the EI, which represents energy productivity, the higher the latter, the higher is the production per energy unit (1 toe).

[12] Approach used by Bernard Laponche in "Prospective et enjeux énergétiques mondiaux: un nouveau paradigme énergétique" (Global Energy Prospects and Stakes: A New Energy Paradigm), 24-26 Nov 2006.

Figure 4 - Energy saving potential generated by the total energy intensity decrease



Source: Plan Bleu (State of the Environment and Sustainable Development in the Mediterranean - 2009, p. 49)

Managing to significantly reduce energy consumption amounts to effecting change on the energy and, in fine, the climate situation. Given this alternative, the task then consists in identifying, in the first place, the main energy consumption items in the Mediterranean.

The building sector emerges as one such item, while offering room for economically viable actions and ones that carry a strong social impact. It is, therefore, only natural that this study should focus on the opportunities and prospects offered by this sector in matter of energy saving.

2. The building sector in the Mediterranean: A key sector for energy saving

Accounting alone for over a third of the Mediterranean countries' energy consumption, the building sector should allow for up to 60% energy saving at fairly competitive cost. It is based on a more detailed consideration of the characteristics of this sector—right from a energy breakdown as per type of construction, through to a review of existing construction types in the Mediterranean—that we can specifically identify the priority measures likely to help achieve substantial energy saving.

2.1. The residential as a key leverage

2.1.1. Building: A particularly high energy-consuming sector with a proven saving potential

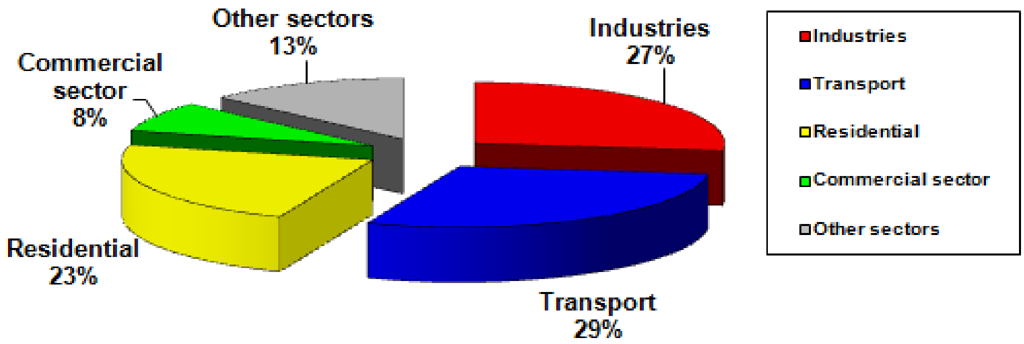
On global level, the building sector alone accounts for 35 to 40% of final energy consumption[13] and contributes by around a third to CO_2 emissions.

Besides, it is estimated that the energy saving potential in this sector is about 40%, and this, for the major part, via economically cost-effective measures. It is also an eminently strategic sector due to the long lifecycle of the buildings[14]: current constructions determine durably future consumptions on a permanent basis, and a well thought-out building, at design stage, will always be more efficient and less costly than a posteriori renovated building. While the renovation sector is crucial in view of the existing housing stock, new construction must be exemplary throughout.

[13] UNEP, WBCSD, IEA

[14] In France, for instance, the rate of renewal of the housing estate is around 1% per year.

Figure 5 - Share of the various sectors in final energy consumption on global level in 2007

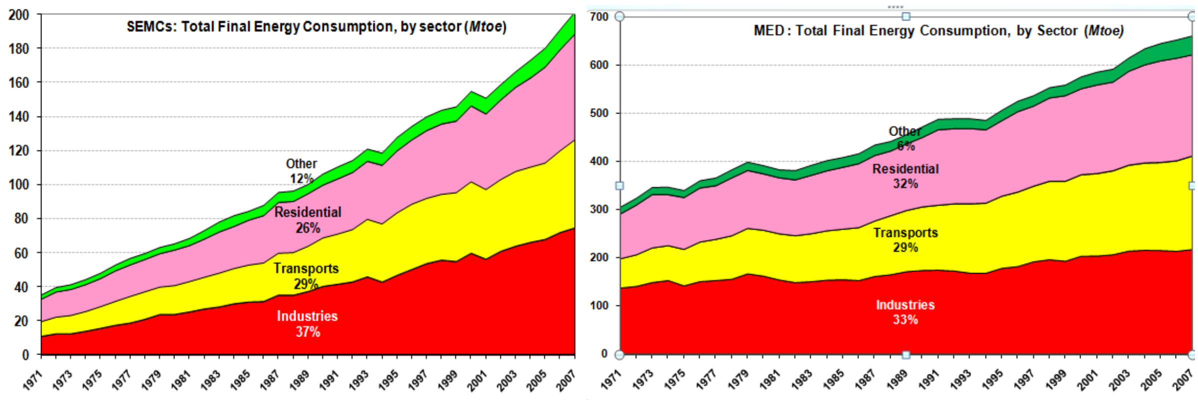


Source: IEA, Energy Balances of non-OECD countries, edition 2009
NB: The share of the construction sector is the agregation of the "Residential" and "Commercial" with a certain proportion of "Other sectors" (agriculture, services ...)

At Mediterranean level

The SEMCs and the NMCs are no exception to this observation since, on average, the building sector accounts for around 38% of the final energy consumed (this rate ranges between 27 and 65% in the SEMCs) and that a significant energy saving potential exists in this sector[15]. Pilot projects have revealed that, for an overcost of 10 to 25% at construction stage, up to 60% energy saving could be achieved[16].

Figure 6: Share of the various sectors in final energy consumption in the SEMCs



Source: IEA-Energy Balances, OECD and non-OECD countries, Sept 2009

2.1.2. "Residential" construction: Subject of this study

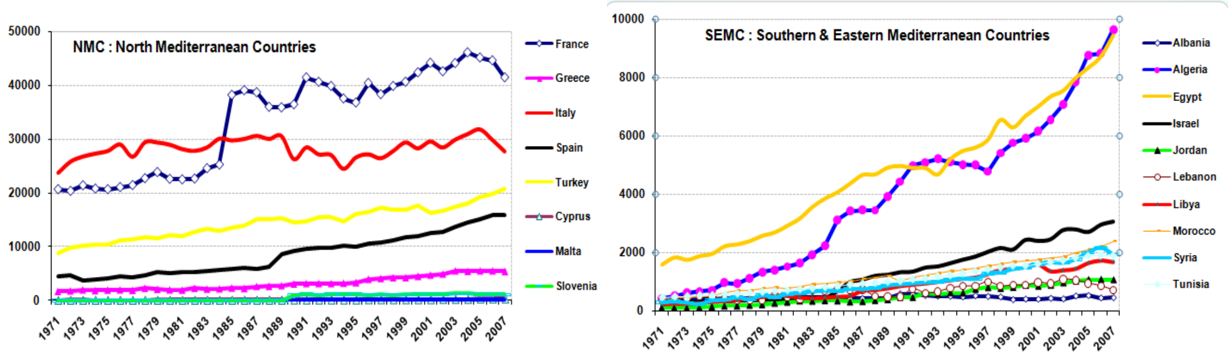
As mentioned above, the building sector accounted for around 38% of final energy consumption in 2007 in the Mediterranean. The share of the "residential" is dominant in this, with 26% of this final energy consumption in the SEMCs (that is, between 16 and 42% of the total according to the countries17) and 21% in the NMCs.

Besides, while the share of the residential sector in total final consumption can be regarded as having been stable, on the whole, over the past decade, consumption in absolute value has been steadily on the increase, having multiplied by over 2.5 between 1990 and 2007.

[15] Egypt National Consultancy, MED-ENEC, Egypt, May 2009.
[16] MED-ENEC
[17] IEA, 2007 data in "Energy Balances in non-OECD countries, September 2009"

If we now consider electricity consumption, the residential sector consume between 21% and 51% of the national power generation.[18] These trends are unlikely to be reversed in the years to come given the region's population growth and the rise in whole standards of living, which entails an increasing equipment rate.

Figure 7 - Energy consumption in the residential sector (in ktoe) (1971-2007)

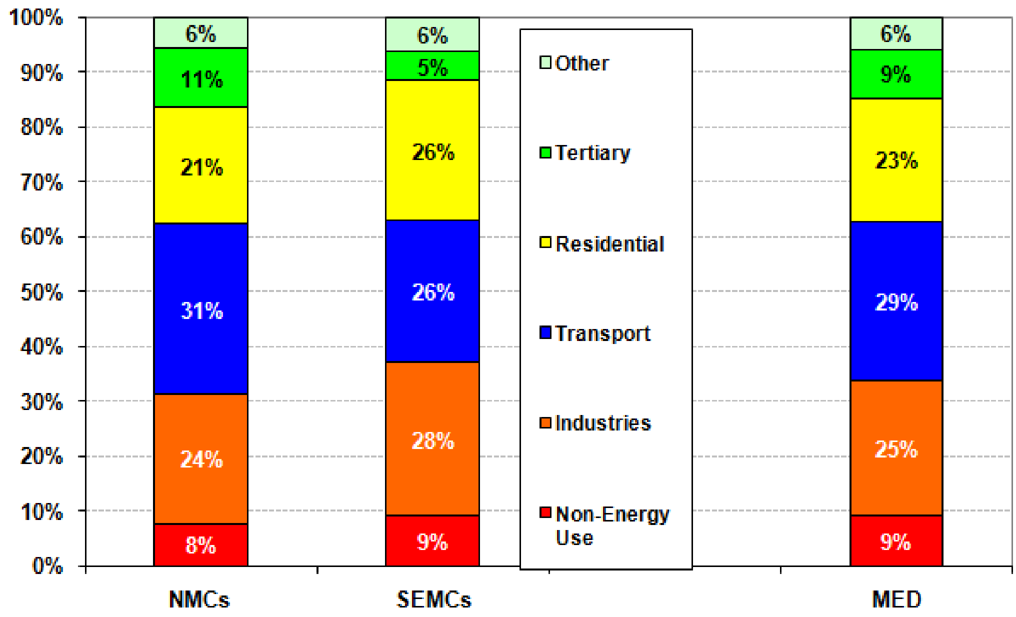


Source: Plan Bleu 2010 (*SEMCs data* from Medstat, except for Libya and Turkey, *NMCs data* from IEA - Sept 2009)

Figure 8 recalls the breakdown of sectoral energy consumptions in 2007 for the SEMCs together with a comparison with that of the NMCs. It is worth noting here that the building sector groups the shares for the "Residential", "Tertiary" and "Other".

While the prevalence of the "Residential" over the components designated "Tertiary sector" and "Other" is beyond any doubt in terms of energy consumption, it must be emphasized that data concerning the latter 2 components are extremely difficult to gather in a reliable way for the SEMCs. Additional data collection work must be carried out.

Figure 8 - Sectoral energy consumptions in the Mediterranean in 2007



Source: Plan Bleu (calculations based on IEA-Energy Balances, 2009)

Accordingly, this study has elected to exclusively focus on the residential, knowing that this sector accounts for over 70% of the emissions due to the building sector and that the data relating to this sector are sufficiently precise to constitute a baseline for prospective scenarios.

[18] Algeria : 51%, Egypt : 31%, Israel : 28%, Jordan : 31%, Morocco : 25%, Syria : 36% and Tunisia : 21% (IEA, 2007 data in "Energy Balances in non-OECD countries, September 2009"). For the Palestinian Territories, this share stands at 24% (source: ADEME, 2009). Finally, for Lebanon, this share amounts to 65% for the residential and tertiary (MEDSTAT II, 2009).

2.2. Overview of current construction patterns: High energy use of the recent housing buildings in the Mediterranean

Figure 9 - Sid Boussaid in Tunisia

While the NMCs, member of the EU, have already engaged action towards enhancing the energy efficiency of buildings (see Part 3.1), recent building history in the SEMCs is marked by a construction standardization trend copied on a construction model which could be qualified as "international". Indeed, since the past century, the increasing predominance of major international construction groups in the Mediterranean region has only exacerbated this phenomenon and accelerated the loss of ancestral know-how. Once built in thick walls, with few openings onto the outside, and characterized by a sound heat insulation, housing units today are, first and foremost, made up of thin concrete walls and poorly insulated flat roofs, if not metal sheet roofs for the more modest dwellings...

Table 1 offers a description of the main construction developments in the SEMCs and their main consequences.

Examples like the "musharrabyah", or the Es-Suhaymi house in Cairo, or Sid Boussaid homes in Tunisia: an element of traditional architecture.

At the architectural level:

- Adjustment of house alignment / an esthetic contribution
- Increasing the useful area without enlarging the plot
- Private area observance: this ensures seeing without being seen

As regards thermal comfort:

- Inside:
  - protection from the sun
  - incoming outside fresh air: creating a stream of air through the house
- Outside:
  - shade over the street and the lower floors
  - refreshing outside air

The recent generalization of unsuited construction practices and of a “globalised” architecture, relying more on equipment (heating and air-conditioning) than on the outer structure (envelope) to ensure comfort conditions, is particularly a reason for concern. Indeed, access to heating and artificial air-conditioning remains a luxury for most families and many are now led to live in thermal discomfort. Such a situation entails adverse impacts on health and on individual productivity and is not viable in the long term....

Table 1 - Summary description of construction trends

	Traditional architecture	Modern architecture	Evolution + and -
Setting Layout			
Urban profile	Collective management of weather changes	More marked individualism	Less mutual solar protection of buildings
Joint ownership	High	Low (except in high-pressure land property)	Higher exposure to weather elements (outside temperature, sun)
Inside planning	House constructed around a patio, with all rooms opening onto this patio. Corridor around the patio.	Houses are no longer provided with a patio; they are constructed around a main room, the living room.	Disappearance of the patio and loss of its many heat advantages Interconnection of the rooms
Entrance	The entrance (front-room, called sqifa) is a kind of a zigzag anti-chamber, thus evading outsider's looks.	The entrance has become more straightforward, though it is still placed close to the living room in order to avoid direct access by the guests to the other parts of the house.	Disappearance of the front-room (sqifa)
Utility rooms	The kitchen is remote from the other rooms, to ward off odours.	The kitchen has become a room like any other and, hence, is no longer remote from the other rooms.	
Apertures/ Openings	Of small size measurements and close to the ground.	Larger apertures than was the case for traditional architecture, often provided with a air-conditioning system set up after construction of the building.	Impact and questionable usefulness of larger apertures.
Construction pattern			
Walls	There are several wall types, according to the materials used Stone walls Earth walls Wood-frame walls Thatch **walls**	Walls Bearing structures of post / girder / hollow brick masonry type	Significant reduction of materials thickness → lower insulation Use of earth on the wane
Wall surfacing	Surfacing imperviousness (water-tightness) filling uneven surfaces Coating (lime, earth, organic matter) imperviousness (water-tightness) aesthetic outlook regular application Ceramics (tiling)	Surfacing (plaster, lime, cement based) Ceramics (tiling) Coating	Preference for sustainable application, avoiding seasonal application
Horizontal crossing structures	Floors: Wooden floors: wood or plywood Vaults: stone built Cupolas	Floors: Two types: - Wooden floors - Concrete floors	
Roofing	Flat roofs Sloping roofs Cupola	Flat roofs Sloping roofs	Insufficient heat insulationThe cupola used to present a certain heat advantage (radiative cooling)

Source: After Mohamed Abdessalam, Adel Mourtada, “Etat de l'art dans le domaine de la maîtrise de l'énergie dans le domaine des pays tiers méditerranéens” (State of the Art in the Field of Energy Efficiency in Mediterranean Third Countries), ADEME/ SOLENAR agreement – Final Report, February 2006 & Stéphane Pouffary

2.3. A twofold strategy

Construct highly energy efficient buildings and provide for a renovation of the existing housing stock

Within the framework of this study, it was decided to focus, as a first step, on "new" buildings of the formal sector, knowing that an inventory of legal, technical and financial actions bearing on "existing" buildings should form the subject of a complementary study. Indeed, operator interaction in matter of "new" buildings and "existing" buildings is not the same, and it is not possible to extend the recommendations made for the "new" to the "existing".

Moreover, the significant deficit of housing in most of the SEMCs was such that most of the countries concerned have launched large-scale construction programmes for the coming years (see Part 2). In view of the quantitative objectives set, this situation is likely to cause the rise of many housing units that are designed and built "in haste"… This sector is, therefore, of paramount importance when it comes to avoiding rebound effects that are harmful for the region.

Figure 10 - Examples of unsuitable practices and architectures for SEMCs

Algiers

Amman

Cairo

Rabat

Photos credits: Stéphane POUFFARY

3. Enhancing the energy efficiency of the building sector: Current measures and real barriers

The enhancement of energy efficiency in buildings is a two-speed phenomenon in the Mediterranean. Most of the NMCs, prompted by the EU, have already put in place a strict and binding legal framework which has facilitated the effecting of several measures. On the other hand, the SEMCs present contrasted situations which largely depend on the progress state of their regulations, and on their actual enforcement when the latter do exist. This Part is advisedly dedicated to the SEMCs, stock-taking of the regulations on the northern rim of the Mediterranean being dealt with in detail further down (Part 3.1).

3.1. Thermal regulations and other national and international initiatives

3.1.1. Thermal regulations: An indispensable basis for action, but difficult implementation on the ground

In the building sector, setting out thermal regulations is often a crucial first step towards a dissemination of energy efficiency. Indeed, designing thermal regulations already implies an appreciation of the current situation and a consideration of the potential savings to be achieved. In practice, it is essential to identify a climatic zoning, conduct an impact assessment study of the various parameters of the building shell on heating consumption and cooling requirements, carry out an impact assessment study in economic terms and CO_2 emissions, set out a performance (efficiency) threshold and put forward appropriate measures. Thermal regulations constitute a minimum requirement for the housing units to be constructed and are liable to periodical review.

The regulations generally stipulate the requirements in matter of energy performance (efficiency) of the shell (thermal insulation, rates of glazing per orientation, solar protections, etc) and may urge for covering a portion of the energy needs by renewable energies. Lastly, they generally require efficient systems of heating, air-conditioning, production of running hot water and lighting.

Various more or less successful attempts at setting out thermal regulations have been made by the SEMCs. In the early 1990s, the European Commission thus co-financed a Maghrebi Thermal Regulation of Buildings (RTMB) project involving Algeria, Morocco and Tunisia.

In Morocco and in Algeria, only the first phase of the project concerning the preliminary studies was implemented. In Morocco, a Global Environment Facility (GEF) project, over the period 2008-2012, with a $ 15 million budget should allow the design of thermal regulations in the residential, commercial buildings and hospital sectors.

Tunisia, on the other hand, is the most advanced Maghreb country today in matter of thermal regulations, as a GEF/ FFEG)/ AFD project, conducted from 2000 to 2006, carried out to a successful conclusion the approach incepted by the RTBM project. Tunisia thus has had, since 2008 a mandatory thermal regulation for new buildings. Being as yet voluntary, various exemplary operations have been conducted for purposes of demonstration and awareness-raising purposes among the building sector operators[19].

Another project supported by GEF (2002-2005) in Lebanon and in the Palestinian Territories has led to drafting a simplified and theoretical document on the thermal envelope of buildings, though remaining unimplemented as yet, all the more so as this document is voluntary. In Lebanon, this initiative followed upon a pilot project for the promotion of energy efficiency in buildings (ALMEE-ADEME; FGEF-AFD) whose objective was to demonstrate the technical and economic feasibility of energy enhancement in collective housing, in particular via 5 demonstration sites.

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[19] Cf. web site: www.enerbat.nat.tn

In **Egypt**, a UNDP/ GEF[20] project has led to the formulation of thermal regulations for new residential buildings whose enforcement Decree dates to December 2005. These regulations remain, however, voluntary and are, to date, largely unimplemented.

In **Syria**, a "Energy-Efficient Building Codes in Syria" project, launched by the UNDP and the GEF, led to designing obligatory thermal regulations in late 2008, but which remain as yet unimplemented.

Israel has had thermal regulations since 1998 and has, as from 2005, developed a voluntary standard called *Green Buildings.*

For **Lebanon**, there are voluntary certifications (such LEEDS) called CEDRE for industrial buildings and ARZ for buildings of service sector (tertiary) which started in 2011 and work continues to hit residential buildings, a number of points to certify these green building is attributed to energy efficiency

Table 2 (see paragraph on institutional mechanisms) helps appreciate the progress status in terms of thermal regulations for each of the SEMCs.

Accordingly, and as mentioned above, most of the residential buildings are constructed without thermal insulation (except partly in Israel and in Turkey).

Yet, thermal insulation of buildings has become for two decades a core component of governmental energy policies. Thermal insulation standards have either been set out or are in design process in these countries, but their implementation remains low, if not non-existent.

The main limitation of these various cooperation programmes whose objective was to set out thermal regulations is that they have fallen short of actual implementation. The difficulty of an actual implementation of these thermal regulations is due to several reasons, of which:

- no instrument has been really put in place to control their implementation;
- these thermal regulations are sometimes copied on imported models and do not correspond to the reality of the local climate and know-how, or still to the materials and technologies locally available.

Given the stakes, and given the results of pilot projects, measures of regulatory actions or standards have gradually been adopted by the riparian countries.

Countries	State of Regulatory
Algeria	Regulation Technical Document (DTR) in 1996 Obligatory since 2000
Egypt	Standard thermal insulation required in 1998 EE Code in buildings for residential mandatory in 2003 EE Code in buildings for tertiary volunteer in 2005
Israël	Thermal Standard Residential 1986 Office 1998 Mandatory Implement. Good Green Buildings code 2005 volunteer. Implement.: Low
Jordan	Standard thermal insulation 1990 EE Code in buildings required (being adopted)
Lebanon	Standard insulation in 2005, revised in 2010
Morocco	Current regulations; Cf National Program for EE in the building that is the introduction of a Building Energy Code. The year 2010 saw the development of the technical elements of the proposed thermal building regulations in the residential / tertiary sectors.
Syria	EE Code in buildings required in 2008
Tunisia	Thermal regulations required for office in 2008 Thermal regulations mandatory for collective residential buildings in 2009
Turkey	Standard thermal insulation 2000 Mandatory standard

Source: Plan Bleu, A.Mourtada (Lebanon), R.Missaoui (Tunisia) & Med-Enec

[20] The Energy Efficiency Improvement and Greenhouse Gas Reduction project (1999-2007) also comprised a component on setting out energy efficiency standards for 3 electric household appliances: washing-machines, refrigerators and air-conditioners. As from 2003, a Decree issued by the Ministry of Industry requires local manufacturers and importers to specify the energy efficiency of their products by displaying a energy efficiency label.

3.1.2. International and regional programmes underway

Several programmes address the issue of energy efficiency in the building sector, be they at global level (ESWB, SBCI, etc) or at regional level (MED-ENEC, IB-Med, or the RTMB project mentioned above, etc). One of the stakes of this study is thus to derive the lessons learnt from the progress made in terms of appreciation of the mechanisms and opportunities of the building sector, with a particular consideration of SEMCs specificities.

Indeed, despite the various initiatives and cooperation projects aimed at setting out thermal regulations of buildings or at conducting pilot projects, the building sector in the SEMCs remains still quite largely indifferent to energy saving measures, even though qualified opinion must be brought to bear on the case of Turkey, engaged in a EU pre-accession process, Israel or even Tunisia where progress has been observed.

Energy Efficiency Agencies and their "MEDENER" association

The establishment of such agencies is revealing of a will to act at State level as they are tasked in particular with contributing to setting out and enforcing standards and that they constitute a key interlocutor for the various stakeholders. The room for manoeuvre offered to such entities depends, however, on their history, their status (extent of autonomy) and their human and financial means. Thus, one cannot compare the case of Lebanon, where there is not a designated agency dedicated to this subject but various associations of which ALMEE and LCEC[21], a non-profit associations with no permanent members, with that of Tunisia, where the National Agency for Energy Efficiency (ANME) has the status of national agency, with a staff body of 130 employees (in 2006) and a budget amounting to 15 million € (Senit, 2008). The national energy efficiency agencies of the Southern Mediterranean rim are given in Table 2 (see paragraph on institutional mechanisms).

The association MEDENER, established in 1997, groups the entities entrusted with energy efficiency of 12 Mediterranean riparian countries[22]. Its objectives are to promote the exchange of best practices among the countries of the two rims of the Mediterranean and to sustain regional initiatives in the field of energy efficiency. MEDENER has a rotating presidency, and it is the new General Manager of ADEREE (Morocco), Mr. Said MOULINE, who was elected as incumbent at the last General Meeting held on 12 of May 2010 in Valencia (Spain).

The Union for the Mediterranean (UfM) and the Mediterranean Solar Plan (MSP)

The Union for the Mediterranean (UfM) was launched on 13 of July 2008 and groups 43 member States. It aims at promoting a new Mediterranean-wide cooperation and development policy. For so doing, the Union for the Mediterranean seeks to implement concrete projects tailored to the main challenges which the countries of the two Mediterranean rims are confronted with. The Mediterranean Solar Plan (MSP) belongs in the six large-scale projects of regional interest. The MSP aims mainly at building a 20 GW "low carbon" power production capacity by 2020 and the development of an interconnection of the networks in order to particularly facilitate the export of part of this green electricity to Europe. While this component of the plan may seem, in actual fact, as an issue the MSP also includes "the investing of significant efforts in energy demand management and in boosting energy efficiency and energy saving in all countries of the region". The MSP does not give access to additional financial resources, but it can help foster a investment dynamics in the countries of the region and facilitate the emergence of quality projects by serving as a coordination factor among the various parties concerned.

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[21] Lebanese Association for Energy Efficiency and the Environment (ALMEE) and Lebanese Centre for Energy Conservation (LCEC).

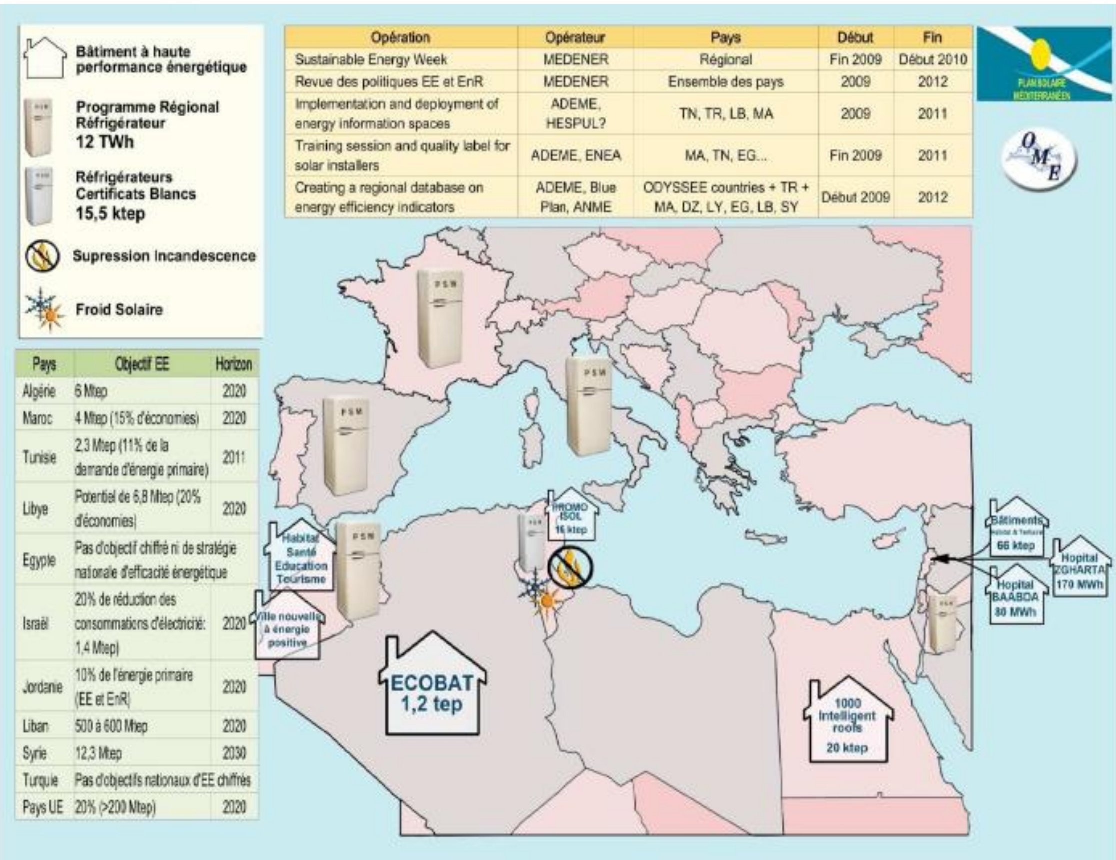
[22] Agence pour la Promotion et la Rationalisation de l'Utilisation de l'Energie (APRUE) for Algeria, Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME) for France, Centre for Renewable Energy Sources (CRES) for Greece, Agence Nationale Italienne pour les Technologies Nouvelles and Energie et l'Environnement (ENEA) for Italy, National Energy Research Centre (NERC) for Jordan, Association Libanaise pour la Maitrise de l'Energie et l'Environnement (ALMEE) for Lebanon, Palestinian Energy and Environment Centre (PEC) for the Palestinian Territories, Centre de la Conservation de l'Energie (ADENE) for Portugal, Institut pour la Diversification et l'Economie de l'Energie (IDAE) for Spain, National Energy Research Centre (NERC) for Syria, Agence Nationale de la Maîtrise de l'Energie (ANME) for Tunisia, as well as ADEREE (Agence Nationale pour le Développement des Energies Renouvelables et de l'Efficacité Energétique), the new agency set up in replacement of the former CDER (Centre de Développement des Energies Renouvelables) for Morocco.

The Euro-Mediterranean Investment and Partnership Facility (FEMIP), which groups the set of instruments provided by the European Investment Bank (EIB) in the Mediterranean partner countries organized its 8th Conference from 10 to 12 May 2010 in Valencia (Spain) on: "Energy: New Challenges for the Mediterranean". The conference was focused on the energy challenge in the Mediterranean, with such major topics for reflection as the importance of a institutional, legal, economic and financial framework that provides incentives for and is conducive to investments in renewable energies, innovation and the set up of instruments likely to promote energy efficiency and the development of, and access by, the electricity produced by renewable energy sources to the power grid. The results of the preliminary of study conducted on the Mediterranean Solar Plan projects were also presented on this occasion.

Mr. Philippe de Fontaine Vive, EIB Vice-President, pointed out that developing renewable energies and energy efficiency is one of the six priorities adopted in July 2008 by the first summit meeting of the UfM. Actually, EIB was entrusted in November 2008 with drafting a roadmap for the Mediterranean Solar Plan. The study related to the following objectives: (i) identification of the renewable projects envisioned by the various countries up to 2020 and which are likely to fit into the MSP; (ii) analysis of the main economic impacts of developing the projects identified (investment, difference between renewables (RE) costs and those of the substituted energy, and CO_2 emissions reduction); and (iii) identification of the main barriers to the implementation of the projects, namely technical, legal and financial.

According to the preliminary results, the RE projects identified up to 2020 (ranging from 4.1 to 10.3 GW) relate to investment needs for the identified capacity (ranging from 7 to 21 billion €), as well as to remove three main barriers to the implementation of these projects: financing, regulations and interconnection and electricity grid capacity. From the various presentations, it emerges that a transfer of large quantities of green electricity from North Africa to Europe will require a major scale-up of the interconnection and electricity grid capacity between the two regions.

Figure 11 - "Immediate Action Plan (IAP) 2009-2010" of the Mediterranean Solar Plan



Source: OME, 2008

3.1.3. Other national initiatives

Besides the national energy efficiency agencies mentioned above, other mechanisms are in force in certain SEMCs to promote energy efficiency (EE) in the building sector. A sample of these various measures is given further down. They represent the basis for action in the coming years, while also revealing the gaps existing in certain countries of the region.

Institutional mechanisms

There are indeed, alongside with these agencies, other institutional mechanisms that are worth mentioning. Thus, in Algeria, there is a "Cross-Sector Energy Efficiency Council – CIME" (Conseil Intersectoriel de la Maîtrise de l'Energie) which is a body facilitating consultation among stakeholders: representatives of public authorities, local government, funding agencies, energy companies, researchers, professional associations, etc. Another example is found in Tunisia: there, the Interdepartmental Council (CI) dedicates at least one meeting per month for energy efficiency policy.

The existence of such mechanisms facilitates decision making and the monitoring of energy efficiency policies. It is worth noting that the national agencies implement the national policies and action plans and contribute themselves to setting out an appropriate legal and incentive framework.

Various support mechanisms

For thermal regulations to be concretely implemented, support mechanisms are necessary. The following Table 2 gives an overview of the various mechanisms whether deployable or not in the SEMCs. It is worth pointing out that this table has been worked out based on available information and expert opinion as to actual implementation of the measures concerned.

There is, therefore, an achievement that must be recognised. It is, nonetheless, undeniable that the various bodies and initiatives in place need to be strengthened in order to address the arising challenges.

Table 2 - Types of measures for energy efficiency implemented by the SEMC

	ALG	MOR	LYB	TUN	EGY	PAL	ISR	SYR	LEB	JOR	TUR
Energy efficiency dedicated agency	Yes (APRUE)	In progress (ADEREE[23])	No	Yes (ANME)	Yes (OEP/NREA)	Yes (PEC)	No	Yes (NERC)	No	Yes (NERC)	Yes (EIE)
National EE programme	Yes	Yes	No	Yes	Yes, but incomplete or unimplemented	No	No	No	No	No	Yes
National EE law	Yes	In progress	No	Yes	No	No	No	No	No	No	Yes
Electric household appliances labels and standards	In progress	In progress	No	Yes	Yes	No	Yes	Yes, but incomplete or unimplemented	Yes, but incomplete or unimplemented	Yes, but incomplete or unimplemented	Yes
Thermal regulations	Yes, but incomplete or unimplemented	In progress	No	Yes	Yes, but incomplete or unimplemented	Yes, but incomplete or unimplemented	Yes	Yes, but incomplete or unimplemented	Yes, but incomplete or unimplemented	Yes, but incomplete or unimplemented	Yes
Mandatory energy audit programme	Yes	No	No	Yes	No	No	Yes	No	No	Yes, but incomplete or unimplemented	In progress
EE dedicated fund	Yes	No	No	Yes	Yes	No	No	No	No	No	No
Reduction of taxes and duties (tax incentives)	No	Yes, but incomplete or unimplemented	No	Yes	No	No	No	No	No	No	No
Subsidies and concessional loans	Yes, but incomplete or unimplemented	No	No	Yes	No	No	Yes	No	No	No	In progress
Awareness-raising campaigns	Yes	Yes	No	Yes	Yes	No	Yes	Yes, but incomplete or unimplemented	Yes	No	Yes

Source: Pascal Augareils

Green	Yes
Yellow	In progress
Orange	Yes, but incomplete or unimplemented
Red	No

[23] In Morocco, CDER (Centre de Développement des Energies Renouvelables/ Renewable Energies Development Centre) was recast in May 2010 into a National Agency (ADEREE) and is, henceforth, also entrusted with the implementation of the energy efficiency policy.

3.2. Barriers to the implementation of energy efficiency measures in the building sector

Besides the technical, economic and legal barriers, various other aspects hinder a large-scale dissemination of energy efficiency in the building sector: these are information related, organisational and social barriers.

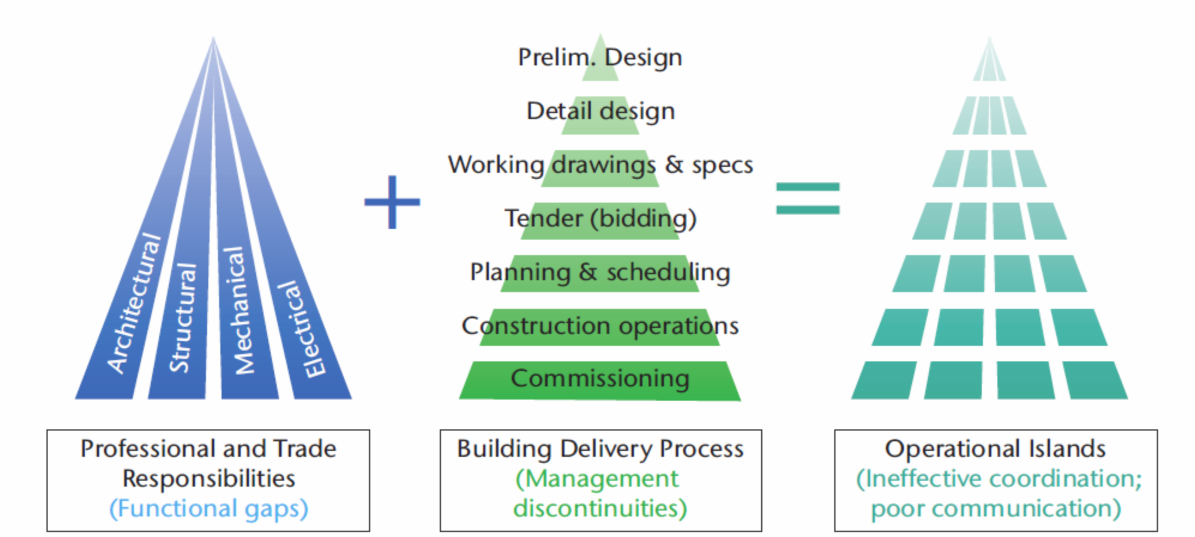
3.2.1. Building: an intrinsically complex and disparate sector

First of all, the building sector is quite fragmentary and mobilizes a multitude of actors over a long time, which adds difficulty to a large-scale action in matter of energy efficiency. This is all the more true when one considers that any ambitious undertaking to have high environmental quality building must belong in a consistent urban development approach[24]…

Indeed, energy efficiency measures in the building sector are by definition of a disparate nature in the sense that only an aggregation of actions and a combination of technologies will make it possible to achieve a significant result. It is, therefore, necessary to adopt a comprehensive and integrated building sector-wide approach, which implies coordination between the various actors and makes induction costs all the more important.

Figure 12 illustrates the complexity of the actors' interaction in the building sector. The diversity of the professional sectors mobilized (1st pyramid), coupled with a quite fragmented construction process (2nd pyramid), make this sector extremely complex and difficult to encompass (3rd pyramid).

Figure 12 - Fragmentation of the building sector



Source: World Business Council for Sustainable Development (WBCSD), 2007

Moreover, quite often, the various stakeholders of the building sector (construction professionals, architects, financiers, owners, tenants, etc) have divergent vested interests. The most typical is the divergence between owners and tenants: the former seeking above all to keep the construction costs down, and the latter seeking above all to keep housing operating costs down. In addition, the tenant is seldom willing to invest in energy efficiency measures, in particular those concerning the building envelope, as the latter would lose the return on his/her investment when leaving the premises.

[24] Thus, an urban development approach and, hence, a consistency between the building and the manner in which it fits in its environment, are crucial in any energy efficiency approach to the building sector. Proximity to public transport, existence of collective heating or cooling networks, provision of green spaces, functional neighbourhood mixes (housing, shops, offices, recreation areas, etc) are some of the items fostering and ensuring sustainability of greater energy efficiency.

3.2.2. Unsuited international instruments: Example of the Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM) is one of the flexibility mechanisms of the Kyoto Protocol which can normally be used to promote energy efficiency projects in the SEMCs. The CDM makes it possible for the Kyoto Protocol Annex I countries (industrialized countries) to finance renewable energies (RE) and energy efficiency (EE) projects in non-Annex I countries (i.e., developing countries). These projects are co-financed by investors from the North (countries or companies) which receive, in exchange, emissions permits. It thus allows access to financing for projects for which a technology transfer allows an unquestionable additionality and a measurable reduction of greenhouse gas (GHG) emissions. As the countries of the Northern Mediterranean rim are moving gradually to a requirement of low consumption buildings for all new constructions (probably by 2019 at European level) a technology transfer between the two rims is becoming increasingly essential.

However, there is a two-fold difficulty in the implementation of CDM projects in the building sector in the SEMCs. This two-fold difficulty consists in:

- Barriers due to the geographical zone itself and its fairly low attractivity for investor: indeed, according to the OECD provisional classification for 2009, "country risk"[25] for the SEMCs is generally considered as being fairly high: a maximum (category 7) is attributed to Lebanon. Libya and Syria are ranked 6, Jordan 5, Egypt and Turkey 4, and the other countries 3 (the Palestinian Territories are not ranked). The investment climate is, thus, set to become more attractive not only for foreign investors, but also for nationals.
- Barriers related to the type of actions concerned: Besides the fact that energy efficiency projects carry less return on investment than others, an additional difficulty lies in the fact that the CDM rests, first and foremost, on a given technology, while energy efficiency measures in the building sector cannot be effective unless they combine several technologies. This makes it complex to develop a project within the framework of the CDM and implies cumbersome and costly control and monitoring systems. Moreover, there is still a lack of entry data for setting out a baseline scenario from which the avoided emissions are calculated and, hence, the emissions certificates, are delivered. Lastly, as has already been noted, better energy efficiency does not systematically result in a measurable reduction in consumption and, hence, in GHG emissions, when electrical equipment is added within the framework of new constructions (new electric uses). In addition, the more intangible impacts, such as a behavioural shift, are not taken into account by the CDM.

Broadly speaking, very few CDM projects have been registered in the SEMCs[26] to date: as at end September 2009, sixty one (61) projects were validated or were in validation process (that is, 1.3% of all CDM projects validated or in validation process worldwide), with none of them concerning energy efficiency in the residential sector, except—significantly enough—for the carbon credit sale contract entered between the National Energy Efficiency Agency (ANME) and ORBEO (French joint venture between Société Générale and Rhodia) concerning the solar thermal programme, called PROSOL[27].

A proof that this situation is not peculiar to the Mediterranean region, there are currently worldwide only 21 projects related to energy efficiency in the residential sector, that is, 0.45% of the whole projects, accounting for around 0.15% of the certified emissions reductions to be delivered[28]. The attractivity of this type of project is thus very low, and it is necessary to urgently proceed to upgrading this mechanism so that it can more easily sustain hold-all projects of the "energy efficiency in the building sector" type.

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[25] Country risk, strictly speaking, is the likelihood that a country will service its external debt. Certain countries may present vulnerabilities with regard to international investments. The analysis of vulnerability vis-à-vis this type of risk becomes a necessity in financial risk management.

[26] It is worth noting that Turkey belongs in the Kyoto Protocol Annex I countries.

[27] The CDM - PROSOL project consists in the installation of 460 000 m² of solar water heaters in the residential sector over the period 2007-2011, which is likely to help avoid on average the emission of 35 000 tons CO2 equivalent per year.

[28] UNEP Risoe / CD4CDM : http://cdmpipeline.org/

3.2.3. A society still too reluctant to espouse the energy saving concept

Broadly speaking, and more specifically as far as the more well-to-do households are concerned, the concept of control over consumption is not always properly grasped and may be looked upon as the questioning of a more or less recently acquired comfort and consumption capacity. The concept of consumption is indeed still largely associated with social progress and synonymous with high social status. A paradigm shift from the consumption concept to that of comfort is thus necessary, but it requires a commensurate awareness-raising and information dissemination work.

It is worth mentioning here that a greater energy efficiency of buildings and, hence, a lighter household energy bill, at constant comfort, will not systematically translate into a decrease in consumption. It should also allow obtaining an enhanced comfort level without burdening the energy bill. This make-up phenomenon adds complexity to an appreciation of the results of the measures taken. Besides, this underscores the importance of conducting a sociological approach to energy efficiency which implies a consideration of building use in order to better grasp user aspiration.

In the light of this summary stock-taking of energy and buildings in the Mediterranean, it is easy to appreciate the level of complexity entailed by any mainstreaming of energy efficiency measures in construction projects. Lack of awareness-raising among the stakeholders, complexity of the building sector, geographical and structural unsuitability of certain support instruments and mechanisms are instances of the barriers that need to be lifted, and this, as promptly as possible. Indeed, the situation now calls for urgency: in fact, as demographic growth and accelerated urbanization present a sure sign of a high and imminent demand on new housing, it is essential to immediately act on the EE component of these buildings, insofar as the energy forecasts for the region give rise to concern, if not are alarming indeed…

III. Alarming trend scenarios at the horizon 2030

1. An alarming baseline scenario: Alarming evolution of the energy and climate situation

By 2030, the shortcomings of the current energy situation in the Mediterranean would be likely to become more marked. Indeed, in the face of an ever-increasing energy demand of a timid renewable production, energy dependence remains and is likely to increase. Geopolitically speaking, the implications of such a context are a reason for concern.

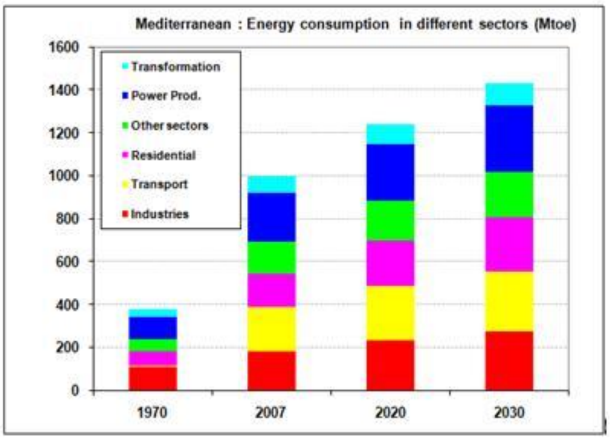
1.1. Significant increase in demand

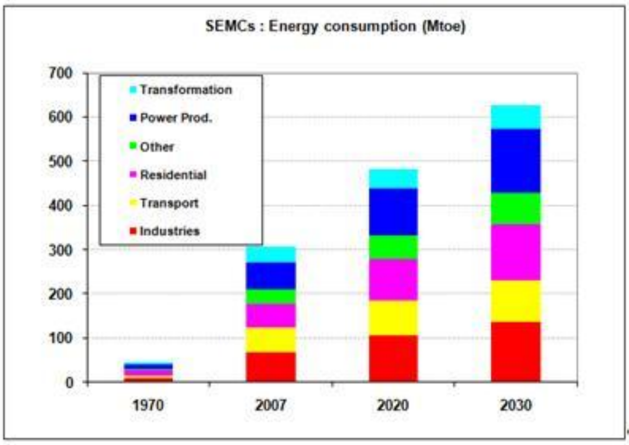
Total primary energy demand, Mediterranean basin-wide, is likely to be multiplied by 1.5 within the time frame 2030, passing from around 1000 Mtoe in 2007 to around 1450 Mtoe by 2030 (that is, an increase by 2.7 % per year on average). For the time frame 2030, the Mediterranean share of global energy demand is likely to remain fairly stable, that is around 9%. The SEMCs are set to report a energy demand growth rate that is four to five times higher (3.2%) than that of the NMCs, and their share in total consumption would pass from 30% to 42%.

Energy demand is also characterized by a significant growth of power demand. Indeed, power demand in the Mediterranean is much higher than economic growth, consumption of primary energy and demography.

The SEMCs, which will report a higher growth than the NMCs, will require an increased production. Economic and social growth in the SEMCs will stimulate power consumption in this zone: from 1730 kWh per inhabitant per year at present to around 3700 kWh by 2030. To meet demand in 2030, the countries will have to install more than 310 GW of new power plants and rehabilitate the old ones. More than a half of the additional constructions of new power production capacities will have to be carried out in the SEMCs.

Figure 13 - Sectoral energy demand in the Mediterranean and in the SEMCs





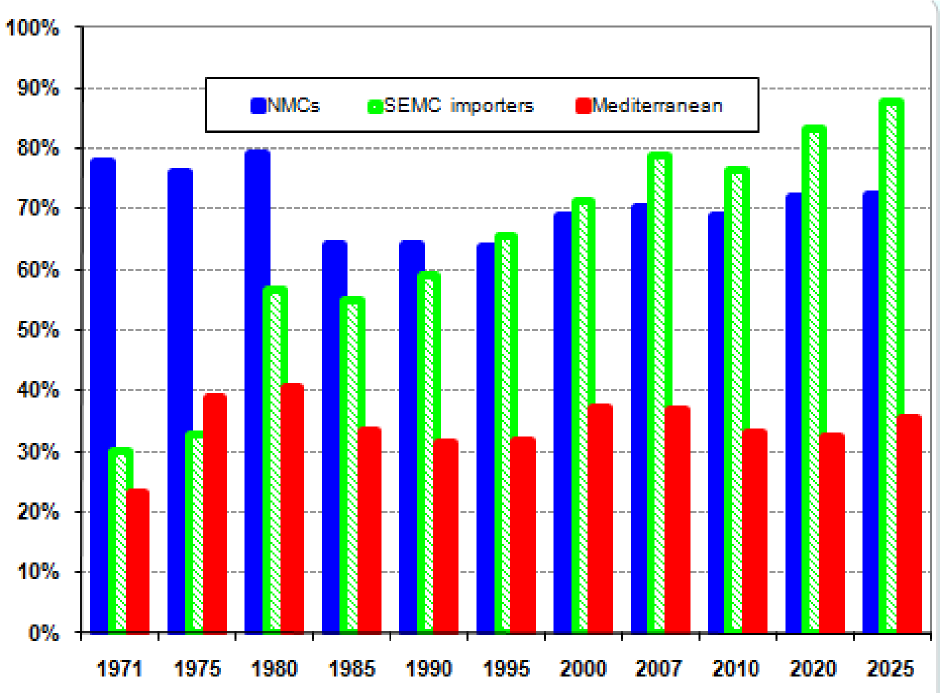
Source: Energy IEA-Balances, OECD countries and non-OECD countries, September 2009 for the retrospective, OME) and Plan Bleu for the prospective

1.2. Energy supply and energy mix below the needs

Fossil energy dependency will remain into 2025, and the region would be importing 39% of their oil needs and 28% of their gas needs.

Indeed, according to this baseline scenario, the energy future of the Mediterranean seems to remain mainly based on fossil energies, which would still account for around 80% of the primary energy demand by 2030. Oil would remain the dominant energy source with 36% by 2030. In spite of the development of gas for power production, demand on oil will continue to increase, together with the demand on fuels in the transport sector. Demand on gas is likely to double up, thus reaching over 500 billion m³ by 2030, and would account for 32% of the energy mix in the Mediterranean. Demand on coal would continue to grow at a rate of 0.8% per year on average, thus accounting for slightly more than 10% of the energy mix by 2030. Renewable energies will increase, starting admittedly from lower values, thus accounting for a mere ten percent (inclusive of hydropower) of the primary energy demand. Insufficient tapping of the renewable energies potential predicts, in this baseline scenario, an energy future in the Mediterranean which remains almost entirely based on fossil energies. Such a scenario is likely to have significant impacts, particularly in terms of GHG emissions.

Figure 14 - Total energy dependency (in %)



Source: Retrospective 1971-2007 (IEA 2009) and prospective 2025 (Plan Bleu 2009).
N. B.: The term "Mediterranean" designates the average between the Mediterranean importing countries ("North" and "SEMCs" importers) and exporter countries.

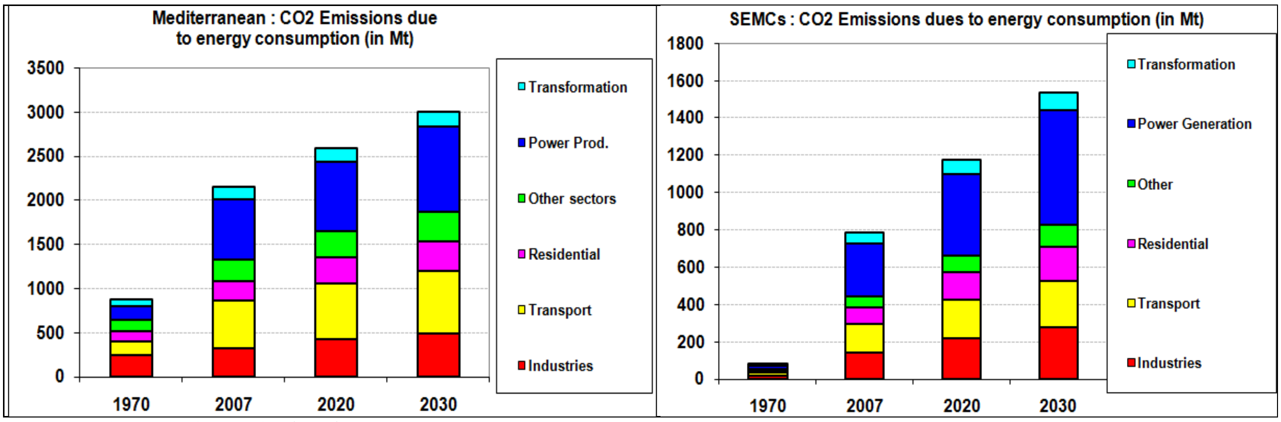
1.3. CO_2 emissions and a region particularly vulnerable to climate change

The Mediterranean region is subject to many risks. It is particularly sensitive to meteorological disasters and earthquakes. The historical vulnerability of Mediterranean cities is henceforth exacerbated by climate change impacts. The Mediterranean is one of the world's regions where global warming impacts are likely to affect the environment and human activities. A whole range of meteorological and physical risks, already affecting the Mediterranean, will have their impacts aggravated by rapid coastal urbanization and climate change: landslides, floods and forest fires. Coastal areas, both on the northern and southern rims of the basin, as well as high demographic growth zones (southern and eastern rims) where dense cities and suburbs are found, are among the most vulnerable. Mediterranean cities that emit GHG due to high energy consumption would be more affected than other regions in the world and must therefore be at the forefront for the development of climate change adaptation strategies.

This overwhelming impact is exacerbated by the consumption of fossil energies which generates significant effects in terms of CO_2 emissions: indeed, the latter are likely to double up in the SEMCs by 2030 (standing at around 1550 MT CO_2, representing a growth rate of 3 % per year.) In these same SEMCs, CO_2 emissions per capita passed from 2020 kg in 1990 to 2895 kg in 2007. They are likely to reach 4760 kg by 2030.

Yet, the SEMCs are particularly vulnerable to climate change, and such increases in CO_2 emissions cannot be treated lightly… Indeed, the SEMCs will bear the brunt of climate change more than other regions in the world, in general, and the Northern Mediterranean rim, in particular.

Figure 15 - CO_2 emissions due to energy activities (1971-2030; in MT CO_2)



Source: IEA (1971-2007), OME), Plan Bleu

The rise in temperature and the decrease in rainfall are likely to be more marked there. For the Mediterranean region, climate experts predict the following during the 21st century[29]:

- An increase in atmospheric temperature ranging between 2.2 C° and 5.1 C° for Southern European countries and the Mediterranean region over the period 2080 - 2099 compared with the period 1980 – 1999[30];
- A significant decrease in rainfall, ranging between -4 and -27% for Southern European countries and the Mediterranean region (while the Northern European countries would report a rise ranging between 0 and 16%)[31];
- An increase in drought periods, resulting in a high frequency of days where the temperature would exceed 30°C[32]. Such extreme events as heat waves, droughts or floods could be more frequent and violent;
- • A sea level rise which, according to some studies, would be around 35 cm by the end of the century.

Climate change impacts on the Mediterranean environment will concern particularly:

- Water, via a change in its cycle due to a rise in evaporation and reduction in rainfall. This water issue will be a core concern in the sustainable development challenge in the region;
- Land, via an exacerbation of the already existing desertification phenomenon;
- Land and marine biodiversity (animal and plant), via a displacement towards the North and in altitude of certain species, the extinction of less mobile or more climate change sensitive species and appearance of new species;
- Forests, via an increase in fire and parasitic risks. These impacts will amplify the already existing pressures on the natural environment related to anthropogenic activities.

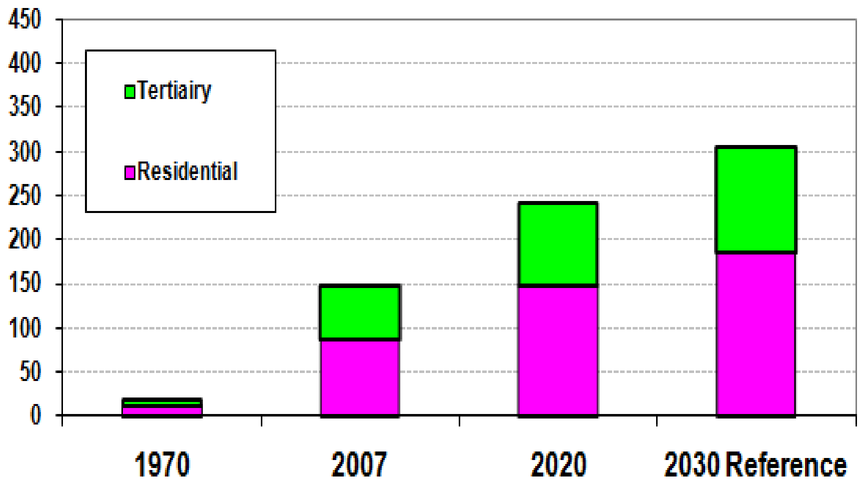
While the current energy situation is already gearing action towards a greater control over energy demand, the scenarios for 2030 only come to further confirm this priority.

Besides, the SEMCs experience dynamics and, hence, challenges and opportunities that are somewhat different from those of the northern Mediterranean rim. This dynamics pleads for an even more urgent action. At the same time, the standard of living of the population is improving, which translates, inter alia, into an increase in the equipment rate of households with, for example, a more widespread use of air-conditioning. This combination of a steady demographic growth and a rise in the average standard of living

[29] These forecasts are quoted from the report entitled "Climate Change and Energy in the Mediterranean" – Plan Bleu, July 2008.
[30] IPCC 2007, scenario A1B
[31] IPCC 2007, scenario A1B
[32] Giannakopoulos et al. 2005

entails an increasing energy demand, **particularly in the building sector with emissions of CO_2 increasingly important.**

Figure 16 - SEMCs: CO_2 Emissions in the Residential & Tertiairy sectors (in Mt)



Source: IEA for past figures, and calculations from Plan Bleu
NB : Are not included in this graph, CO_2 emissions due to electricity consumption in residential and tertiary sectors, which would double the level of emissions.

2. An unprecedented need for new housing

While the issue of a shortage of housing is shared by the two Mediterranean rims, the policies related to the residential sector vary considerably: the NMCs adopt a logic of renovation of existing housing, while the SEMCs undertake large-scale construction programmes. As mentioned above, action has to be targeted in priority order at new constructions, and this is why the section hereafter has elected to focus on the situation in the SEMCs.

2.1. Demographic growth and rapid urbanisation

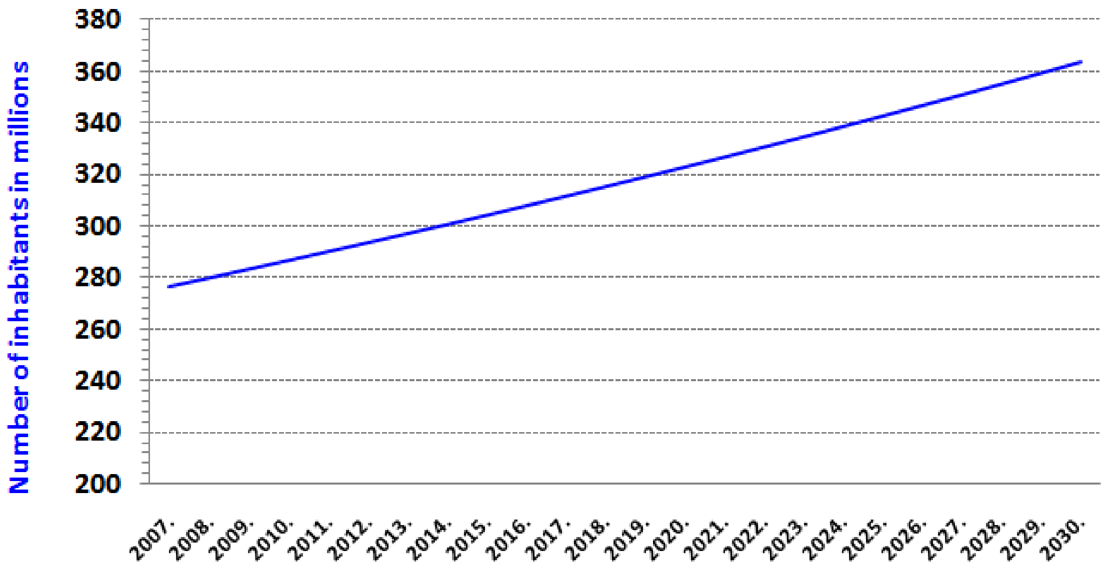
The SEMCs report a high demographic growth. The population has doubled up within the past thirty years and, though growth rates have been on the decrease since the 1970s, they remain high (generally in the range of 1.1 and 1.8%). The population of the SEMCs would thus reach 323 million inhabitants by 2020 and over 360 million inhabitants by 2030.

The rate of urbanization is quite high, too: the 2/3 of the Mediterranean population is urban today, and it is expected that over ¾ will be urban by 2030. In the Mediterranean, some thirty political or economic capital cities and a few metropolises of several million inhabitants concentrate the activities, financial resources and the most well-to-do population, while housing barely one third of the urban population of the countries concerned. Approximately 18% of the city dwellers live in 85 medium-sized cities (between 300.000 and 1 million inhabitants), and almost a half of the urban population lives in more than 3000 towns of less than 300 000 inhabitants.

In the Southern and Eastern Mediterranean Countries (SEMCs), these medium-sized and small cities report a high population growth while lacking resources and technical capabilities: thus, while a certain progress has been reported over the past twenty years in service provision, strong disparities persist between large and small towns, urban areas and peripheral areas, favoured and disfavoured neighbourhoods.

Rapidly increasing informal housing: This urban sprawl has been accompanied by a proliferation of informal housing. This phenomenon must be connected with rural migration, but it is also fostered by the urban population itself, given the cost of land and housing in the formal sector[33]. Thus, up to 20% of the population of Cairo is concerned by this phenomenon, and it is estimated that, on the whole, between 30 and 60% of the urban housing stock in the SEMCs would qualify as unregulated housing. This phenomenon is compounded by that of self-construction. The absence of legal control over these constructions, the legal uncertainty in which they are, and the low incomes of most of their occupants make this sector particularly impervious to energy efficiency dissemination measures. Finally, it must be pointed out that little data are available on this sector, other than fragmentary elements based more on expert opinion than on rigorous scientific and sociological studies.

Figure 17 - Population forecasts of the SEMCs (2007-2030)



Source: WDI 2009 for 2007, and UN World Population Prospects series (mean variance) for 2030

Figure 18 presents the evolution into 2030 of the main cities of the Mediterranean basin. It appears clearly that the cities whose population is likely to grow more rapidly are located on the Southern Mediterranean rim as a result of a two-pronged dynamics: population growth and urban sprawl.

These growth prospects of Mediterranean cities can only prefigure an aggravation of current problems that are already alarming, all the more so in view of the number of housing to be built and of the energy and power consumptions of the residential sector.

2.2. Consequences in terms of housing construction

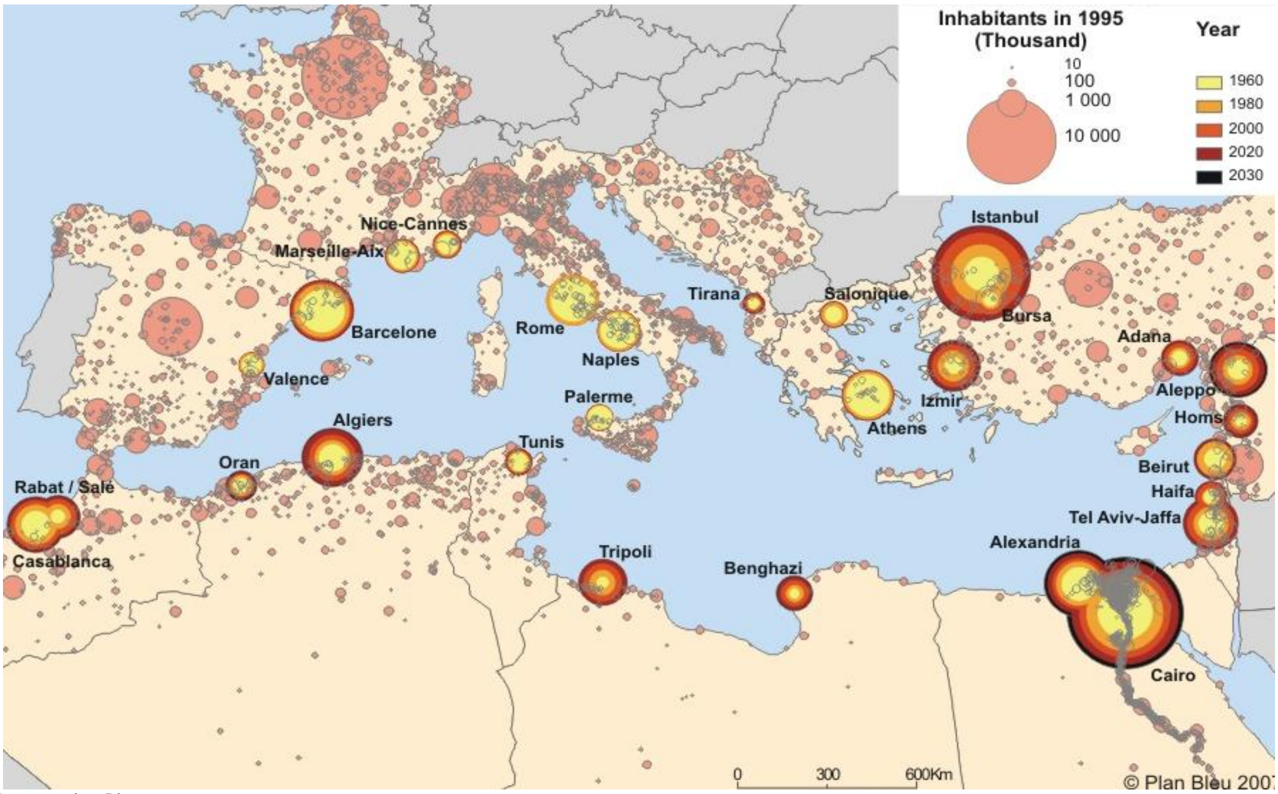
Based on the construction forecasts of new housing mentioned in the case studies conducted in Lebanon, Morocco and Tunisia and on a compilation of other forecasts comprised in the national publications of short and medium-term construction programmes (see further down), as well as on an extrapolation of these figures to the whole region, there are around 1.4 million housing units to be built in the SEMCs on a annual basis.

The number of new housing units is estimated as 1.6 million per year in 2010 and as 1.9 million per year in 2020, to reach 2.3 million per year in 2030. In other words, and as shown in the Figure 19, around 42 million new housing units would be built in the SEMCs by 2030 (passing from 66 million in 2007 to over 107 million by 2030).

[33] The formal sector may be defined as the whole range of economic activities subject to legal, social and fiscal legislation and which are reported in the National Accounts.

This high demand on new housing constructions can constitute an opportunity for a dissemination of energy efficiency in the building sector, namely via the large-scale programmes initiated by the various governments.

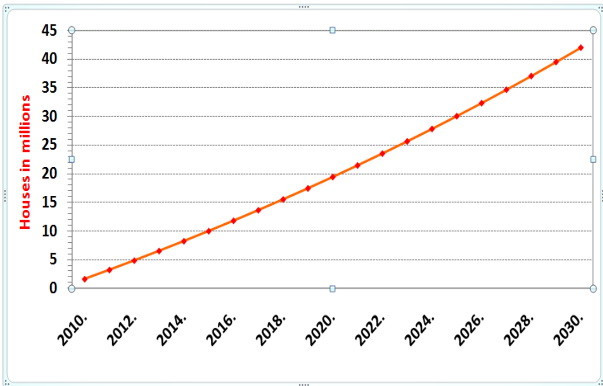
Figure 18 - Evolution of the cities of Mediterranean countries - Projections 2030



Source: Plan Bleu, 2007

Figure 19 - Projection of the number of new housing units in the SEMCs (H2030)

	Population (in millions)						Number of housing (in thousands)	
	2007	2030		% /year	% /year		2007	2030
				1971-2007	2007-2030			
Turkey	73,0	92,5	Turkey	2,0%	1,0%		23550	38528
Algeria	33,9	44,7	Algeria	2,4%	1,2%		6045	11468
Egypt	80,1	104,1	Egypt	2,2%	1,1%		19338	27387
Libya	6,2	8,4	Libya	3,1%	1,4%		919	1760
Morocco	30,9	39,3	Morocco	2,0%	1,1%		4748	7904
Tunisia	10,2	12,5	Tunisia	1,9%	0,9%		2494	3188
Israel	7,2	9,2	Israel	2,4%	1,1%		2087	3053
Palestinian Territories*	3,8	7,3	Palestinian Territories*		2,8%		480	1220
Jordania	5,7	8,6	Jordania	3,6%	1,8%		1199	2516
Lebanon	4,1	4,9	Lebanon	1,4%	0,8%		889	2463
Syria	20,5	29,3	Syria	3,2%	1,6%		3989	7917
SEMCs	275	361	SEMCs	2,3%	1,2%		65737	107404



Source: Population, source WDI 2009 for 2007and UN World Population Prospects series (mean variance) for 2025 and 2030; then Plan Bleu estimates for 2025 & 2030.

*Estimates by the author based on the demographic growth of the WDI 2009 - PALTEL (Palestine) states in 2005 more than 300 000 wirelines subscribers - http://www.financesmediterranee.com/pdf/pays/palestine38.pdf

2.3. Overview of selected construction/renovation policies in the SEMCs

While the housing deficit in the SEMCs is well proven, this phenomenon is not recent and many governments have already set out and implemented housing construction and renovation policies. According to the context of the country, these policies are focused on outright construction or, quite obviously, on restoration and rehabilitation. The following overview[34] of large-scale political programmes helps realize the extent of the needs in matter of decent housing in the SEMCs:

In **Algeria**, a considerable deficit was reported in housing construction, and this, several years back. Between 1967 and 1978, only 379 000 housing units were constructed, that is, 31 000 housing units per year, on average. The annual construction capacity has, since then, reported significant improvement during the five-year programme 2005-2009, thus passing from 110 000 units in 2004 to 220 000 in 2008. Two programmes have been launched successively since 2004. The first is a programme whose objective was to construct a million housing units over the five-year period 2005-2009, an objective now "achieved", according to data provided by the Minister for Housing and Town Planning. Algeria has, then, announced a second programme for the construction of a further two million housing units between 2010 and 2014, representing an average construction rate of 400 000 housing units per year. This new programme, confirmed on 26 August 2010 during the session held by the President of the Republic with the Minister for Housing, consists in the construction of 800 000 public rental housing units, 500 000 promotional housing units and 700 000 rural housing units (for the sake of information, construction in France has been of over 462 000 new housing units during the past few years).

Tunisia has opted, on its part, more for a renovation policy. A significant effort has, indeed, been made towards promoting programmes dedicated to the rural and urban populations living in scarcely decent conditions. Among these programmes, one may mention the National Project for the Renovation of Low-Income Quarters comprising 223 neighbourhoods, the Programme for Re-Housing the Residents of "*Oukalas*" (Tunisian-Arabic term for collective downtown enclosure housing), with around 1300 beneficiary families, and the National Plan for Clearing Rudimentary Housing. The latter programme allowed the construction of around 94 000 housing units between 1987 and 1998, thus contributing to the improvement of housing conditions as attested in particular by a reduction of the share of rudimentary housing from 44% in 1956 to 1.2% in 1999, and by an increase in the number of households in ownership of their house to 78.2% in 1999. Moreover, subsidized loans were granted to this target population, either by the Housing Promotion Fund for Employees (FOPROLOS) towards the construction or purchase of around 2 500 social housing units per year, or by the social security funds towards housing renovation, construction or purchase.

Morocco has set itself an objective for the period 2003-2007 of doubling up the annual construction of social (affordable) housing, and this, with a view to reaching a rate of 100 000 units per year, in order to take into account the needs for social housing estimated as 125.000 units per year. Moreover, King Mohammed VI launched in 2004 the programme entitled "Cities without Shantytowns" aimed at dismantling around 1000 shantytowns in 83 cities over the period 2004-2010. Individuals may access loans reimbursable over a period of 20 to 35 years provided by the Housing Solidarity Fund (FSH). The said programme concerns 280 000 households (1.5 million people). The government has also launched a programme of social housing in rural environment to meet the housing needs in rural areas and to promote settlement of the population in the rural districts located in the vicinity of large urban centres in order to prevent the proliferation of indecent housing. Lastly, the Kingdom has decided, with a view to curbing and diverting urban sprawl, to set up two new cities in the vicinity of Marrakech (Tamansourt) and of Rabat-Salé-Témara (Tamesna).

In **Egypt**, the largest share of the demand on housing construction originates from public investment: the National Budget Housing Project indeed envisions the construction of around 500 000 housing units by

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[34] Besides the descriptive account on the Algerian context, this overview rests on the report drafted by Carole-Anne Sénit, entitled "L'efficacité énergétique dans le secteur résidentiel : une analyse des politiques des pays du Sud et de l'Est de la Méditerranée" ("Energy Efficiency in the Residential Sector: Analysis of the Policies of the Southern and Eastern Mediterranean Countries - SEMCs"), Sciences Po-IDDRI, 2008.

2014. Besides, the development of new cities is pursued: this is attested by the emergence of such new neighbourhoods around Cairo as New Heliopolis, Medinet el Shourouk, New Cairo, Kattameya and the city of 6th October.

In order to provide the country with housing units affordable by a low-income population category, **Turkey** set up 1984 an entity under the direst purview of the Prime Minister's Office called the Housing Development Administration of Turkey (TOKI). This entity is entrusted with implementing the provisions outlined in the emergency action plan for housing, in particular those concerning social housing. This entity also envisioned the construction of 250 000 new housing units in 2007.

Lastly, the context offered by **Lebanon** is somewhat different. As the country experienced a conflict in 2006, reconstruction needs are considerable. However, due to the fact that the State tax revenue is very low, political life scarcely rests on programmes or proposals: there is, accordingly, no policy in matter of social housing in Lebanon, the private sector being largely dominant. Nevertheless, a housing entity was set up with a view to financing construction projects by individuals via the granting of loans. The State has also entered a contract with private banks: the banks pledge to grant loans to individuals and, in exchange, the State refunds the interest on the loans.

In the face of this glaring shortage of housing construction, and in view of the urgency of the situation, it is quite natural that the governments should seek in priority to accelerate construction and renovation projects. For instance, in its concern to ensure the fastest construction pace possible, Morocco has granted exemption from any tax, duty, royalty, participation and contribution to housing estate developers that pledge to construct at least 2500 housing units within a five-year time period. This stands as an eloquent expression of the fact that what is as yet given priority order is a short-term logic where the priority is to meet this high demand at low cost and as urgently as possible. This need to act promptly is not, therefore, conducive to the introduction of innovative techniques and technologies, such as energy efficiency, which incur an unquestionable induction cost.

Yet, though this situation seems to be a priori fairly set and done with, one might choose to see the glass as "half full" and look upon all these construction projects as being as many potential opportunities to mainstream energy efficiency and renewable energies measures in the residential sector.

The SEMCs energy prospects for 2030 only confirm and consolidate the issues which they are already confronted with today: increasingly stronger dependence on fossil energies and, concurrently, increase in demand on energy. Yet, while the expected boom in the building sector is, by its very nature, a energy consumer, it also represents the largest energy saving potential.

For this to materialise, there are several options which make it possible to reduce demand on energy: the most important ones consist in tapping the high energy efficiency potential, and this, via the promotion of clean and efficient technologies, as well as the dissemination of renewable energies. For instance, technologies allowing over 30% reduction of energy consumption in the building sector by 2030 with substantial reductions of CO_2 emissions are already available worldwide.

These measures must, obviously enough, be translated into and quantified within alternative scenarios suited to the SEMCS and which could be brought to bear mainly on energy demand management. This is, indeed, what the following Part purports to address.

IV. Energy Rupture Scenario

As outlined above, the situation with regard to energy policy in the housing sector in the Mediterranean varies considerably according as to whether one looks upon it from a NMCs or a SEMCs perspective. After an overview of the proactive legal framework currently in place in the NMCs, this Part will specify the outline of a rupture scenario based on the energy efficiency policies envisioned for the SEMCs.

1. Implementation of energy efficiency policies in the NMCs

While the energy policies in the SEMCs are far from being homogeneous, the NMCs have already set out, under the impetus of the European Union (EU), the milestones for a large-scale change in matter of energy efficiency in the building sector.

The European Union was fairly early to realize the potential held by the building sector in terms of reduction of final energy demand *(the sector accounts for 40% of energy consumption in Europe)*, as well as in terms of reduction of greenhouse gas (GHG) emissions *(36% of the EU GHG emissions are due to the building sector)*. Accordingly, the EU has since 1993 constantly considered energy saving as a core component of the strategy to combat climate change. To this, there must be added not only the issues pertaining to security of energy supply but also those of job creation and economic development. This is why the building and construction sector has been for a long time at the heart of the Community's concerns, whether this related to the economic, technical, climatic or energy aspects.

It should be noted that, out of the 12 Northern Mediterranean Countries (NMCs), only 7 countries belong to the EU-27, namely France, Greece, Italy, Slovenia and Spain, together with Cyprus and Malta. It is also worth noting that it is not possible to present here in detail the whole range of actions carried out in the NMCs. For purposes of the report, we will present here the European legal context, as well as an example of implementation with a focus on France[35].

1.1. European regulations concerning the reduction of energy consumptions

The objective of this report is not to conduct an exhaustive review of the efforts invested towards improving energy efficiency in the building sector. The intention is to simply recall the elements that have facilitated this collective construction and which might be of use to the SEMCs in the approaches they will have to develop. The EU efforts aimed at reducing energy consumption in the construction sector actually started upon issuance of the Directive called "SAVE" (93/76/EEC) of 1993 related to reduction of carbon dioxide emissions via an improvement of energy efficiency. This Directive required that Member States set out energy efficiency programmes and draft reports on the results obtained in the building sector. It is also useful to recall:

- The **EPBD Directive**[36] of 2002 on the energy performance of buildings (2002/91/EC) which covers at the same time residential and non-residential buildings. It is regarded as an instrument complementary to SAVE, proposing concrete actions in order to fill the existing gaps.
- The SAVE Directive was replaced in 2006 by the **ESD Directive**[37] relating to energy efficiency in end uses and energy services (2006/32/EC) which took into account the construction sector within the framework of its comprehensive energy saving efforts.
- More recently (December 2008), the EU adopted the **Climate-Energy Package** which consists in a range of legislative measures aimed at significantly reducing EU GHG emissions by 2020. The Climate-Energy Package sets 3 clear objectives to fight climate change:

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[35] Source: « L'efficacité énergétique dans l'Union Européenne : panorama des politiques et des bonnes pratiques » (Energy Efficiency in the European Union: Overview of Policies and Best Practices), ADEME - November 2008.

[36] EPBD : Energy Performance of Buildings Directive

[37] ESD : Energy Services Directive

- to reduce GHG emissions by 20% compared to 1990 levels,
- to increase to 20% the share of renewable energies in energy consumption,
- to reduce energy consumption by 20%.

While the first two objectives are more or less binding, i.e., that failure to comply with them makes the Member States liable to sanctions, the objective relating to energy saving is only indicative… (in fact, to date, only the renewable energies objective is, strictly speaking, binding).

Concretely, to achieve these objectives, new directives have been developed (e.g.: the RE Directive and the Quotas Directive), while others have been revised. The recast of the EPBD Directive is set to contribute significantly to achieving the objectives of the Climate Package with regard to energy saving (see details further down).

Table 3 presents a compilation of the main information on the 2 key European directives in matter of reduction of energy consumption:

Table 3 - The 2 key European directives for the reduction of the energy consumption

European legal framework	Objectives & Targets	Transposition by Member States
EPBD Directive *« 2002/91/EC » Energy Performance of Buildings*	Objective: Reduce energy consumption via mandatory measures: thermal regulation, energy performance diagnostic, certification and control. According to the Commission, a proper implementation of the Directive will allow a reduction by 11% of the EU final energy consumption by 2020. Target: New and existing buildings of the residential and tertiary sectors (offices, public buildings, etc.)	Role of States: Member States are responsible for the development of minimum standards. They shall also ensure that certification and inspection of buildings are carried out by qualified and independent experts. Progress status: Transpositions by Member States have been deemed insufficient in view of the extent of the stakes attached to the building sector. Accordingly, a recast of the Directive was proposed in 2008 in order to extend its scope of application and to clarify and give further effect to certain provisions, especially with a view to providing for a leading role of the public sector (Cf. details further down).
ESD Directive *« 2006/32/EC » Energy efficiency in end uses and energy services*	Objective: The Directive requires Member States to set themselves a minimum objective of 9% reduction of energy end use by 2016 and to establish the institutional and legal frameworks and measures likely to remove barriers to an efficient energy end use. Target: Varied and cross-sector. Non fixed equipments, of the "household appliances" type, are particularly targeted. There is no mandatory requirement related to energy efficiency in buildings, but the States are free to propose measures for this sector.	Role of States: Each Member State had to submit to the Commission its national Energy Efficiency Action Plan (EEAP) by mid-2007, revisable once every three years. Progress status: The Commission evaluated in 2008 the first versions of a number of EEAPs and its assessment was rather lukewarm: While the proposed strategies should probably help achieve savings beyond the 9% required, these plans were hardly ambitious and were often limited to reiterating measures already envisioned or in progress … The Member States are required to produce a more ambitious version of their EEAPs before 30 June 2011.

Source: http://www.buildup.eu/

It would be useful to undertake a more in-depth consideration of these two Directives insofar as they may be enlightening to the SEMCs. To illustrate this legislative transfer, the Arab League of States, which includes 11 SEMCs, already adopted by the council of ministers of electricity, the guidelines of the energy efficiency at the electricity final consumer. The Arab League currently developing a strategy aimed at developing a Arab EE Directive based on the European ESD Directive "2006/32/EC". By end 2010, the participating countries must submit the EEAPs for the period "2011-2014".

1.1.1. European EPBD Directive on energy performance of buildings

As may be seen in the overview above, the EPBD Directive is the Community's main legislative instrument providing a comprehensive approach in matter of energy efficiency use in the building sector. It addresses perfectly the issues considered in the present study.

Box 1 - Characteristics of the EPBD Directive in its initial version

The EPBD Directive, entered into force in January 2006, rests on the following four main elements:

- an integrated methodology to evaluate the energy performance of buildings;
- minimum energy efficiency standards for new buildings and those subject to renovation;
- certificates of energy performance for buildings;
- regular inspections of heating and cooling systems.

The common calculation methodology rests on an integrated approach. Indeed, all the elements determining energy efficiency are taken into account (heating and cooling installations, lighting installations, location and orientation of the building, heat recovery …), together with the insulation quality of building.

As indicated in the Table 3, the Member States are responsible for the development of minimum standards and must ensure that certifications and inspections of buildings are carried out by qualified and independent experts.

As regards its scope of application, the Directive takes into account the residential sector and the tertiary sector (offices, public buildings, etc). Nevertheless, certain buildings are excluded from the scope of application of the provisions relating to certification, such as historic monuments, industrial sites, etc. The Directive addresses all energy efficiency aspects of buildings in order to establish a really integrated approach.

1.1.2. Recast of the EPBD Directive[38]

The objective of recasting the EPBD Directive is to clarify and simplify certain provisions of the initial version, to extend its scope of application, to strengthen some of its provisions so that their impact is more effective, and to provide for the leading role of the public sector. This readjustment of the Directive proved to be necessary **to enable** Europe to achieve the objective of "20% energy saving by 2020" of the Climate-Energy Package.

The transposition and implementation of the EPBD Directive will thus be facilitated, and a significant portion of the remaining cost-efficient energy potential in the building sector will be rapidly tapped. At the same time, the objectives and principles of the current Directive are retained and, again, it is left to the Member States to determine the concrete requirements and ways to implement the Directive as before.

This recast is likely to result in additional reductions between 5 and 6% of total EU energy consumption, and by 5% of CO_2 emissions. It is also likely to generate jobs ranging between 280 000 and 450 000.

Box 2 - Proposal of recast of the EPBD directive contribute at many modifications to the 2002 text

- it clarifies the wording of certain provisions;
- it extends the scope of the provision requiring Member States to set up minimum energy performance requirements when a major renovation is to be carried out;
- it reinforces the provisions on energy performance certificates, inspection of heating and air-conditioning systems, energy performance requirements, information, and independent experts;
- it provides Member States and interested parties with a benchmarking calculation instrument which allows the nationally/regionally determined minimum energy performance requirements ambition to cost-optimal levels to be compared;
- it stimulates Member States to set themselves objectives for the time frame 2020 with regard to low or zero energy buildings;
- it encourages a more active involvement of the public sector to provide a leading example via its active participation.

[38] Source: web site EUR-Lex 'eur-lex.europa.eu'

These measures will be supported by the "Intelligent Energy Europe", the Commission's EPBD and BUILD-UP platforms and the Commission's Economic Recovery Plan.

Finally, the experts have deemed the necessary investments and the administrative costs pertaining to the implementation of the Directive to be fairly low compared with the benefits and return on investment expected.

The recast version of the Directive was adopted at second reading by the European Parliament in May 2010.

1.2. Example of the "Building" component of the *Grenelle de l'Environnement* in France[39]

The improvement of the energy performance of buildings, especially that of existing buildings, is indispensable for a reduction of GHG emissions. Aware of the potential held by the building sector, France has already deployed a battery of instruments for the tapping thereof: legal instruments, financial incentives and other accompanying measures.

Regulatory objectives of Grenelle in matter of energy performance of buildings:

The Grenelle of the Environment has set quite ambitious objectives for the building sector which reinforce and complement measures already implemented in the sector[40].

- Existing Buildings: The Grenelle requires a reduction by at least 38% of the primary energy consumption of the existing buildings stock. For housing units, the objective is to reach an average consumption of 150 kWh of primary energy per m² and per year.
  - To achieve this objective, there must be undertaken:
    - a programme of thermal and energy renovation of residential buildings. The pace to be reached must be of 400 000 full renovations per year as from 2013;
    - renovation of the whole social housing stock, with—as a start—the execution of works involving the 800 000 social housing units that are most energy consuming by 2020;
    - renovation of the stock of State buildings in order to reduce their energy consumption by 40% and their GHG emissions by 50%. The renovations are to actually start by 2012.
- New buildings: The Grenelle requires the generalization of Low Consumption Buildings (BBC/ LCBs) by 2012 and of Positive Energy Buildings (BEPOS/ BEBs) by 2020 (Box 3).
- Coaching the sector professionals: Taking up the 2 preceding challenges requires full maturity and responsiveness on the part of the French sustainable construction market. In order to ensure the expected results, the Grenelle has envisioned a whole battery of accompanying measures pertaining to recruitment, to training and to development of relevant industrial sectors.
- Financial incentives in place:

  France was already proposing a certain number of incentive financial mechanisms to promote investment by individuals, companies, etc. These comprise:

  - Energy Saving Certificates (CEE/ ESCs),
  - "Sustainable Development" tax credit,
  - Exemption from built real estate tax (in certain cases),
  - Sustainable Development account,
  - Government aid via ANAH (National Housing Improvement Agency),
  - Public funds in support of energy efficiency works.

[39] Source: Fifth National Communication of France to the UNFCCC - November 2009

[40] The main "Pre-Grenelle" measures are: thermal regulation RT 2005, tax credit, High Energy Performance (HPE) label, Energy Performance Audit (DPE), and research within the framework of PREBAT.

Box 3 - LEB Buildings in France

Low energy buildings in France

LEB standards, green house for tomorrow

From 1 January 2013, only energy-efficient buildings will get a construction permit. To raise environmental awareness, a package of tax incentives has been issued under way.

LEB standards, what is it?

The French, though still lags behind some European countries are beginning to realize the benefit of low energy buildings (LEB), especially through tax incentives.

LEB means a building whose energy consumption is less than 50 kWh per m^2 per year. It is 250 kWh per m^2 per year for a traditional house. The purpose of government is to bring an increasing number of new buildings to accommodate thermal standards in 2012, with the line of sight 1 January 2013, the date from which all new housing must be the LEB.

Nearly 20,000 housing in the process of construction were the subject of an application for certification LEB in 2009 against 2582 in 2008 and 853 in 2007.

To achieve this, the design must take account of the latest techniques for efficiency gains in insulation, ventilation and heating...

While the cost of construction standards LEB is 10-15% higher than a traditional house. But french agency ADEME estimates that this additional cost could be reduced by two years. Anyway, the energy savings (heating, water heating, lighting, ...) allow depreciation over 10 or 15 years. The installation of solar panels on the roof of a house and a storage allows a saving of 80% of the consumption of hot water.

Government subsidies

The State has implemented a range of financial aid for energy savings in new and existing buildings.

The work done by the Grenelle of the Environment has resulted mainly in consolidating 2 measures (these are the "Sustainable Development" tax credit and the "Energy Saving Certificates" – EEC/ ESCs) but, above all, to the instatement of the zero-rate eco-loan (ECO-PTZ). The ECO-PTZ is dedicated to individual owners and targets the projects of improvement of energy performance in their main homes. Granted for a 10 year period, with possibility of extension to 15 years by the bank, it allows for financing up to 30 000 € of energy efficiency improvement works on the housing unit and may be accessed concurrently with the other support facilities.

Other accompanying measures in place:

Informing the stakeholders (both about the regulations in force and the performances of their building), training professionals, controlling the quality of the work done and disseminating the results are all strategic aspects to sustainably develop the sector. For so doing, France has set out the following measures, inter alia:

- mandatory Energy Performance Audit (DPE) at the time of sale or rental of a house,
- organise country-wide a network of Info-Energy Forums to inform both the public and companies,
- develop a label/ certification for small RE equipment and installations,
- finance research on energy in the building sector (PREBAT and PACT),
- train sector professionals.

The latter measure was reinforced within the framework of the Grenelle of the Environment. Initial and continuous vocational training actors will be encouraged to engage, in coordination with the regions, a multiannual programme for the training of the professionals of the building sector with a view to promoting the building renovation activity in its dimensions pertaining to thermal and energy performance, acoustic performance and quality of inside air. The FEEBAT (Training in Energy Saving of Contractors and Craftsmen of the Building Sector), a ambitious training programme launched in 2008, eloquently attests the will of the French State to incept a historic shift in the building sector.

The latest energy assessment of France for 2009, issued in June 2010, presents some of the outcomes of these measures. It reveals in particular that the residential and tertiary sector[41] is that which has been least disrupted by the crisis. The energy consumption of the residential and tertiary sector, after several years of a jigsaw growth, has stabilized at -0.9% (to be compared with + 2.2% annual growth between 2002 and 2008). Thus, the consumption for 2009 is back at its level of 2005. This result is all the more remarkable as the number of housing units is steadily on the increase, even though the rate has reported a downturn due to the crisis: + 1.2% in 2009. In spite of the decrease observed, the number of housing units completed in 2009 is higher than that of the year 2007. It amounted to 466 000 units in 2009, after 474 000 in 2008, and 454 000 in 2007.

Table 4 - Production in housing equivalent per type in France

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of housing units in thousands											
Stand-alone	133,1	153,1	159,1	157,3	160,5	160,3	172,4	179,8	188,7	189,0	177,8
Grouped	30,0	34,2	31,0	31,4	34,4	36,5	41,2	46,7	51,9	56,5	59,2
Collective	112,6	125,8	109,7	100,7	104,5	112,3	125,1	146,9	175,9	196,5	204,0
In residential block	3,8	6,1	8,6	9,2	9,6	9,3	11,4	16,3	18,7	20,3	21,2
All types	279,5	319,3	308,4	298,6	309,0	318,4	350,0	389,7	435,1	462,3	462,3

Source: SOeS, Energy balance 2009

In this sector, too, growth in demand does not seem to be inescapable. It is, above all, oil and gas consumptions which are on the decrease, as against power and renewable energies. Indeed, one observes a rapid development of renewable energies since 2006. Used alone, renewable energies claim 6 points of market share, and even more than 8 points when considering their use combined with another energy.

This EE growth takes place mainly at the expense of natural gas, whose market share has been slashed more than twice in two years, and of fuel oil, which has become, henceforth, negligible in new buildings (less than 1% of individual housing units opted for it in 2008). Electrical heating is booming: 48% of households opt for it as single heating energy, and 17% combine it with another source. The preliminary results of the 2009 survey confirm these trends, particularly the high growth of combined power + RE heating (heat pumps, electric heating + wood).

As a result of these trends, the total CO_2 emissions due to energy decrease by 5.7%, after -1.2% in 2008. They stand at 9.1% below their level of 2005 and 6.1% below that of 1990. In 2009, it is mainly industry and the energy sector that contribute most to the decrease.

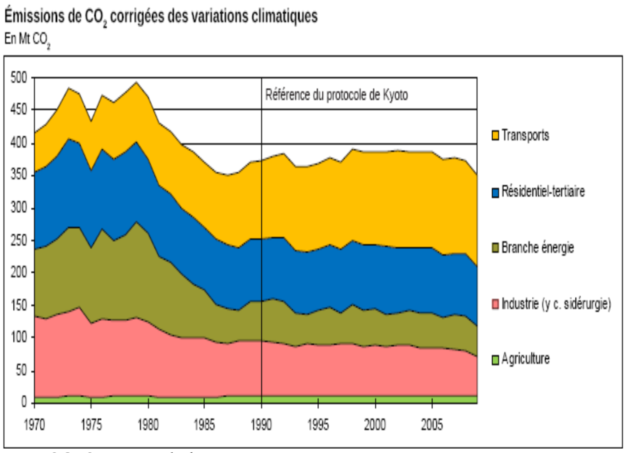
Box 4 - Thermal regulation or Building code

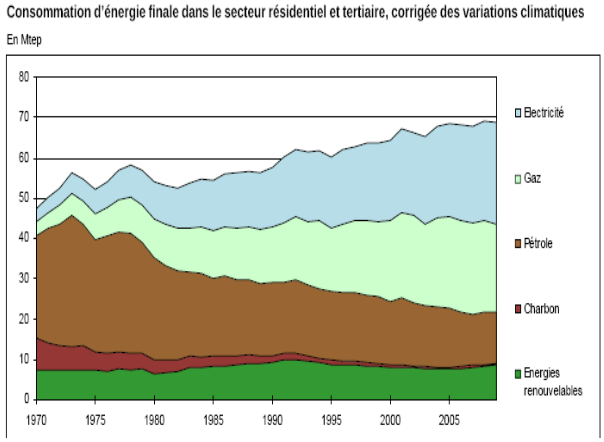
Thermal Regulation (TR) stipulates insulation and energy performance standards for new buildings. The first was established in 1974, following the oil crisis. The standards became more stringent in 1982, then in 1988. In 2000, the requirement level was significantly reinforced, and an objective of slashing by four the GHG emissions of France by 2050 was set. For so doing, various measures were undertaken, notably in the building sector which consumes 39% of final energy and emits 18% of GHG. Since then, the thermal regulation is reviewed every five years in order to gradually decrease the energy consumption of buildings.

The TR 2000 applies to all new buildings, irrespective of the energy used. It aims at reducing energy consumption in building and housing units by 20%, with respect to the standards prescribed before its issuance. The RT 2005, which supplants the TR 2000, puts up the energy performance requirements for new buildings by 15%, with respect to the standards prescribed by the RT 2000. It also aims at reducing the use of air-conditioning. The RT 2005 came into force in July 2006.

[41] This concerns household energy consumption and that of the tertiary sector. In other words, this relates above all to energy dedicated to heating, cooking, air-conditioning and operating electric or electronic appliances.

Figure 20 - Energy consumption and CO_2 emissions in France





Source: SOeS, Energy balance 2009

Table 5 - Dissemination over 20 years of gas and electricity powered equipment

Main heating energy	Housing stock in 2008 (in thousands)			Growth between 1988 and 2008 (in thousands)			Average annual growth between 1988 and 2008 (in %)		
	Tenants	Owners	Total	Tenants	Owners	Total	Tenants	Owners	Total
SH	360	980	1340	-2000	-1610	-3610	-9	-4,7	-6,3
Fuel oil	1030	3340	4370	-980	390	-590	-3,3	0,6	-0,6
Gas	5380	5820	11200	2430	3210	5640	3,1	4,1	3,6
Electricity	3680	4580	8260	2240	2370	4600	4,8	3,7	4,2
Other	1010	910	1920	-50	-70	-120	-0,2	-0,4	-0,3
Total	11460	15630	27090	1640	4290	5920	0,8	1,6	1,2

Source: CerenScope: Main houses in metropolitan France
*SH: Storage heater

2. Energy rupture scenario in the SEMCs

2.1. Definition of the rupture scenario

The rupture scenario is an alternative energy efficiency scenario that is proactive with regard to the transposition (mainstreaming) of EE measures and RE development. It requires a massive implementation of measures that are currently the most technically, economically and politically mature for a large-scale dissemination.

2.2. Assumptions of the rupture scenario in the SEMCs

After identifying the region climate zones and the technologies suited to this context, this section will set out the assumptions selected with regard to the rate of dissemination of EE measures in the construction sector of existing and new buildings.

2.2.1. Representative climates in the SEMCs

Considered as one of the "cradles of civilisation", the Mediterranean basin is located in a delimited zone in latitude, within a range, for the coastal areas (being the most urbanised), comprised between:

- 30° for the lowest latitudes (Alexandria),
- 45° for the highest latitudes (Venice).

The SEMCs have climates that range from the Mediterranean type to the continental type. Characterised by a wet season that is fairly moderate and a markedly dry summer, the climate—as well as seismicity—have generated a common traditional architectural response as the outcome of right compromises.

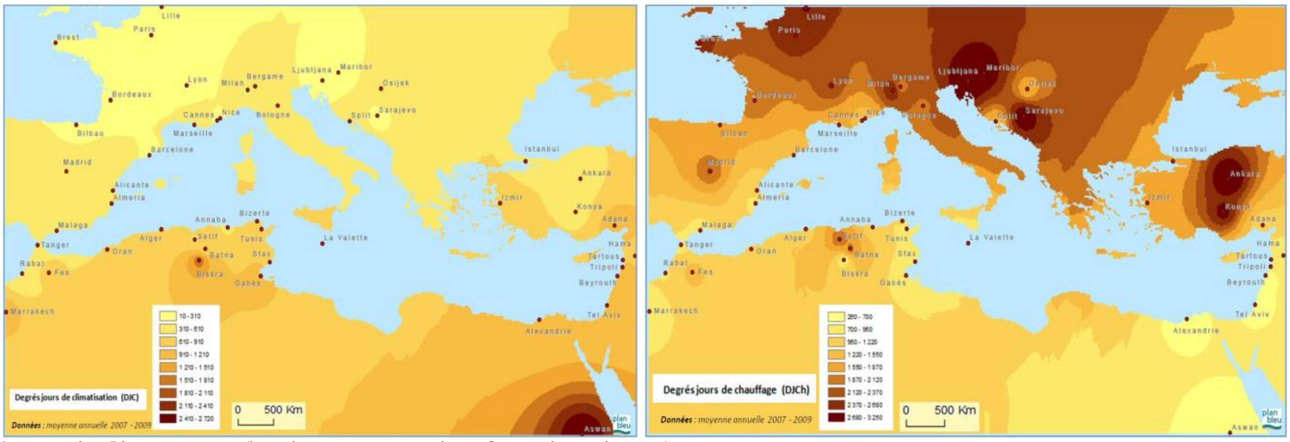
The existing thermal regulations in the building sector in the SEMCs have delimited climatic zones in each country. An analysis and synthesis work is necessary to identify homogeneous climatic zones at SEMCs scale. In the meanwhile, it is proposed to consider 4 representative climates:

- **Z1 - Coastal zone** (example: Beirut, Lebanon). The climate is of a wet moderate Mediterranean type, characterized by rainfall concentrated in the winter and early spring, and hot and dry summers, with a fairly high relative humidity.
- **Z2 – Mountain zone** (example: Marrakech in Morocco, or High-Plateaux in Algeria). The climate tends to be arid, characterized by high seasonal and daytime temperature ranges. This zone presents a significant rainfall deficit in the summer. In the winter, night-time temperatures are cool. On the other hand, in the summer, the temperatures are scorching hot.
- **Z3 – Desert zone** (example: Gafsa in Tunisia). In this zone, the climate is very dry and hot. There are, on the other hand, quite significant differences in temperature between day and night.
- **Z4 – Continental zone** (example: Ankara in Turkey). The summers are sunny in the day and cool in the night. The winters are cold, with rain and snow.

As a complement to this climatic distribution, a zoning based on degree-days is of great use, for it highlights the needs for heating and cooling. Indeed, the degree-day is, for a given place, a value representative of the variance between the temperature of a given day and a temperature pre-defined threshold. It helps evaluate the energy expenditure for heating or cooling.

The 2 maps of Figure 21 allow a visualization of the needs for heating and cooling in the Mediterranean region. The baseline temperature selected is 18°C for heating degree-days and 21°C for cooling degree-days. From a visual standpoint, the darker the colour, the more significant the needs are. Also, and as may be observed, the needs of the SEMCs are mainly related to cooling, while those of the NMCs are more related to heating.

Figure 21 - Representation of the number of degree-days cooling (DDc) and the number of degree-days heating (DDh)



Source: Plan Bleu, June 2010 (based on 3-year mean data of www.degreedays.net)

2.2.2. Measures envisioned in the rupture scenario

The energy efficiency measures envisioned in the rupture scenario, corresponding to the most mature technologies from a technical, economic and political standpoint for the SEMCs, are as follows:

- Large-scale dissemination of efficient shells for new buildings (and this, via enforcement of the existing thermal regulations, with the assumption of periodic revisions),
- Gradual elimination of incandescent lamps from the market,

- Thermal renovation of buildings (roof and wall insulation, change of windows),
- Dissemination of efficient household appliances and heating and air-conditioning equipment,
- Dissemination of solar water heaters.

The priority measures, as per climate zone, and according to their energy saving potential and economic cost-effectiveness, are given in the Table 6.

Table 6 - Energy Efficiency (EE) measures by climate zone according to efficiency

Energy Efficiency (EE) options or measures	Coastal Zone (Z1)	Mountain Zone (Z2)	Desert Zone (Z3)	Continental Zone (Z4)
Roof insulation	Green	Green	Green	Green
Wall insulation	Yellow	Green	Green	Green
Window insulation	Yellow	Green	Green	Green
Solar protection of windows	Green	Green	Green	Green
Natural lighting	Green	Green	Green	Green
Efficient lighting	Green	Green	Green	Green
Solar water heater	Green	Green	Green	Green
Efficient cooling	Green	Green	Green	Red
Energy efficient household appliances	Green	Green	Green	Green
Efficient heating	Green	Green	Green	Green
Lighting by photovoltaic panels	Yellow	Yellow	Yellow	Yellow

Source: Adel Mourtada & Rafik Missaoui

Green	Highly efficient
Yellow	Fairly efficient
Red	Non efficient or unsuited

2.2.3. Dissemination assumptions selected

The assumptions selected for the 5 measures listed above are as follows:

- Large-scale dissemination of efficient shells for new housing constructions

  This consists in a strict implementation of the thermal regulation in place or in progress in all SEMCs, with a periodic revision every 5 years. The hypothesis selected for this first measure is a gradual large-scale dissemination from 13 to 80% between 2010 and 2030 for new buildings.

- Thermal renovation of buildings

  The renovation consists mainly in an insulation of the shell of existing buildings. This insulation may relate to roofs, walls and windows in zones 2, 3 and 4 and roofs and walls in zone 1. The hypothesis selected for this second measure is a gradual renovation from 1 to 30% between 2010 and 2030 for existing buildings.

- Efficient lighting: Gradual elimination of incandescent lamps from the market and large-scale dissemination of efficient light bulbs

  The various countries are gradually eliminating incandescent lamps from the market, starting with the highest power lamps (150 W and 100 W). The objective is to totally eliminate this type of lamps and to generalise "efficient light" lamps and LED[42]. It is expected that there will be a gradual increase in the dissemination rate, estimated as 20% in 2010, with a view to reaching 100% by 2020.

- Dissemination of efficient electric household appliances

  The enhancement of the energy performance of electric household appliances relates mainly to:

  - Refrigerators whose regulations provide already for a gradual elimination of the less efficient classes in certain countries;

[42] Light-emitting diode lamp

– Air-conditioners are equally subject to the regulatory logic of gradual elimination of the less efficient appliances;
– Other appliances, such as washing machines, dish-washers, etc.

The scenario predicts a gradual dissemination of this measure to achieve its large-scale dissemination to all buildings for the time frame 2030.

- Dissemination of solar water heaters

  The scenario envisions a accelerated pace of dissemination of solar panels in the existing housing stock and in new constructions to reach a penetration rate of 30% in existing buildings and of 35% in new buildings by 2030.

The assumptions selected for penetration of these measures are given in the Table 7.

Table 7 - Rate of penetration of EE measures in the residential - Horizon 2030

	Existing residential			New residential		
Large-scale disseminated measures	2010	2020	2030	2010	2020	2030
Large-scale dissemination of efficient shells for new buildings				13%	50%	80%
Thermal renovation of existing buildings	1%	10%	30%			
Efficient lighting	20%	100%	100%	20%	100%	100%
Dissemination of efficient electric household appliances, heaters and air-conditioners	10%	50%	100%	10%	50%	100%
Dissemination of solar water heaters	7%	20%	30%	5%	25%	35%

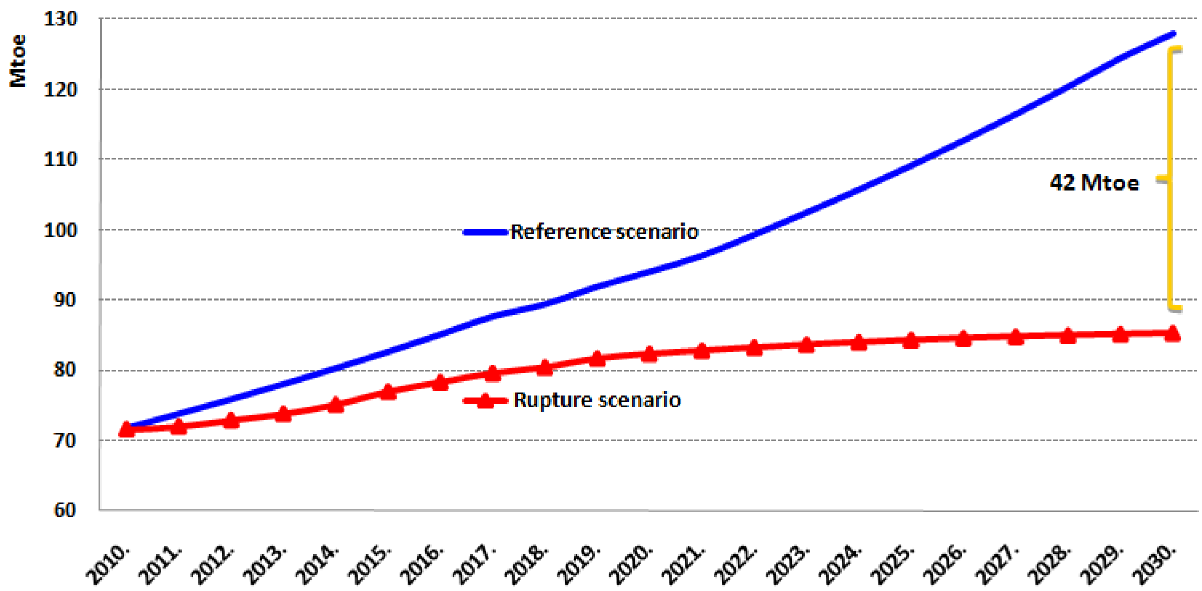
Source: According to the hypothesis used by the expert group of the study /Plan Bleu

2.3. Results of the energy rupture scenario in the SEMCs

2.3.1. Possible results in terms of reduction of final energy consumption:

The energy consumption of the residential sector is likely to reach around 100 Mtoe by 2020 and around 130 Mtoe by 2030. As shown by the Figure 22, **the implementation of the rupture scenario in the SEMCs represents an energy saving potential of around 40 Mtoe for the time frame 2030.**

Figure 22 - Curves of the Final energy consumption of the residential sector of the SEMCs according to the scenario

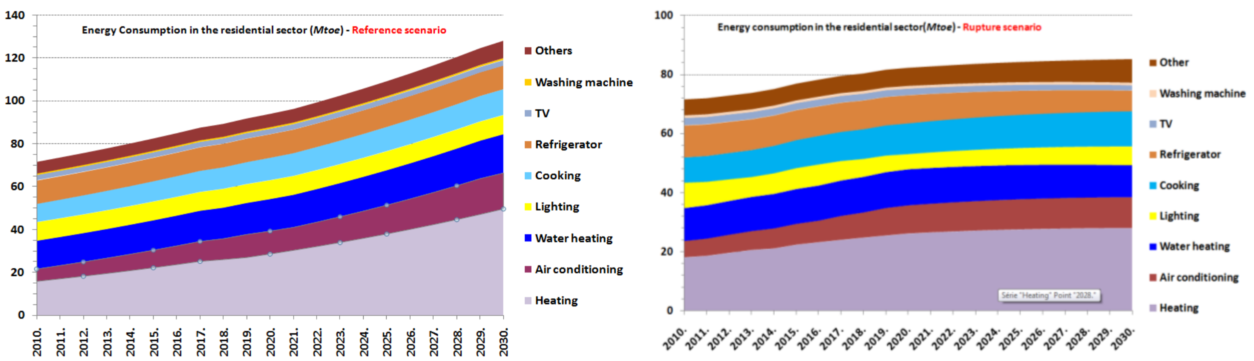


Source: Calculation Adel Mourtada, validated by the experts group study /Plan Bleu

Based on a simulation of standard housing constructions in the selected 4 climatic zones (via the VisualDOE.3 software; Box 5), and considering a distribution of housing constructions of the SEMCs in these climatic zones, we will estimate the needs in final energy of the residential sector. Figure 22 gives the evolution of the final energy consumption of the residential sector for the two scenarios: the baseline scenario which represents a continuation of the current situation (Business as Usual), and the rupture scenario which is regarded as the alternative scenario of energy efficiency.

Incorporating the measures selected and taking into account the dissemination assumptions outlined above, the rupture (or energy efficiency) scenario is given in the right-hand in Figure 23.

Figure 23 - SEMCs – Final energy utilization in the residential sector – Baseline and Rupture scenarios



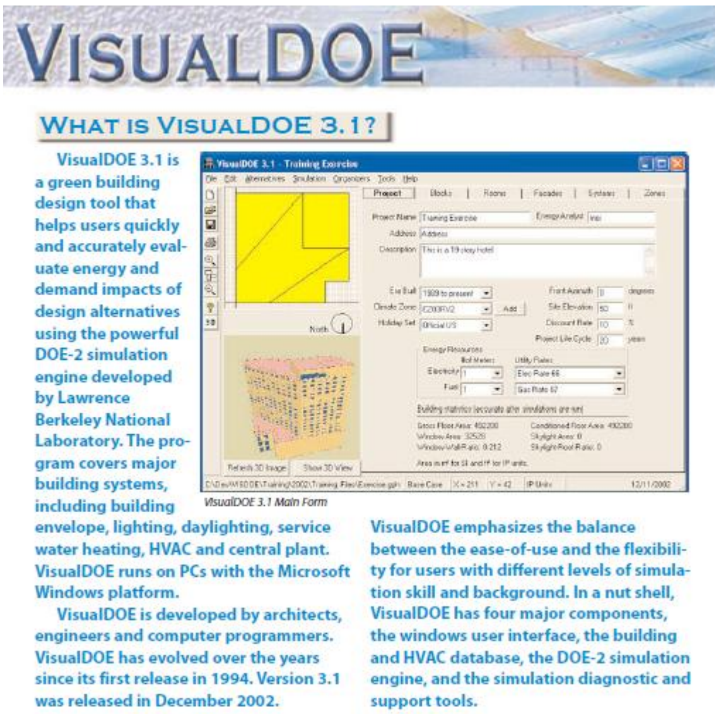
Source: Calculation Adel Mourtada, validated by the experts group study /Plan Bleu

The energy saving potential is thus estimated in this rupture (or energy efficiency) scenario as around 42 Mtoe (of final energy) by 2030, compared to the baseline scenario.

These energy savings were calculated by energy source (coal, oil products, natural gas and electricity). The estimates of these savings are around one Mtoe for coal, 9 Mtoe for oil products, 17 Mtoe for natural gas and 14 Mtoe for electricity, to which there must be added an increase by 4 Mtoe in renewable energies. Afterwards, they were broken down, as specified in the Figures, by use (heating, air-conditioning, hot water, lighting and electric household appliances). This breakdown was carried out based on the VisualDOE software (described in the Box 5).

The most significant reductions, according to the uses, are due to heating and air-conditioning by around 60%, followed by lighting by around 50% and by electric household appliances by around 33%.

Box 5 - Software VisualDOE 3.1



Source: www.eley.com & http://sabrinaphillips.com/visualdoe.pdf

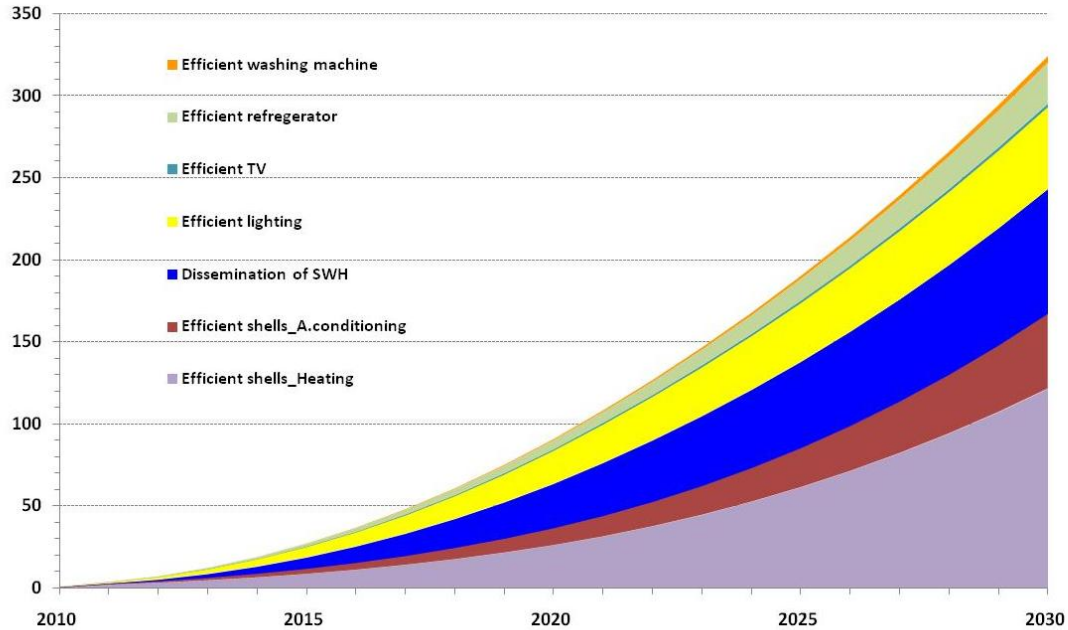
Table 8 - Energy consumption in the residential sector (in Mtoe)

(in Mtoe)	Heating	A.Conditioning	Water Heating	Lighting	Appliances	Others	TOTAL
Baseline scenario	58,0	19,6	11,5	8,9	14,4	15,8	**128**
Break-up scenario	26,2	8,4	10,8	4,7	9,5	26,0	**86**
Reduction	-55%	-57%	-6%	-47%	-34%	64%	-33%

Source: According to the calculations of the experts group study / Plan Bleu

The potential aggregate final energy savings over the period 2010-2030 are estimated to be over 320 Mtoe, as illustrated by Figure 24.

Figure 24 - Aggregate final energy savings of the residential sector of the SEMCs –Rupture scenario vs baseline scenario (between 2010 and 2030, in Mtoe)

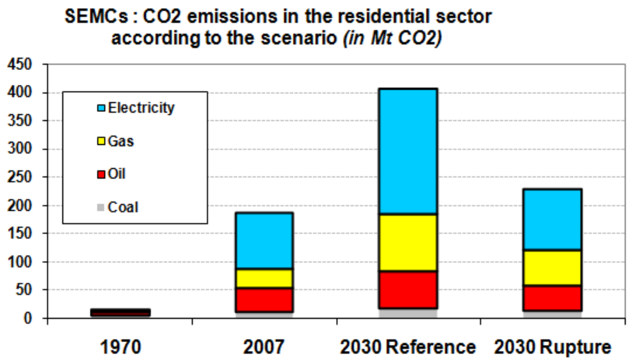


Source: Calculation Adel Mourtada, validated by the experts group study /Plan Bleu

2.3.2. Possible results in terms of GHG reduction

The CO_2 emissions reduction potential by 2030 is estimated based on **primary energy savings (oil, gas & coal and also those due to indirect consumption of electricity sector)** and on substitutions due to contributions by renewable energy sources. Considering the evolution of the energy mix in the SEMCs and a penetration by renewable energies of around 11% (15%, including hydropower) by 2030 in the energy balance of the SEMCs, estimates of the annual reduction of CO_2 emissions would be around 179 $MtCO_2$ by 2030. Aggregated reduction of CO_2 emissions over the period 2007-2030 would be around 2 $GtCO_2$.

Figure 25 - CO_2 Emissions in the SEMCs, according to scenarios



CO_2 emissions in the residential sector (Mt CO_2)	1970	2007	2030
REFERENCE	**15**	**186**	**407**
Coal	*4,0*	*10,7*	*16,3*
Oil	*7,0*	*41,5*	*67,0*
Gas	*0,1*	*34,6*	*100,4*
Electricity	*3,4*	*99,0*	*223,3*
RUPTURE	**15**	**186**	**228**
Coal	*4,0*	*10,7*	*13,0*
Oil	*7,0*	*41,5*	*44,9*
Gas	*0,1*	*34,6*	*62,6*
Electricity	*3,4*	*99,0*	*107,9*

Source: IEA for retrospective, and calculations Plan Bleu for prospective.

3. Cost of action on the building lifecycle

Table 9 presents the needs in investment necessary for a actual implementation of the rupture scenario. **The total investment amount would then stand at 262 billion €** for the SEMCs over the coming 20 years, broken down per country and per measure as in Table 9.

Table 9 - Investment needs for the measures of the rupture scenario, per country (in billion €)

Measures	Total investment needs over 20 years	Algeria	Egypt	Israel	Jordan	Lebanon	Libya	Morocco	Palestine	Syria	Tunisia	Turkey
TOTAL *(in billion €)* of which:	**262,0**	**33,3**	**74,3**	**7,0**	**4,5**	**2,8**	**6,0**	**30,3**	**4,1**	**19,2**	**3,6**	**77,2**
Large-scale dissemination of efficient shells for new buildings	**132**	16,5	37,2	3,5	2,2	1,6	3,0	15,1	2,1	9,6	1,2	40,2
Thermal renovation of buildings (roof and wall insulation, changing windows)	**49**	6,1	13,8	1,3	0,8	0,4	1,1	5,6	0,8	3,5	1,4	14,1
Gradual elimination of incandescent lamps from the market and dissemination of ELB/ ELD	**3**	0,4	0,8	0,1	0,1	0,1	0,1	0,4	0,0	0,3	0,0	0,8
Dissemination of efficient electric household appliances, heating and air-conditioning	**40**	5,3	11,5	1,2	0,7	0,4	0,9	4,8	0,6	3,1	0,5	11,2
Dissemination of solar water heaters	**38**	5,0	11,0	1,0	0,6	0,3	0,9	4,4	0,6	2,8	0,5	11,0

Source: Estimations of the experts group study /Plan Bleu.

3.1. Evaluation of additional construction costs (new buildings)

For a housing unit of an average area of 100 m^2, the additional cost of the measures of insulating the envelope of the building (roof, walls and windows) and of installing efficient equipment (heating and air-conditioning) translates into an overcost in the order of 3300 € per new building; this represents an overcost in the range of 7 to 20% of the construction and energy equipment costs.

This overcost can be absorbed by the construction market on condition that the current financing instruments (credit amounts, interest rates, etc) are adapted. The financing needs over 20 years in new buildings would be around 132 billion €.

- Distribution of the cost over the life cycle of the buildings

  The overcosts are distributed as follows: 70% as initial over-investment and 30% as over-investment related to energy efficiency equipment for the 20-year period (including replacement of certain equipment).

- Cost of the tCO_2 avoided

  The cost of the avoided tCO_2 over the building lifecycle between 2010 and 2080 (based on a building lifecycle of 50 years) is of 38 €.

3.2. Evaluation of the costs of rehabilitation of existing buildings

For a housing unit of an average area of 100 m^2, the cost of the measures of insulating the shell of the building (roof, walls and windows) is in the order of 2500 € per unit. *According to the typology of the existing buildings, the collective housing stock is sizeable, which results in a reduction of the costs of insulation of the roofs of collective buildings related to unit housing; likewise, the replacement of windows by double-glazing should report a low penetration rate in coastal area.*

The financing needs over 20 years, regarding existing buildings, would be around 49 billion €.

- Cost of the tCO_2 avoided

  The cost of the avoided tCO_2 over the lifecycle of renovated buildings is of 42 €.

3.3. Evaluation of the overcosts of efficient lighting

Assuming that, by 2020, efficient lighting would be disseminated at 100% in new and existing buildings, the financing needs over 10 years would be around 3 billion €.

- Cost of the tCO_2 avoided

  The cost of the avoided tCO_2 is around 39 €.

3.4. Evaluation of the overcosts of efficient equipment

Assuming that, by 2020, efficient equipment would be disseminated at 50%, and that, by 2030, all old equipment would be replaced by efficient equipment, and considering only the overcosts incurred by this measure, the financing needs of the overcosts, over 20 years, would be around 40 billion €.

- Cost of the tCO_2 avoided

  The cost of the avoided tCO_2 is around 39 €.

3.5. Evaluation of the costs of solar water heaters

Assuming a rate of dissemination of solar water heaters at 30% in existing buildings and at 35% in new buildings by 2030, and considering a continuous decrease in the prices of solar-water heaters, the financing needs, over 20 years, would be around 38 billion €.

- Cost of the tCO_2 avoided

  The cost of the tCO_2 avoided is of 120 € (considering that, in certain countries such as Lebanon, Jordan and Syria, water heating based on electricity is quite common).

3.6. Summary of costs

The Table 10 sums up the financing needs, as well as the cost of the tCO_2 avoided, per energy efficiency (EE) measure.

Table 10 - Investment needs for EE measures over 20 years and average cost of the tCO_2 avoided over the lifecycle of each measure

Measures	Investment needs over 20 years in billion €	Cost of the tCO_2 avoided over the lifecycle of the measure* in €/tCO_2
Large-scale dissemination of efficient shell of new buildings	132	38
Thermal renovation of buildings	49	42
Large-scale dissemination of efficient lighting	3	9
Dissemination of efficient electric household appliances, and heating and air-conditioning equipment	40	39
Dissemination of solar water heaters	38	120
Total	**262**	41,5

*The lifecycle of the measures with regard to buildings is taken as 50 years.
Source: Estimations of the experts group study /Plan Bleu.

4. Cost of inaction on building lifecycle

An increasing number of studies have addressed the "cost of inaction"[43]. This consists in estimating the costs of the impacts due to climate change if no measure is taken to reduce GHG emissions. This concept thus extends beyond the concept of cost avoided as such. It makes it possible to compare the cost of action and that of inaction in order to set out a adaptation policy that is as cost-effective as possible. This evaluation is, obviously enough, an approximation, given the various unknown factors of the equation: climate evolution, interaction between various sectors, occurrence of extreme events, discount rates, energy price trends, etc.

4.1. Definition of climate change assumptions at regional level

The future climate change must be taken into account as of now in long term investment decisions in the Mediterranean region (buildings, energy, transport, water management, etc). In view of the lifecycle of the investments considered in the building sector, energy efficiency and renewable energies must be regarded as priorities, taking into account the future climatic conditions. The last IPCC report[44], issued in 2007, outlines climate change assumptions in the region.

According to the IPCC report, the average temperature of the Mediterranean region is likely to increase by between 2.2 and 5.1°C, that is, significantly more than the global average. Maximum warming would occur in the summer and would be detectable within 15 to 25 years, with an increase ranging between 2.7 and 6.5°C, as against 1.7 and 4.6°C in the winter.[45]

Climate change will have a direct impact on hydropower production which is affected by the water height stored in dams. Total rainfall will probably decline by 4 to 27%. The southern Mediterranean rim would be more affected than the northern rim, and impacts of climate change would be definitely detectable within the few coming years:

- An increase in the frequency, duration and intensity of heat waves is, thus, to be expected;
- total rainfall will decline especially on the southern Mediterranean rim;
- a decline in productivity is expected, with values of up to 50% locally.

Climate change climatique risk to:

- act as a amplifier of the inequalities already present in the Mediterranean region (between the countries and within each country),
- hamper economic development,
- jeopardize the future of the coming generations,
- give rise to new conflicts over control of water,
- cause the population to leave rural areas and to migrate.

4.2. Evaluation of additional energy consumption due to climate change

4.2.1. Scenario of a stable rate of equipment in air-conditioning (30%) by 2020:

Assuming an average temperature increase by 3 C° in the summer and by 2 C° in the winter during the lifecycle of the buildings, there would likely be an increase by 21% in air-conditioning and a decline by 6% in the needs for heating. The increase in the needs for air-conditioning will exert pressure on the needs for power production that have not been taken into account so far in the demand evaluation models. This would result in an increase by 2.5% in the primary energy consumption of buildings due to power

[43] The most well-known being certainly the "Stern Review on the Economics of Climate Change - October 2006"
[44] Intergovernmental Panel on Climate Change (IPCC, www.ipcc.ch)
[45] «Anticiper le changement climatique autour de la méditerranée » (Anticipate Climate Change around the Mediterranean), IPEMED, 2008.

production, offset by a reduction by 2.5% in primary energy associated with heating. The overall balance is nil, but the needs for investment in power production would increase by 5% with respect to what was envisioned previously (considering a decline in hydropower production).

4.2.2. Scenario of increase in the penetration of air-conditioning:

Climate change would result in an increase in heat waves in the summer, which would boost the penetration of air-conditioning to reach an equipment rate of 50% by 2030. This would result in an increase in primary energy consumption due to air-conditioning by 11.5%. Primary energy consumption due to heating remains of the same order as for the preceding scenario; the assessment reveals an increase in the primary energy consumption of the residential sector by 8% and of the power capacity to be installed by 12% compared to the trend scenario without climate change.

The implementation of energy efficiency policies, particularly in the building sector, holds significant stakes for the Mediterranean region. Yet, enlisting financing niches for such a policy requires awareness of the benefits that it generates in the medium and long term. The emergence of a energy efficiency market in the building sector rests mainly on the economic analysis which would move the stakeholders into action. The public authorities are called upon to play a key role in the materialization of favourable conditions conducive to the emergence of such a market, particularly by relaying the macroeconomic benefits thus induced.

V. Conditions for an implementation of the rupture scenario

As stated several times, the NMCs belonging to the European Union have already implemented a series of measures intended to manage the energy demand of the building sector. The recent recasting of the EPBD Directive, which was intended to allow a more effective implementation of the regulations related to the energy performance of buildings, will contribute actively towards the European objective of 20% energy saving by 2020.

As regards the SEMCSs, the immediate task is to implement a break-up scenario that requires the lifting of a whole range of barriers, and this, via innovative and cross-cutting instruments.

1. Barriers to an implementation of the rupture scenario

The barriers to the development of a large-scale energy efficiency market in the building sector in the Mediterranean countries, within the framework of the rupture scenario, are of several orders:

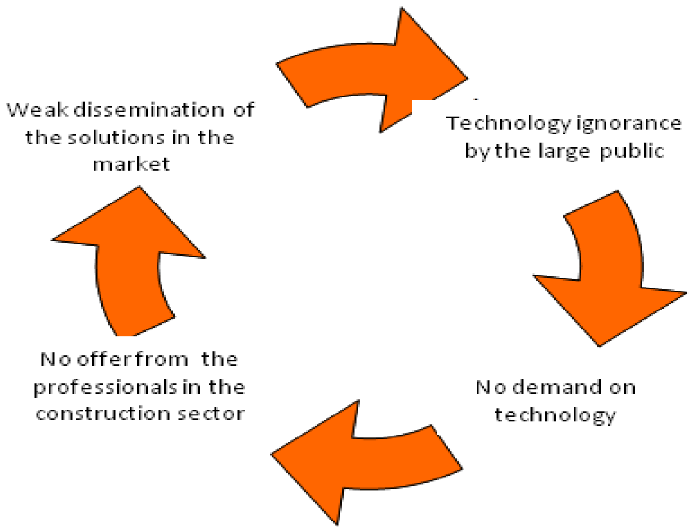
- Informational,
- Economic,
- Organisational,
- Technical.

1.1. Informational barriers

In the southern Mediterranean region, very few EE and RE measures currently report a significant penetration rate in the building sector. They consist almost exclusively in solar water-heaters and efficient light bulbs in few countries of the region. Accordingly, most of the technical solutions available for energy efficiency and, more particularly, their economic impact are not sufficiently known either by the public at large, or by the professionals of the building sector, or still by decision makers.

The resulting situation is that of the classic vicious circle of dissemination of innovation, as illustrated by Figure 26.

Figure 26 - Scheme on the barriers to the circulation of innovationon



Source: Rafik Missaoui

Under these circumstances, the implementation of energy efficiency solutions by a sensitized professional incurs him too high transaction costs to convince the end user, which becomes dissuasive for him.

Yet, there are several means to break this vicious circle (which will be outlined further down), but that will imply in any case the active contribution of the public authorities.

1.2. Economic barriers

These often prove to be the major ones, and they may be due to two main reasons:

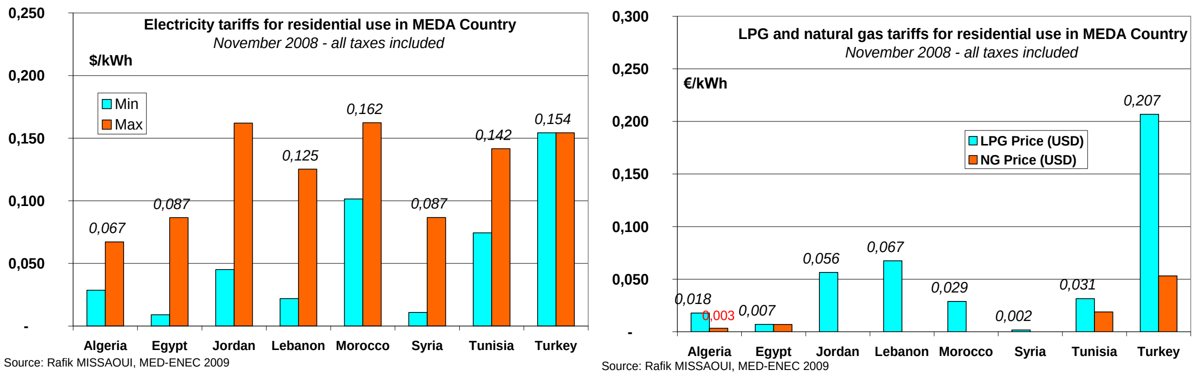
- Low return on investment in the measures for the end users,
- High initial investment costs, compared with the self-financing capacity of households.

1.2.1. Low return on investment for the end user

The return on investment for the end user depends, on the one hand, on the cost of the technology and, on the other hand, on the energy tariffs.

Concerning conventional energy tariffs, they are still largely subsidised in several countries of the region. The following graphs in Figure 27 show the difference in tariffs between the MENA region countries.

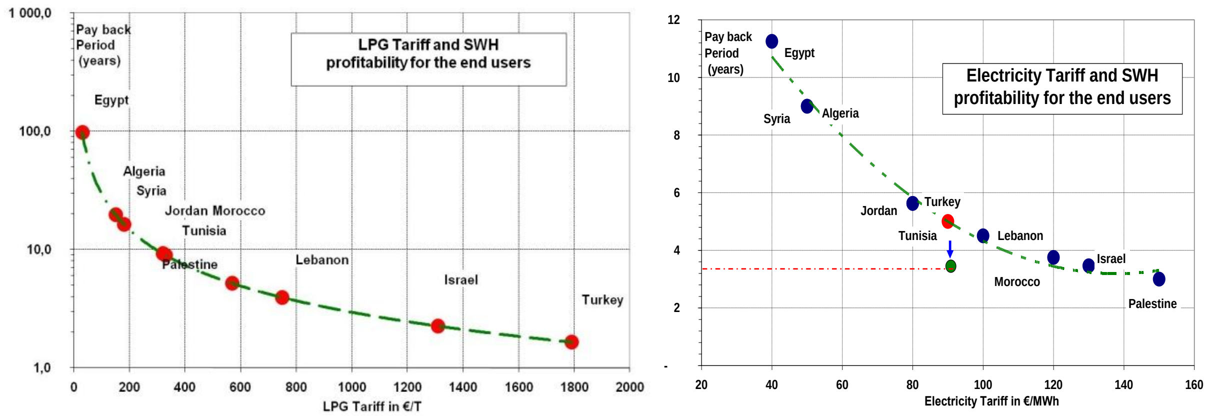
Figure 27 - Economic barriers to the implementation of a rupture scenario



Source: Rafik MISSAOUI, MED-NEC 2009

The difference of the tariffs explains to a large extent the difference in return on the energy efficiency measures in these various countries. For the sake of illustration, the following graph in Figure 28 presents an analysis of the return on investment for the end user of the solar water-heater (SWH) in certain countries of the region, which is measured as return on investment time for the consumer.

Figure 28 - Return rate and effects of electricity tariffs /LPG

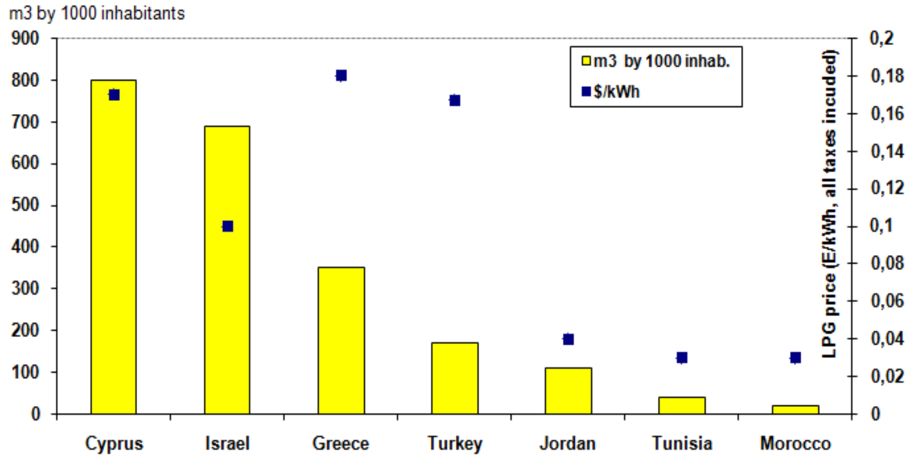


Source: ALCOR (Tunisia)

Thus, considering the energy tariffs, the payback period on the purchase of a solar water-heating (SWH) compared to a LPG water-heating in Egypt will be over a hundred years, while being of about 30 years in Algeria and in Syria. The payback return is however less than 2 years in Turkey.

Naturally, this profitability difference leads to penetration rates that are quite different from one country to another (Figure 29).

Figure 29 - Penetration of SWH versus LPG prices in some countries

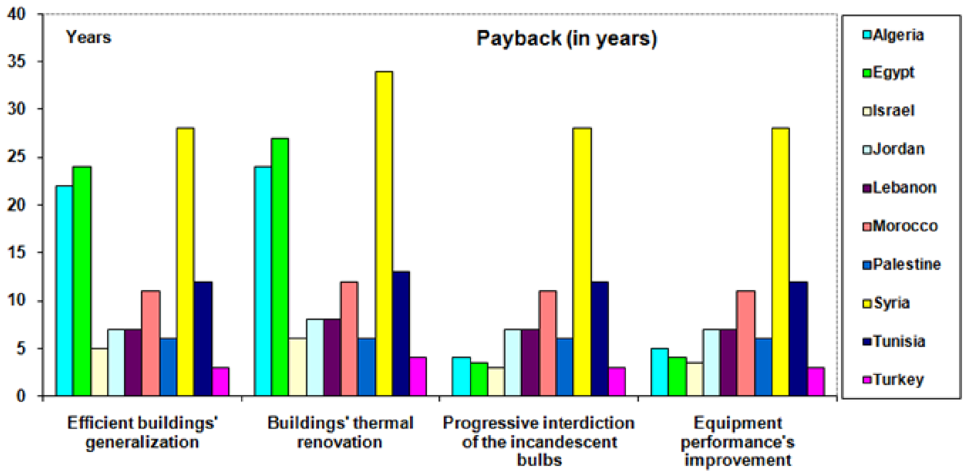


Source: ALCOR (Tunisia)

The magnitude of the penetration rate in Israel can also be explained by the additional regulatory measures that require of households to set up a SWH from the moment that the building height is lower than 27m.

The same analysis can be made on all the other measures, as shown Figure 30 and on Table 11.

Figure 30 - Payback time for the consumer, by country



Source: ALCOR (Tunisia)

Table 11 - Return on investment time of the various measures for the end user

	Large scale dissemination of energy efficient building	Thermal Renovation of Buildings	Gradual prohibition of incandescent lamps	Improvement of equipment performance
Algeria	20,9	24,6	1,8	4,7
Egypt	24,5	26,9	1,4	3,6
Israel	4,9	6,3	1	2,5
Jordan	7,5	9	0,8	1,9
Lebanon	7,5	9,2	1	2,5
Morocco	10,3	11,8	0,8	1,9
Palestine	6,1	7,6	0,9	2,2
Syria	29,5	31,2	1,4	3,6
Tunisia	10,8	12,5	0,9	2,2
Turkey	3,1	4	0,8	2

Source: ALCOR (Tunisia)

This economic analysis helps derive some key lessons as to the conditions necessary for the development of a market for energy efficiency solutions in the buildings of the region.

The dissemination of efficient light bulbs is, in general, the most profitable measure for the end user, with a return on investment time that is generally less than two years. Except for Algeria, Syria and Egypt, the return on investment time is less than one year.

The dissemination of efficient electric household appliances ranks second in terms of profitability for the end user. The return on investment time is generally around 2 years, except for the three countries where electricity is still highly subsidized, namely Algeria, Egypt and Syria.

Regarding these two measures, there are really no economic barriers to their large-scale dissemination. If there is any barrier, it is rather of an informational nature, consisting in a lack of awareness-raising and information of the public and the operators as regards the benefits to be derived from these measures.

Thermal renovation and the construction of new efficient housing units are, however, measures that carry little return on investment for the final user and will be difficult to promote based on spontaneous market mechanisms in most countries of the region.

Due to low LPG and natural gas tariffs, the return on investment times often exceed the acceptable limits for the end user, except in Turkey and, to a lesser extent, in Israel.

1.2.2. Initial investment constraint

In certain cases, the significant initial costs of energy efficiency measures, by comparison with the consumers' financing capacity, can constitute a barrier to dissemination.

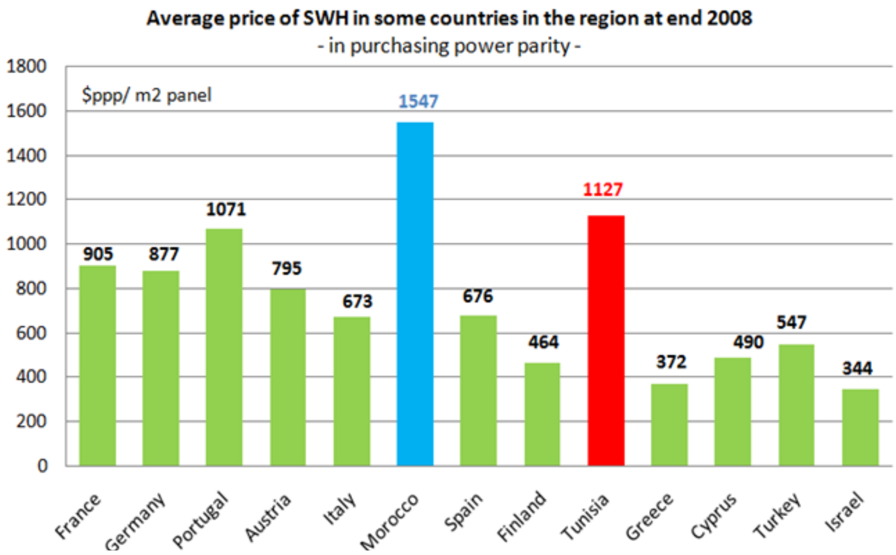
Thus, even if the return on investment time for the consumer were to become interesting and attractive for households, a change of scale of the market could still be hampered by the barrier of the initial investment which exceeds the capacity of payment of a major portion of households. In this case, only a small portion of the potential market could be tapped.

For the sake of illustration, Figure 31, which presents the acquisition prices of solar water-heaters at purchasing power parity (PPP), highlights the constraint of the cost of the solar water-heater in certain countries of the region, such as Tunisia and Morocco.

Besides, the construction of efficient housing would cost, on average, according to the countries and to the category of housing (high grade, economic or social), between 3% and 10% more per housing unit. This overcost will not be absorbed by the current market mechanisms.

Similarly, the cost of thermal renovation of buildings (roof insulation) would cost between 1000 and 2000 € per housing unit, which would exceed the capacity of payment of a major portion of households.

Figure 31 - Average price of the SWH by country, in 2008



Source: ALCOR, 2009

1.3. Organisational barriers

At the organisational level, the building sector presents certain specific characteristics which constitute barriers to the implementation of a energy efficiency scenario.

The first obstacle is the fragmentary and heterogeneous character of the building sector which tends to increase transaction costs and makes it costly to set up a mechanism for the dissemination of energy efficiency measures. These difficulties are compounded by the prevalence, in most southern Mediterranean countries, of self-construction, if not informal construction sectors. It thus becomes difficult to rally the actors of these sectors to a energy efficiency policy in this market segment.

Besides, the building sector is characterized by a multiplicity of actors: real estate developers, planners, architects, banks, owners, tenants, administration in charge of the management of the sector, etc. These actors sometimes have conflicting interests, motivations and constraints which impede the dissemination of energy efficiency measures. For example, real estate developers and banks often seek to produce lower cost housing in order to be competitive on the market, without however taking into account the cost of operation of the housing unit throughout its lifecycle, namely energy consumption. Even States, within the framework of their policies of production of social housing, often adopt strategies of minimization of selling prices at the expense of operation costs.

All in all, when housing is occupied by a consumer different from the owner, there is a tendency towards minimization of the capital costs, without taking into account the future expenditure related to the energy consumption of the building, and this, in view of the fact that the investor will not be the one to benefit from the energy performance of the building.

1.4. Technical barriers

These barriers are mainly due to a lack of know-how and control over technologies related to energy efficiency measures by the professionals of the building sector, at all levels:

- Designers, including architects and engineering consultants: The latter are for this reason incapable of identifying the technical solutions most suited to each context and of effectively integrating them right from the building's design phase;
- The building firms which do not have qualified personnel capable of implementing the technical solutions according to the book. For instance, the thermal performances expected from wall insulation could be completely cancelled out by thermal bridges likely to be left by masons during construction work.

In addition, the unavailability of a credible local supply of energy solutions and materials necessary for their application (solar water-heaters, insulation materials, efficient household appliances, etc) can constitute a major obstacle to the implementation of any scenario of energy efficiency in buildings.

2. Ways and means of an implementation of a rupture scenario

The implementation of the rupture scenario, resting on strong energy efficiency policies, requires the deployment of diversified instruments which must be designed and used in a complementary and consistent manner. Four types of instruments seem to be essential:

- Legal instruments,
- Incentive instruments,
- Sector capacity building and coaching instruments,
- Institutional and organisational instruments.

2.1. Legal instruments

These consist mainly in measures of a mandatory nature whose purpose is to refit the market for energy performance. These measures relate both to the shell of buildings and to electric household appliances.

2.1.1. Energy regulation of electric household appliances

This measure consists, first of all, in mandatory display, on major appliances, of standardized labels specifying the energy consumption level (class). This helps inform the consumer about the consequences of their choice in terms of future energy expenditure by highlighting the appliance's energy consumption cost as an additional criterion of choice besides the purchase cost.

For the sake of illustration, Tunisia laid down, back in 2004, regulations relating to mandatory labelling of refrigeration appliances (8 classes). In 2005, new regulations set a timeline for the elimination of Classes 8, 7, 6 and 5 for the time frame 2007. Then, in 2009, the regulations evolved into a prohibition of Classes 4 and 3. Similarly, a legal text, issued in 2009, made it mandatory to display labels on air-conditioning appliances and set a timeline for prohibiting Classes 8, 7 and 6.

As a complement to this preparatory phase to the introduction of mandatory labelling, the public authorities often undertake a gradual prohibition of marketing appliances of classes corresponding to low energy performance. This measure helps fit out the market for better performance (more energy efficient) appliances.

In the southern Mediterranean countries, these measures should focus in priority on refrigeration appliances whose use often claims the largest portion of the household consumption, as well as on air-conditioning appliances which have reported for a few years now high penetration growth.

Such measures can also extend to lighting by laying down regulations gradually prohibiting the use of incandescent lamps. Several countries of the region are on the way of promulgating such regulations.

As has been demonstrated above, the impacts of these measures are quite positive because they allow energy savings at lower costs. However, the applicability of these measures and the effectiveness of their implementation are conditioned by a certain number of factors:

- It is necessary to have a cost-effective control system of marketing the electric household appliances. That implies close coordination and cooperation with the services in charge of trade and customs authorities;
- It is necessary to put in place an infrastructure for technical testing and certification of the appliances;
- It is necessary to coach the local manufacturers of the electric household appliances subject of the regulations in order to help them improve their products so that they can be upgraded to the legal requirements.

2.1.2. Thermal regulation for buildings

The thermal regulation for buildings aims at making it mandatory for operators to produce buildings that observe a set of minimal requirements in terms of thermal (or energy) performance.

Several countries of the region have already adopted a thermal regulation (Turkey, Tunisia, Algeria, Lebanon, Syria, etc.). Yet, the real challenge lies in an effective application of the regulation provisions on the ground. Indeed, several obstacles may hinder actual implementation, of which:

- The investment overcost that it incurs and which remains at times difficult to absorb by the construction market, especially as far as social housing is concerned;
- The difficulty and high cost of control over its implementation;

- The insufficiency, if not total absence, of provision of service and supply of materials likely to meet the demand created by this regulation, etc.

Accordingly, the promulgation of such a regulation should be preceded by a preparatory phase which consists in creating the sectors activities necessary for the implementation of the related technical requirements (training of competencies, supply of materials, etc).

Very often, the implementation of the regulation in the context of the southern Mediterranean countries had to be accompanied, in inception phase, by financial incentive mechanisms to foster the creation of the sector activities in question and to gradually activate the market mechanisms.

Besides, one of the deficiencies of the regulation-based approach is that it generally covers but a limited segment of the building sector, namely new buildings. More specifically, in almost all countries of the region, the regulation excludes existing buildings, while this regulation comes at a moment when the building sector is nearing saturation. Moreover, because of the difficulties of implementation and control, the regulation often excludes the segment of buildings produced in self-construction mode, be it legal or illegal, which further curtails its impact.

For all these reasons, measures of thermal regulation must be necessarily supplemented by incentives instruments based on a voluntary approach.

2.2. Incentive instruments

Incentive instruments are aimed mainly at removing the two major economic barriers mentioned above, namely: the low return of the measures for the end user and the initial investment constraint.

2.2.1. Improving the return of the measures for the end user

Improving the return of the measures for the end user implies necessarily a decrease in investment cost, all things equal otherwise. In theory, three types of measures, all based on public financial support, can be applied for this purpose:

- Public investment subsidy

  State subsidy for investment in energy efficiency measures is justified by the economic distortion introduced by the public subsidy for conventional energies and which makes alternative solutions hardly profitable and, hence, little attractive, for the end user.

  Often, the implementation of energy efficiency solutions is sufficiently profitable for the State, and this, due to the subsidies avoided on the saved conventional energy (and more particularly so in the wake of the rise in international energy prices), but it is, at the same time, far from profitable for the end user, which is not conducive to a spontaneous demand on these techniques.

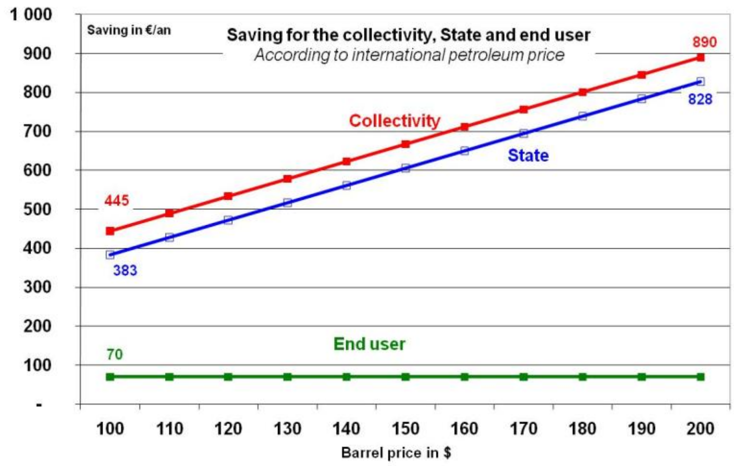
  Thus, the objective sought by public subsidy in intended, inter alia, to balance the redistribution of the windfalls of energy efficiency solutions between the State and the end user, in such a way as to obtain a win-win situation.

For the sake of illustration, the Figure 32 presents the profit accruing to the various actors, as generated by the installation of energy efficiency measures in a standard house of 80 m² in Algeria (MEDENEC pilot project).

While the saving on the consumer's energy bill is around 70 € per year, the saving made by the State ranges, according to the price of the oil barrel, between 383 €/year and 828 €/year. A portion of the profit reaped by the State can in this case be transferred, under the form of investment subsidy, to the end user towards improving return on the energy efficiency measures, while maintaining a satisfactory profitability of this subsidy for the State: the purpose is to obtain a win-win situation between consumer and State.

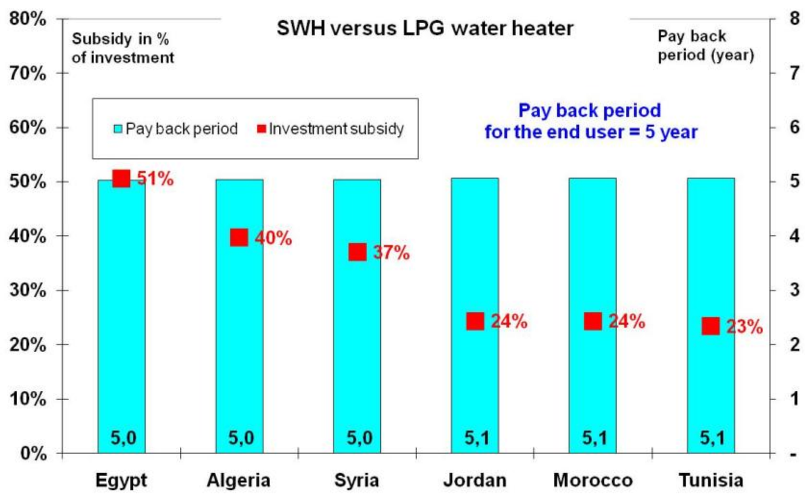
Figure 33 also illustrates the conditions necessary for establishing this win-win situation with regard to a dissemination of solar water-heater in various countries of the region.

Figure 32 - Gain for the community and the consumer, according to the oil barel price



Source: Rafik MISSAOUI, MED-ENEC, 2008

Figure 33 - SWH versus LPG water heating, by country



Source: ALCOR (Tunisia)

Thus, in order to guarantee a satisfactory return time for the end user on the purchase of a solar water-heater, as compared with a LPG water-heater (return time = 5 years), it would be necessary to grant a public investment subsidy of around 20% in the context of Tunisia, Morocco or Jordan. In this case, the return time on this subsidy for the State would be somewhat equivalent, that is, around 5 years.

In the case of Algeria, Egypt and Syria—where energy is highly subsidized—, the State would be required to make further effort in matter of subsidy for solar water-heaters, that is, 40% and more.

Lastly, it is worth emphasizing that this measure cannot be effective in the long term unless the resources upstream intended to be used for public subsidy are sustainable, being generated for instance by allocated tax (case of the National Energy Efficiency Fund (FNME) in Tunisia). Subsidies resting on budgetary resources are risky, and this, because they can be subject to sectoral trade-offs and may, thus, be liable to disappearing or being reduced at any time.

- Indirect tax benefit concessions

  These are measures of reduction of, and even of exemption from, indirect taxes, such as VAT, customs duties, etc. These measures are easy to implement and often neutral for public spending. Indeed, owing to the absence or smallness of the market of energy efficiency measures, there will be no shortfall for State revenue.

Such instruments are already deployed in several countries of the region which have established a regulation exempting completely or partially renewable energies and energy saving equipment from VAT and customs duties (Tunisia, Morocco, Jordan, etc).

- Direct tax rebate

  This measure, commonly known as "tax credit", consists in authorizing the deduction of the investments outlaid for energy efficiency measures (thermal renovation works, acquisition of solar water-heaters, etc) from the income tax base.

In view of the fiscal context in most southern Mediterranean countries, this instrument is often hardly effective.

In sum, the Table 12 presents the advantages and the disadvantages of the three main types of incentive measures aimed at improving the return on investment time for the consumer outlined above.

Table 12 - Pros & Cons of the main incentive measures

Measures	Advantages	Disadvantages
Public investment subsidy	➢ Clear impact on reduction of costs ➢ Strong message to the market ➢ Effective communication vector ➢ Supply driving force	➢ Pressure on public spending ➢ Little sustainability ➢ Difficult and costly management
Indirect tax benefit concessions	➢ Easy to implement ➢ Little pressure on public spending	➢ Little visibility ➢ Hardly efficient in case of informal market ➢ Hardly applicable to cost of services
Direct tax rebate	➢ Little pressure on public spending	➢ Hardly efficient in developing countries ➢ Difficulty of implementation in developing countries

Source: ALCOR (Tunisia)

2.2.2. Lifting the initial investment barrier

Easy access to credit under suitable conditions for the financing of the initial investment is the key measure for lifting this barrier. However, in the case of buildings and in the context of the southern Mediterranean countries, several obstacles hinder access by households to credit:

- low level of banking services, which is likely to exclude most of the households from obtaining bank credit to finance energy efficiency measures in their buildings;
- high cost of credit distribution due to the fragmentary nature of demand and the small loan amounts, which dissuades banks from positioning on this market;
- an often high interest rate due to this high transaction cost.
- Various measures are often used to overcome these barriers. These include the following instruments in particular:
- Setting up credit facilities dedicated to financing energy efficiency in buildings. These facilities which are set up by donors in the countries present the advantage of often proposing concessional conditions and can thus also be harnessed for communication in favour of a dissemination of energy efficiency;
- Subsidising the interest rate in order to reduce the high credit cost;
- Setting up a loan guarantee scheme to urge banks to be more active in financing this type of operations by taking greater risk. Although theoretically speaking, this measure may be tempting, it is in practice often too complex to implement in the context of developing countries.

Table 13 summarizes the advantages and the disadvantages of the three main types of measures outlined above.

Table 13 - Pros & Cons of measures compared to the initial investment

Measures	Advantages	Disadvantages
Dedicated credit line	➢ Resolving the problem of resources upstream ➢ Banking sector participation ➢ Effective communication vector ➢ Possibility of cancelling out reimbursement by reducing the bill	➢ Slow implementation ➢ High credit distribution cost in the case of fragmentary financing ➢ Exclusion of households with no access to banking
Subidised interest rates	➢ Effective communication vector ➢ Improved return on the measure for the end user	➢ Exchange risk cover ➢ Sustainability of the subsidy resource ➢ Distortion of financial market ➢ Pressure on State budget
Loan guarantee scheme	➢ Easier household credit access ➢ Enlisting bank participation	➢ Complex implementation in developing countries ➢ Excess risk (slippages)

Source: ALCOR (Tunisia)

2.2.3. Carbon revenue

In the case of energy efficiency programmes in buildings, the carbon revenue obtaining from the Clean Development Mechanism (CDM) can provide additional financial resources that may be used for consolidating the sustainability of these programmes: financing capacity building measures, communication, etc.

However, given the fragmentary character of the target, CDM methodologies have so far been quite complex to implement. Currently, the application of the new programmatic approach by the CDM Executive Board introduces a great deal of simplification with regard to the registration of these programmes, thus allowing new opportunities.

2.3. Instruments for capacity building of, and support to, sector professions

In order to remove the barriers associated with capacity building and control over the know-how outlined above, accompanying measures would confer credibility on the sector activity provided by local installation professionals. Among the capacity building actions, the following are worth mentioning in particular:

- Communication and awareness-raising

  Communication and awareness-raising targeted at the stakeholders represent a key factor for a change of scale in matter of dissemination of energy efficiency in the building sector. For this reason, it will be necessary to envision communication and awareness-raising activities targeted at the various stakeholders: public at large, architects, planners, real estate developers, banks, decision makers, etc.

- Training of architects and planners

  This type of training is indispensable to build the competencies necessary for a promotion of energy efficiency measures upstream of the production of buildings.

- Training of sector activities professionals and craftsmen

  One of the hindrances to a change of scale in energy efficiency in new buildings is a weak structuring of the services supply, particularly in insulation works small enterprises. Accordingly, one of the accompanying measures proposed consists in setting up a mechanism for the training of craftsmen in the works pertaining to the implementation of the various energy efficiency techniques in close cooperation with the vocational training entities. The objective of these training programmes is, on the hand, to build the capacity of small enterprises operating in the field and, on the other hand, to set up new enterprises in order to meet the increase in demand.

- Setting up a system of accreditation and certification of insulation works enterprises

  In order to reassure real estate developers, as well as housing purchasers, and to ensure at the same time the energy savings commensurate with the energy efficiency measures to be promoted, it is important to set up a effective system of accreditation/ certification of works enterprises (insulation works, solar water-heater installation specialists, etc).

- Setting up a system of control and certification of materials and equipments

  It is often necessary to set up an adequate infrastructure for the control and certification of insulation products and of marketed equipments, and this, for the same reasons as stated above.

2.4. Institutional and organisational instruments

Lastly, the implementation of the scenario of energy efficiency in buildings, which implies a change of scale in matter of dissemination of energy efficiency measures, requires the setting up of an adequate institutional framework. In particular, it seems essential to have a programmes coordination entity capable of operating in a cross-cutting (horizontal) manner with the whole range of stakeholders.

The role of such a structure consists mainly in the following:

- Design of dissemination programmes and mechanisms in concertation with the whole range of institutional and private actors of the building sector;
- Mobilization of funds and set up of financial mechanisms;
- Communication and awareness-raising among the actors;
- Coordination of the intervention of the actors;
- Monitoring and evaluation of programme implementation;
- Preparation and upgrading of the regulation and the incentives system, etc.

In most of the countries, this role rests with to the energy efficiency agencies, such as the ANME in Tunisia, the APRUE in Algeria, etc.

In short, the implementation of a ambitious energy efficiency scenario in the region will require the set up of mechanisms combining, in an adequate way, financial instruments, and organisational and institutional instruments, with several types of measures:

1) Financial instruments
    - A public win-win subsidy to reduce the return on investment time for the end user;
    - Indirect tax measures;
    - Bank credit over a period that is long enough to ease the pressure on the payment capacity;
    - Sufficient resources upstream both for the public subsidy and the credit.
2) Institutional and organisational instruments:
    - A simple and effective credit distribution system;
    - Efficient and certified/ accredited operators;
    - Efficient quality control, without it being cumbersome and costly;
    - Accompanying measures.

3. Example of a successful programme: PROSOL in Tunisia

The PROSOL programme, initiated in 2005, rests on a innovative mechanism aimed at removing the main barriers of a financial, technical and organisational order hindering the development of the solar water-heater (SWH) market.

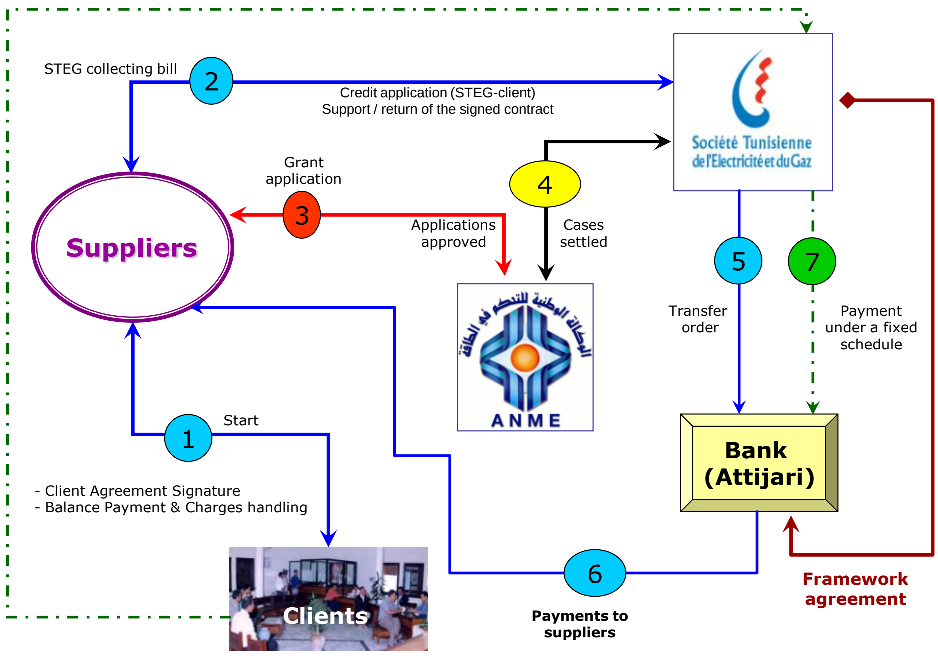
This integrated mechanism is based on a consistent set of measures, namely:

- Public subsidy to the consumer of 100 Tunisian Dinars (TND)/m², determined according to a win-win logic between the consumer and the State. This subsidy is aimed at reducing the return on investment time for the end user (consumer), while generating significant net gains for the State, considering the substituted consumption of LPG and conventional energy for water heating;

- Credit payable via the STEG* electricity bill according to terms adapted to the socio-economic profile of the target, especially with regard to duration. The objective is to remove the initial investment barrier;
- A simple and effective mechanism of distribution and recovery of the credit, involving both suppliers and STEG (STEG: National Electricity and Gas Utility);
- A quality control system both upstream and downstream the distribution of solar water-heaters.

The organisation of the actors of the mechanism is given in Figure 34.

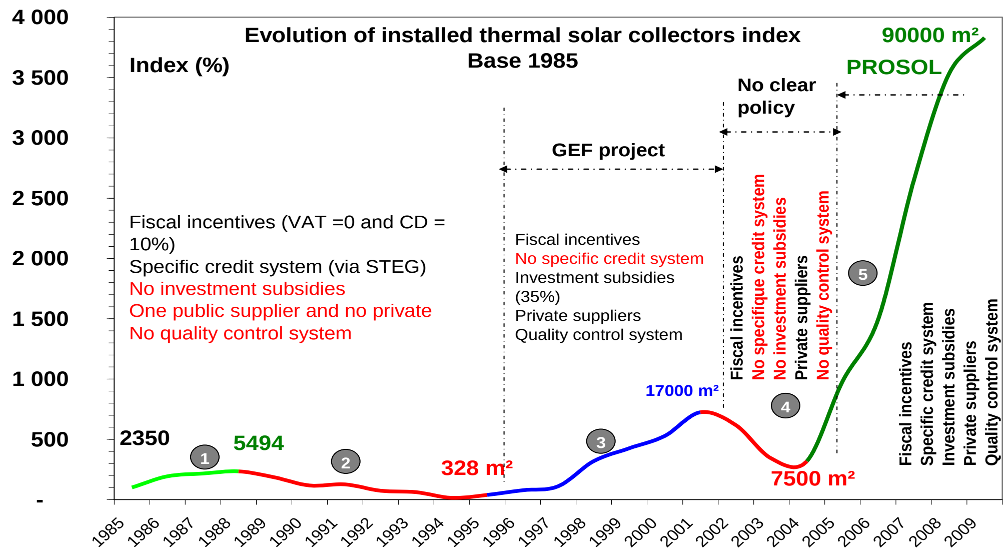
Figure 34 - Organization for the success of a program (example PROSOL Tunisia)



Source: ALCOR (Tunisia)

Thanks to this mechanism, PROSOL has effected a real change of the solar water-heater market in Tunisia, as illustrated by the market evolution graph on Figure 35.

Figure 35 - Transformation of teh SWH market in Tunisia



Source: ALCOR (Tunisia)

Conclusion: Synthesis and key messages

This study submits unambiguously that the building industry is a key sector to address the new energy and climate situation in the Mediterranean.

Whether one considers new buildings or old buildings, and even though the actions to be undertaken are undoubtedly different, it remains true that **now is the time to act on this sector** if we want to substantially reduce the GHG emissions of the region and to thus combat climate change. Beyond this obvious fact, it would not be amiss to recall that a new building poorly constructed is one that will have increased heating and air-conditioning needs over the next 50 years…

In the specific context of the SEMCs, where much remains to be done in terms of structuring the sector, it is important to bear in mind that only **joint action between the various stakeholders** will foster the emergence of a lasting market for sustainable construction.

The conclusions of this report, as well as the recommendations for action, are listed hereunder:

- It is urgent to rethink the building sector as a whole and its territorial footprint

  The energy consumption trend scenarios in the SEMCs are particularly alarming, and the growth of this consumption will be primarily covered by fossil energies, which raises the question of the sustainability of these countries' energy system. For the producing countries, as well as for the importing ones, energy efficiency is thus a major stake, all the more so in the **residential sector which accounts for 27% of the final energy consumption**.

  Alongside with this observation, the demographic dynamics of the SEMCs, associated with a urbanization phenomenon, will generate, **by 2030, a need for 42 million additional housing units.**

  In view of this situation, it is important to provide the conditions necessary for turning this situation of constraints into an opportunity for improving the energy performance of the housing stock. In any case, it is essential to act as promptly as possible so as not to miss this opportunity and, thus, run the risk of witnessing a hasty development of poorly designed and high energy-consuming buildings.

- Priority focus must be placed on new buildings

  As a first step, it is essential to focus on new building given the dynamism of the construction sector in the SEMCs and the existing high demand. This sector could—subject to an incentive legal and financial framework, as well as a local availability of the essential technologies—be targeted by a quite proactive legal framework.

  The issue of the renovation of old buildings is also important, but it must be observed that the country situations still appear to be in many cases not mature enough to address the constraint of this sector.

- Technical solutions are available

  Various technical solutions have been identified as being particularly suitable for the Mediterranean context. Without venturing into any generalization, they have a bearing on:

  - better consideration of a time-honoured architecture which was responsive to bioclimatic principles: passive solar contributions, natural ventilation, building orientation, etc. Moreover, prioritizing the techniques of bioclimatic construction must be also seen from the perspective of revaluating the architectural and cultural heritage and, thus, as an opportunity in terms of tourism windfalls. To learn the lessons from traditional architecture would help towards designing a Mediterranean sustainable building, bearing the hallmark of a strong identity. Pilot projects have already significantly highlighted the usefulness of this know-how even for collective housing.
  - measures presenting a good cost-benefit ratio: insulation of roofs and outside walls, solar protection on the more exposed facings, double glazing, efficient light bulbs, solar energy for water heating … For an average housing unit, the overcost of the whole range of measures selected within the framework of the break-up scenario is estimated as 3300 € for a new housing unit.

- The barriers to a dissemination of these solutions must not be underestimated…

  The barriers hampering the development of a large-scale energy efficiency market in the building sector in Mediterranean countries are of several orders:

  – **Informational barrier**: Broadly speaking, the issue of energy efficiency in the SEMCs is not the offspring of an ancient and shared culture. Most of the technical solutions available for energy efficiency and, especially, their economic impact, are not well-known among the public at large, the professionals of the building sector and, in many cases, the decision makers themselves. The situation is, therefore, akin to that of the classic vicious circle of diffusion of innovation.

  – **Economic barrier**: This is often the major barrier for the consumer. This barrier may be related to two main reasons:

    ♦ the relatively low return on the measures for the end user;

    ♦ the high costs of the initial investment compared to the self-financing capacity of the households

  – **Organisational barrier**: The building sector presents certain specific intrinsic characteristics which hamper to a large extent the implementation of a energy efficiency scenario.

    The diversity of the sector professionals mobilized and the fragmentation of the construction process make this sector extremely complex and difficult to grasp. To this, there must be added the divergent interests of the various stakeholders which significantly hamper the investments (e.g.: the owner and the tenant do not have the same concerns, the former being not inclined to investing in measures which will concretely benefit only the latter…).

  – **Technical barrier**: Besides the informational gap mentioned above, the lack of know-how and of control over the technologies related to energy efficiency measures by the professionals of the building sector is considerable. Without skilled labour and a easily available reliable and efficient technology, the market cannot develop.

    These barriers are not by any means specific to the SEMCs but are particularly important in the economic, social and energy context of the countries of the southern and eastern rim of the Mediterranean.

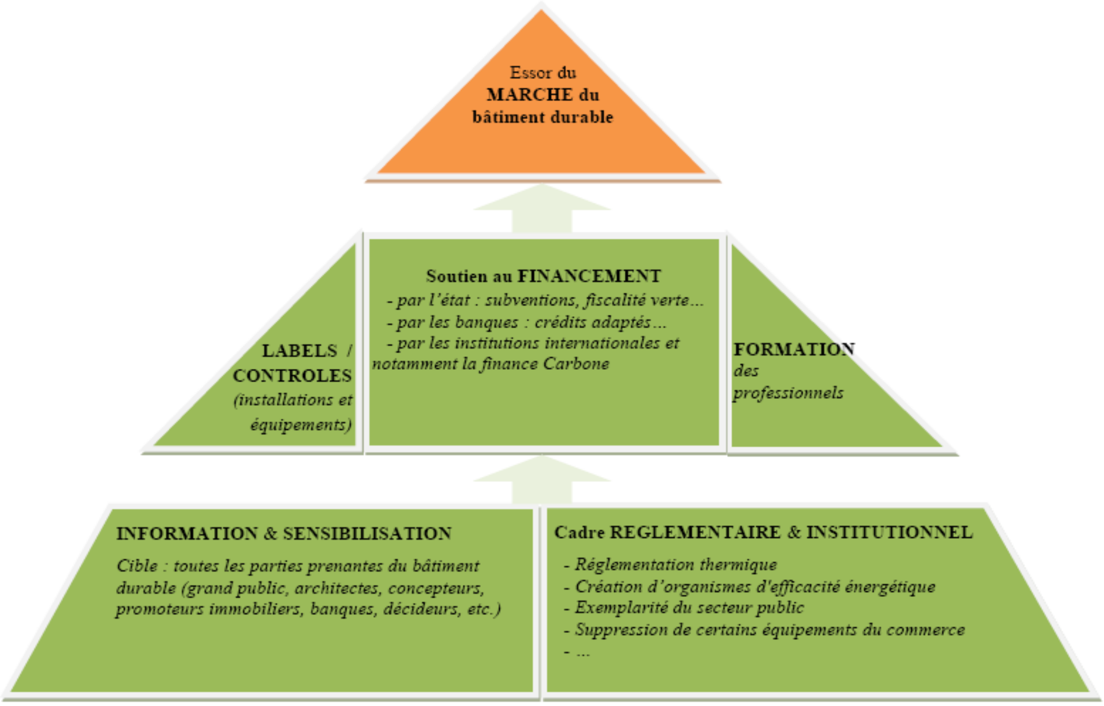
Recommendation of actions to remove these barriers and to develop the market of sustainable building in the Mediterranean

The emergence of a market of sustainable building will not be possible unless there is a firm will on the part of the State. Indeed, it is essential to incept a break-up focused approach, and only the political authority has the capacity to initiate such an approach: break-up in the political options via a dedicated legal framework accompanied by means of control and implementation in an effective way, break-up in the technical options to be promoted via a tailored support system, and, finally, break-up in the manner of encompassing the building right from its design through to its construction, without forgetting the impact of its operation during its lifecycle.

Figure 36 sums up the various key stages to create a market of energy efficiency of buildings. In brief:

- The foundations (necessary, though not sufficient, conditions to assist in deployment of the market): the State must be the driving force of the change, by imposing strict choices in matter of regulation, by proposing an adequate institutional structure and by massively communicating on its policy to the various stakeholders, in order to foster a veritable change of scale.
- The accompanying measures: This consists in creating the conditions indispensable for a dissemination of energy efficiency measures. The economic barrier, which represents no doubt the most important obstacle, can be removed if there are support measures capable at the same time to reduce the initial investment and to make the return on investment time acceptable. Alongside with this, there must be created a climate of "trust". If the professionals are well trained, if the technologies on the market are of quality, and if the works are duly controlled, only then will the consumers be inclined to invest.

Figure 36 - Pyramid of sustainable building in the Mediterranean



Source: Stéphane POUFFARY and Pascal AUGAREILS

To sustainably develop such a market implies the implementation of measures dedicated to organising, financing and accompanying the sector in the long term.

The actions to be undertaken can be classified into the following 3 axes, bearing in mind that their implementation must be conducted in a parallel and coordinated manner. Indeed, there are obvious synergies between the actions proposed (e.g.: to communicate is essential not only to launch the sector but also to ensure its sustainability), and, consequently, it is not possible to, strictly speaking, categorize these recommendations.

Establishing a sustainable building sector

- Set out a binding, cross-cutting legal framework and control its implementation

  The first step consists in developing a tailored legal framework via a thermal regulation or minimum energy prescriptions in construction. Similarly, it is essential that the appliances and equipment be at the heart of the framework. The political authorities must also design a wide range of instruments and accompanying measures allowing effective implementation of the regulations (financial and tax instruments, technical support and assistance in decision-making, control processes as regards enforcement of the measures…).

  Indeed, a thermal regulation is not sufficient in itself to change construction methods. While it is essential to engage accompanying measures, it is even more crucial to ensure proper enforcement of the regulation. Many a well thought-out law will not have any concrete impact on the ground if no control over its enforcement is undertaken.

- Set out a tailored and sustainable institutional support

  The designation of an entity in charge of energy efficiency, as a whole, is essential to effectively accompany the professionals of the sector. So that energy can carry weight in the decisional balance at highest level, it is essential that an entity be entrusted with the development, coordination, control and promotion of governmental programmes and measures. This entity must also inform and sensitize the public institutions (ministries concerned), private sector operators (architects associations, developers and banks) and individual persons. Lastly, in order to become a credible and an indispensable contact point for the sustainable building stakeholders, this entity must be set up from a long term perspective and not only for the measures inception phase.

- Rethink the energy policies

  This consists, in other words, in forsaking the subsidizing of electricity tariffs (particularly in Egypt, Syria, Lebanon, Jordan and Algeria) that sustain the use of electricity for the heating of water and buildings. Moreover, the budget mobilized for these subsidies could be partly re-allocated for energy efficiency support in order to allow a reduction of consumption.

Finance sustainable building

- Set out a tailored tariff system and ensure incentive prices

  The objective is to define an incentive tariff system which valorises, financially speaking, control over consumption, rather than consumption. This concurs with the point raised above concerning a reduction, if not the abandonment, of subsidies of electricity tariffs. Tax credit and investment grants are two mechanisms which have been proven on the northern Mediterranean rim as they help reduce the initial bill for the consumer while guaranteeing a more competitive return on investment time. While these measures may seem to be, at first sight, quite heavy on the finances of the countries concerned, it is important to underscore the economic benefits in the long term. Indeed, "inaction" vis-à-vis climate change and pursuing subsidies on tariffs are certainly the worst options to take from a strictly economic point of view.

- Enlist bank participation and tailor credits

  Access to credit is essential to allow a veritable change of scale in terms of sustainable construction. The financial sector must propose dedicated financing mechanisms and credits under acceptable terms tailored to the economic situation and the uses of the countries concerned. As has already been demonstrated by several examples, it is possible to mobilize banks for the purchase of a energy efficient housing (increasing the amount borrowed, coupled with a lowering of the interest rate).

- Develop Public-Private Partnerships (PPPs)

  Strengthening cooperation between the public sector and the private sector is an effective way of mobilizing additional means. The management capacities of the private sector, as well as its natural integration among the populations, make of it a key development driver. The purpose, here, is not to promote withdrawal of the public sector but to streamline its means by harnessing the performance of the private sector under a strong public orientation and regulation. The example of ESCos, energy services companies, which aim at optimizing the consumption of their clients and derive their remuneration from the savings ensuing therefrom, is revealing. This "win-win" system offers the twofold advantage of being profitable for the company (profit being indexed to the savings made) and less costly for the State.

- Facilitate access to international funding

  It is of paramount importance, at least during the market establishment phase, that the energy efficiency projects in the construction sector be supported by international financial institutions, capable of guaranteeing or covering access to credit. In the same spirit, it is essential to adapt and develop the facilities of the Clean Development Mechanism (CDM) and of joint implementation issuing from the Kyoto Protocol. The CDM "PROSOL" project in Tunisia demonstrates the extent to which this type of mechanism can prove to be advantageous. The new National Appropriate Mitigation Actions (NAMA) discussed under the United Nations Framework Convention on Climate Change would allow a better mainstreaming of the Carbon Finance opportunities in setting out national policies and measures adapted to the building sector.

Ensure a lasting sustainable building market

So that the sector would develop in a sustainable way, it is necessary to establish a climate of trust. The "word of mouth" should convey notions of quality, reliability and economic return. In the two recommendations below, it is important to underscore the value added that can obtain from not only a North-South, but also a South-South, exchange of experience.

- The State to lead by example

  The State must encourage pilot projects in its own building stock, and this, especially when they relate to high demonstration potential sectors, while ensuring that the overcost of these buildings is under control and that the materials and technologies are available locally in order to maximize the replication potential. It is important to see to it that these initiatives extend beyond the mere demonstration project, as has often been the case in the past. For so doing, a monitoring of the performance of these pilot projects would offer better knowledge about what is available.

- Quality of the equipments and developments must be controlled and the professionals trained

  The SEMCs are called upon to develop labels and certifications for buildings and household appliances. In due time, and as soon as possible, the criteria for these reference standards should become recognized at least at regional level and, in any case, be in line with the European and international processes underway. Moreover, it would be advisable to establish a quality control system upstream and downstream in order to assure the consumer, in particular with regard to the technology that they might not be familiar with. In the same spirit, it is essential to set up training programmes dedicated to energy efficiency and sustainable buildings. Inasmuch as possible, the existing training programmes must be revised, complemented and/or adapted. Here again, a regional approach would make it possible to consolidate the effects and to gain in expertise. While these "labelling" (certification) and "training" aspects may seem to be relatively exacting to set up, they are however essential to ensure a large-scale dissemination of energy efficiency measures in the SEMCs.

Annexes: Overview of Lebanon, Tunisia and Morocco country studies

Annex 1: Lebanon case study

(June 2010)

General context

Lebanon, with a total area of 10.452 km², is located in the East Mediterranean and extends over some 210 km along the coast and 50 km inland.

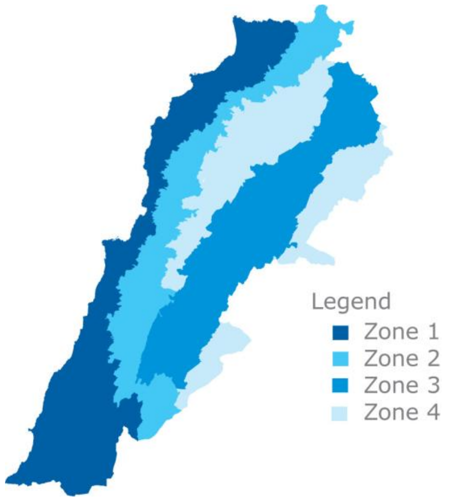
The population counted 3 759 136 inhabitants[46] in 2007. Beirut and Mount-Lebanon – the largest administrative district - accommodate 50.4% of the population. The number of households is 888.813 and the average family size is 4.23.

The GDP of Lebanon stood at 25 billion US$ in 2007, that is 6665 US$/inhabitant.

The climate of Lebanon[47] is typically Mediterranean, with abundant rain in the winter (January to May) and with prevailing drought and aridity during the other seven months of the year. However, the influence of the Mediterranean, the topographic characteristics, and the Syrian desert to the north create a variety of microclimates within the country with contrasted temperatures and distribution of rainfall.

Figure 37 - Climatic Zones of Lebanon

The 4 climatic zones[48] of Lebanon are:
Zone 1 - Coastal
Zone 2 – Medium altitude western mountain
Zone 3 - Continental shelf
Zone 4 - High mountain



Source: Project GEF LEB/99/G35 au Liban

Energy context

Primary energy consumption reported high growth from 1992 to 1998, then a less significant increase, reaching 5.4 million tons of oil equivalent (Mtoe) in 2008 after a temporary decline in 2006 and 2007. Energy needs are met at 95% by imports of oil products. A gas pipeline originating in Syria is in place to supply the "DEIR AMAR" power plant in the north (435 MWe); gas went on stream in 2010 but for half of the power station. The energy bill of Lebanon reached 3.2 billion US$ in 2007 (12.8% of GDP).

46 "The National Survey of Households Living Conditions, 2007", Central Administration for Statistics.
47 "Liban : Enjeux et politiques d'environnement et de développement durable" (Lebanon:Environment and Sustainable Development Challenges and Policies), by Georges Abujawdé and Sylvia Laria, Plan bleu, 64 pages, 2000.
48 GEF LEB/99/G35 project.

Final energy consumption stood, in 2007, at around 2710 ktoe, of which 1271 ktoe in the transport sector (47%), 910 ktoe in the household and tertiary sector (33%), and finally 530 ktoe in the industrial sector (20%). It is worth pointing out that, back in 2004, the household and tertiary sector consumed 1030 ktoe (30.5%), for which an explanation is given further down.

In 2007, final energy consumption was based primarily on oil products (61%), followed by electricity (31%), then by coal (4%), with the remaining 4% consisting of renewable energies.

Final power consumption remains concentrated at 65% in the residential sector and the tertiary sector, then at 30% in the industrial sector, and finally at 5% in the other sectors (agricultural and administrative).

The government subsidizes electricity significantly. These subsidies reached 1.2 billion US$ in 2007 (17% of the national expenditure) and 1.45 billion US$ in 2009, which represents a subsidy of 11.4 cents/kWh taken from the grid in 2007 and 12.7 cents/kWh in 2009.

In 2007, the quantity of power taken from the grid (including Syria's purchase of 972 412 MWh) was of 10547GWh, with the quantity of power loss reaching 1583 GWh.

The Lebanese resort to generator-based power production to meet their needs. Self-production was in the order of 33 to 38% of the production of EDL (Lebanese Power Utility) in 2007 (that is, 3000 GWh)[49]. Final demand on electricity can be estimated as 3354 kWh/inhabitant/year (a figure exceeding by far the IEA and MEDSTAT known statistics which do not take into account self-production).

Current situation of the building sector

The number of main homes was of 888.813 in 2007. In Lebanon, 67% of housing consists in flats in several floor buildings. 52% of the housing units are 4 to 5 rooms. The average housing area in Lebanon is 129.3 m^2.

21.8% of the housing units are power heated, 25% use fuel oil, 27.3% gas (LPG), 17.6% wood or coal. The heating of running water[50] is in 70% of the main homes power based, 25% based on fuel oil and 5% on various sources (LPG, solar water heater, wood, etc).

Buildings are, in general, not insulated.

Draft thermal insulation standards were finalized and made public. These draft standards were not adopted; they are to date non mandatory and are not applied at all. The draft thermal regulation of buildings 2010, developed by the Engineers' Association and ECOTECH with the support of ADEME and ALMEE, is going well since it has been accepted by LIBNOR (Lebanon Standards).

The MEPS (Minimum Energy Performance Standards) for refrigerators, water solar-heaters, air-conditioners and CFL bulbs were adopted by LIBNOR in 2007 and 2008.

There are no labels for refrigerators, solar water-heaters, air-conditioners and CFL bulbs. There are, as yet, no certification laboratories for these appliances.

Trend scenario for 2020 and 2030

The demographic rate was of 1.6% in 2007. The resident Lebanese population would be of 5.4 million inhabitants by 2030.

The number of main homes by 2030 would be of 2.46 million. Non resident Lebanese always seek to purchase a home in Lebanon, which explains why the rate of increase in housing exceeds the rate of increase in the resident population.

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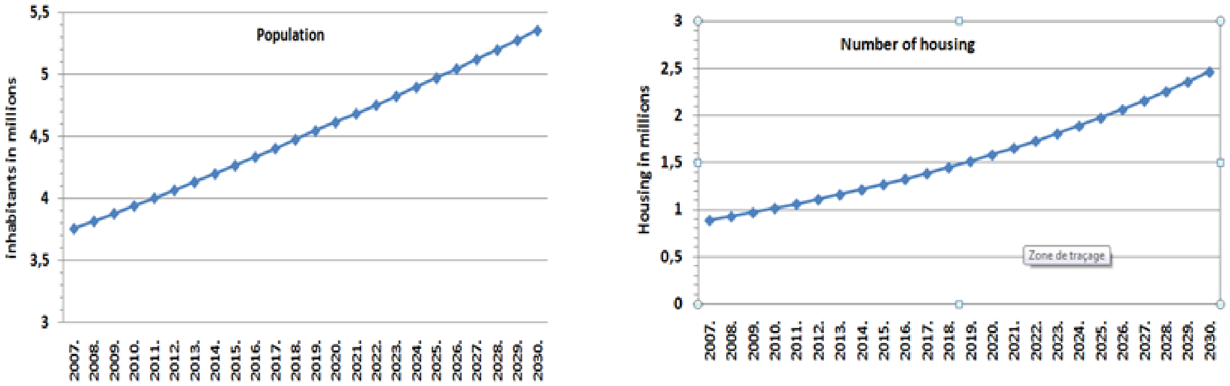
49 "Republic of Lebanon: Electricity Sector Public Expenditure Review", Report No. 41421-LB. World Bank, January 2008
50 "Le marché du solaire thermique au Liban" (Solar Thermal Market in Lebanon), ALMEE, 2003.

Figure 38 - Projected population and housing in Lebanon (H2030)



Source: Adel Mourtada

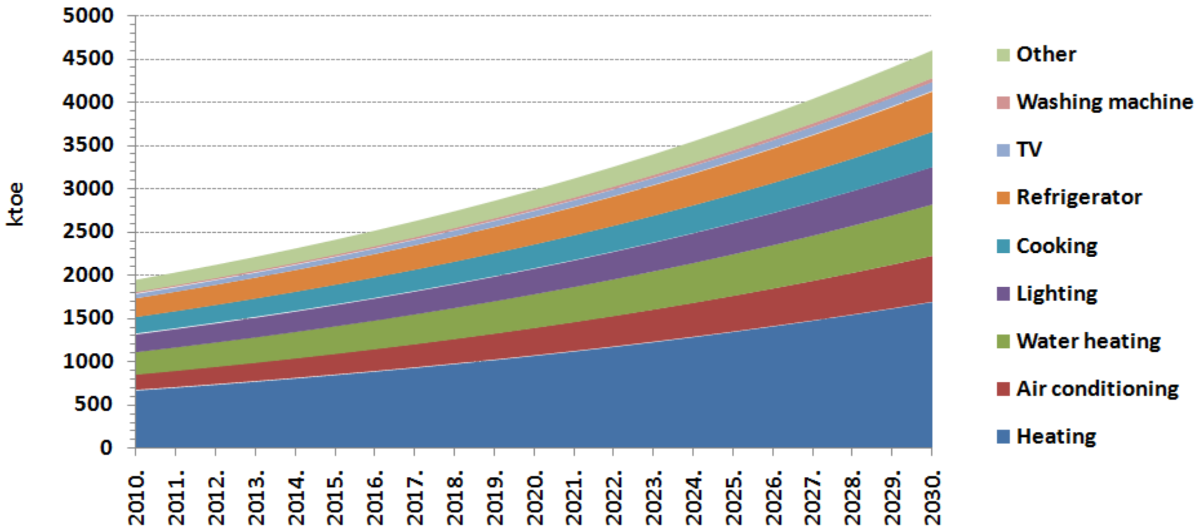
Energy and socio-economic impacts of energy efficiency measures

The evolution of the primary energy consumption of the residential sector according to the trend scenario of continuation of the current situation is given in Figure 39.

In more explicit terms, the following measures are assumed to be applied at a large scale:

- Generalisation of efficient shell for new buildings,
- Gradual elimination of incandescent lamps from the market,
- Thermal renovation of buildings (roof and wall insulation, change of windows),
- Dissemination of efficient electric household appliances, and heating and air-conditioning equipment,
- Dissemination of solar water-heaters.

Figure 39 - Energy consumption in Lebanon, by use in the residential sector, according to Reference scenario



Source: Adel Mourtada

The assumptions considered for the penetration of these measures are in Table 14.

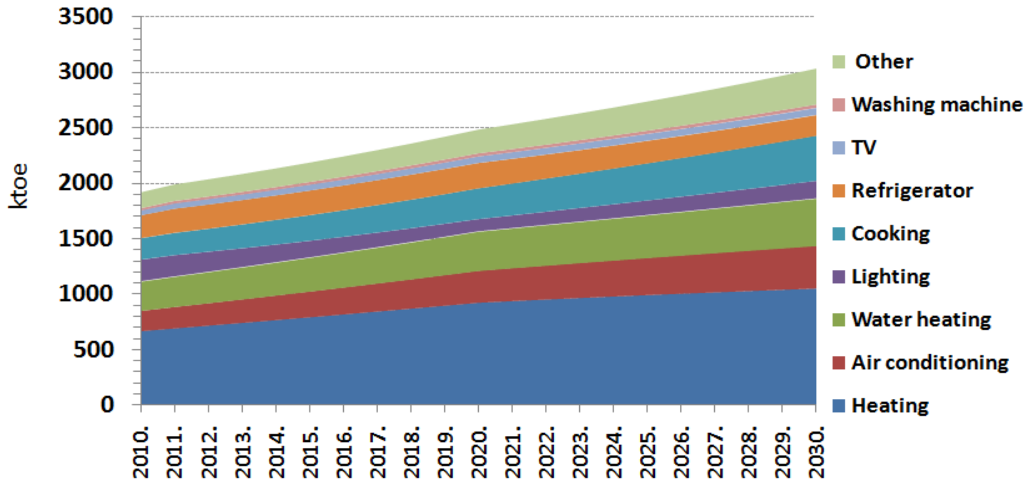
Table 14 - Assumptions of penetration of different EE measures in the Rupture scenario in Lebanon

	Existing buildings			New buildings		
Measures disseminated at large scale	2010	2020	2030	2010	2020	2030
Generalisation of efficient shell for new buildings				2%	50%	90%
Efficient lighting	20%	100%	100%	20%	100%	100%
Thermal renovation of existing buildings	1%	10%	30%			
Dissemination of efficient electric household appliances, and heating and air-conditioning equipment	10%	50%	100%	10%	50%	100%
Dissemination of solar water-heaters	7%	17%	30%	8%	20%	35%

Source: hypothèses retenues par le Groupe d'Experts/Plan Bleu

Based on an aggregate of the measures considered, and taking into consideration the dissemination assumptions outlined above, the energy efficiency scenario is given in Figure 40:

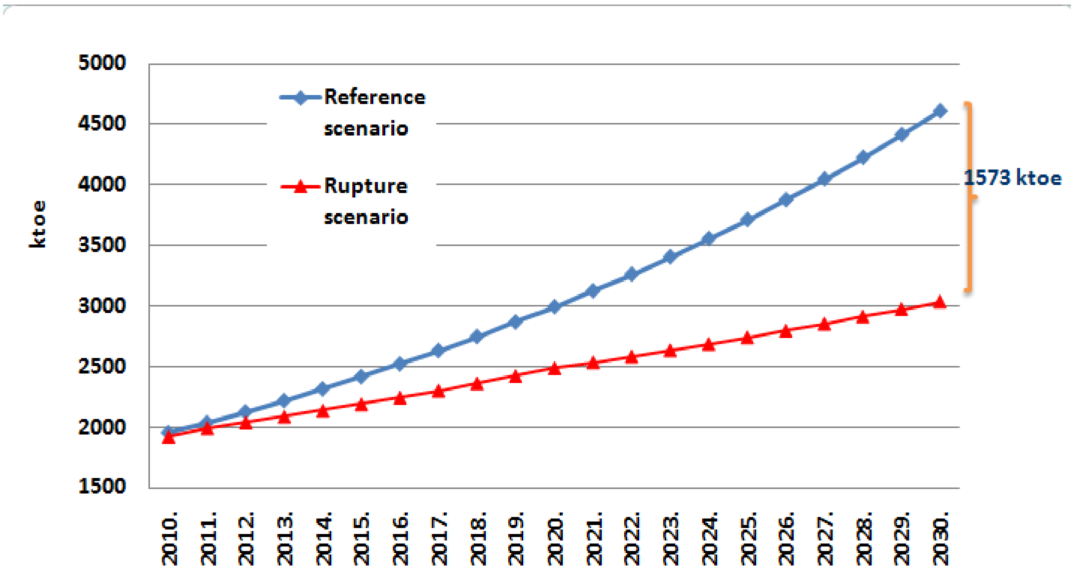
Figure 40 - Energy consumption in Lebanon, by use in the residential sector, according to Rupture scenario



Source: Adel Mourtada

The energy saving potential is estimated at around 1573 ktoe by 2030, compared with the trend scenario, as illustrated by Figure 41.

Figure 41 - Curves of energy consumption in Lebanon - Reference & Rupture scenarios



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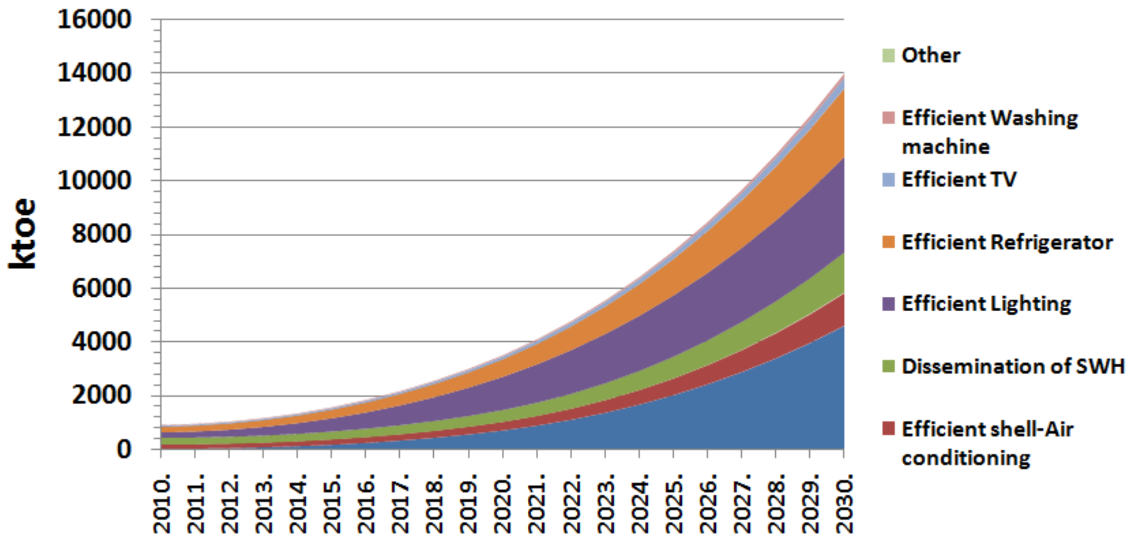
Source: Adel Mourtada

The aggregate primary energy savings over the period 2010-2030 are of 14 Mtoe, as illustrated by Figure 42 and Table 15.

Figure 42 - Cumulative primary energy savings over the period (2010-2030) - Rupture Scenario



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Source: Adel Mourtada

The aggregate energy saving potential per measure for the time frames 2020 and 2030 is given in Table 15.

Table 15 - Energy saving potential by EE measures in Lebanon (H.2030, in ktoe)

Measure	2020	2030
Efficient shell – Heating (in ktoe)	1344	5700
Efficient shell - Cooling (in ktoe)	532	1900
Dissemination of solar water-heaters (in ktoe)	499	1497
Efficient lighting (in ktoe)	803	1810
Efficient refrigerator (in ktoe)	768	2554
Other	175	557
Total (in ktoe)	**4121**	**14018**

Source: estimations Adel Mourtada

In view of this energy saving potential, the aggregate emissions avoided over the period 2010-2030 would be in the order of 39 $MTECO_2$.

A large-scale dissemination of the priority measures will contribute to a significant reduction in the cost of these measures. The total overcost per new housing unit would be in the range of 7 to 10% (exclusive of land cost). Energy savings would range between 40 and 60%.

The aggregate savings, subsequent to a reduction of the oil products importation bill, for the time frames 2020-2030, are given in Table 16.

Table 16 - Aggregate savings in Lebanon, estimates in M$

Measure	2020	2030
Efficient shell – Heating (in MUS$)	1050	4856
Efficient shell - Cooling (in MUS$)	415	1619
Dissemination of solar water-heaters (in MUS$)	390	1275
Efficient lighting (in MUS$)	627	1542
Efficient refrigerator (in MUS$)	600	2176
Other	137	475
Total (in MUS$)	**3219**	**11943**

Source: estimations Adel Mourtada.

The implementation at large scale of the measures recommended will lead to the creation of new business opportunities. Taking into consideration the pace of dissemination of the measures, the number of additional jobs generated in the case of the energy efficiency scenario may be estimated as 12000 jobs by 2030.

- Electric power avoided

  By 2030, the avoided electric power would be around 1800 MWe.

  This avoided power corresponds to a investment in the order of 2 160 MUS$, based on the assumption of 1.2 MUS$ per MW of conventional plants.

- Additional investment volume

  The additional investment volume is given in Table 17.

Table 17 - Additional investment in Lebanon, estimates in millions €

Measure	2020	2030
Efficient shell – Heating (in M€)	229	1577
Efficient shell - Cooling (in M€)	96	416
Dissemination of solar water-heaters (in M€)	83	325
Efficient lighting (in M€)	19	60
Efficient refrigerator (in M€)	42	180
Other	40	250
Total (in M€)	**509**	**2808**

Source estimations Adel Mourtada

Considering the aggregate investments related to the disseminated measures and the aggregate primary energy savings over the period 2010-2030, **the average cost of the TOE saved would be around 237 €/toe, which is much lower than the price of the TOE on the market. But it is necessary to consider the additional savings over the lifecycle of the measures, which further increases the return on these measures**.

The cost of the $tECO_2$ avoided over the period 2010-2030 is of 86 €. Considering the emissions avoided over the lifecycle of the measure, the cost of the $tECO_2$ avoided would be of 20.6 €.

The benefits of the action, according to three energy price scenarios at international level, are given in Table 18.

Table 18 - Payback period of the action, according to oil barel price

	Barrel price in US$	Return time in years	Barrel price in US$	Return time in years	Barrel price in US$	Return time in years
Wall insulation	60	4,9	110	2,7	130	2,3
Roof insulation	60	16,9	110	9,2	130	7,8
Window double-glazing	60	19,3	110	10,5	130	8,9
Efficient lighting	60	1,9	110	1,0	130	0,9
Window solar protection	60	4,5	110	2,5	130	2,1
Efficient air-conditioning	60	2,8	110	1,5	130	1,3
Efficient refrigeration	60	5,3	110	2,9	130	2,4
Solar hot water	60	6,1	110	3,3	130	2,8

Source: estimations Adel Mourtada.

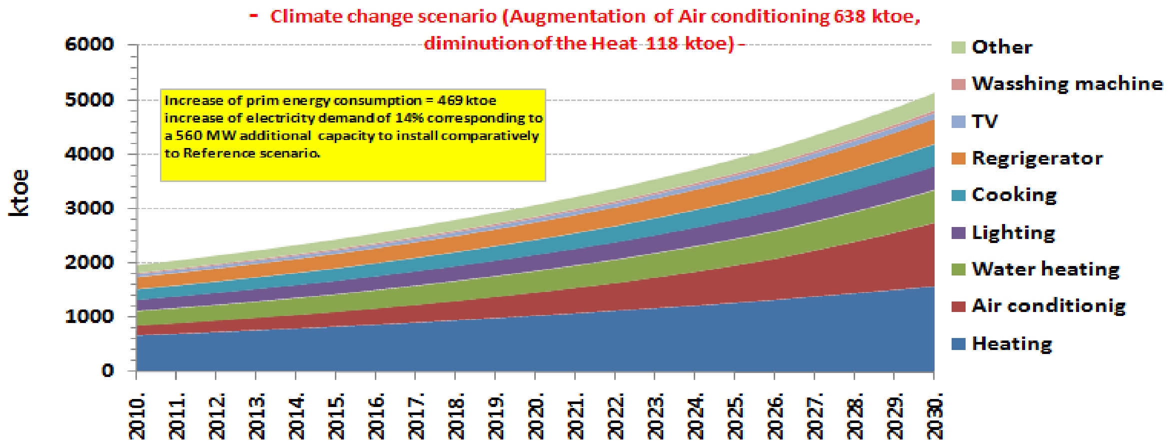
Cost of inaction over the building lifecycle

The increase in the needs for air-conditioning will exert pressure on the needs for power production, the latter being not taken into account in the demand evaluation models. This would result in an increase by 2.5% in the primary energy consumption of buildings due to power production, counterbalanced by a reduction by 2.5% of primary energies due to heating. The overall balance is nil, but the needs in investments in power production would increase by 6.5% compared to what was envisioned previously (taking into consideration the decrease in hydropower production).

Climate change would result in a greater frequency of heat wave days in the summer, which would boost the penetration of air-conditioning to reach a equipment rate of 60% in 2030. This would result in an increase in primary energy consumption due to air-conditioning by 13.5%. Primary energy consumption due to heating remains within the same range as for the preceding scenario; the situation being marked by an increase in primary energy consumption by 11% and in the electric power to be installed by 14%.

The evolution of power demand due to the residential and tertiary sector and the other sectors, considering the climate change assumptions, would require the installation of a additional 1810 MWe, instead of the 1700 MWe initially envisioned for the time frame 2020. The additional capacity to install by 2030, due to climate change (temperature rise, migration to coastal areas, increase in urban temperature ("Heat Iceland")), would be of 560 MWe (due mainly to air-conditioning and refrigeration: increase in the consumption of fridges). The air-conditioning power is also likely to increase because of the increase in the baseline outside temperatures used for the calculation of air-conditioning loads.

Figure 43 - Energy consumption in Lebanon by use in the residential sector (in ktoe)



Source: estimations Adel Mourtada.

Financial means and instruments necessary for action and accompanying measures

The financial needs for the various measures in new buildings over a 20-year period have been estimated as 3316 M€. To this, there must be added 420 million € for other pilot measures (PV, solar air-conditioning, etc.), that is, a total of 3736 billion € over a 20-year time period.

Funding agencies, particularly bilateral ones, could be interested in providing financial support for large-scale energy efficiency development programmes in the building sector. Among such funding agencies, it is worth mentioning in particular the French Development Agency (AFD), the French Global Environment Facility (FGEF), the German Cooperation Agency and the European Investment Bank (EIB).

The intervention of such funding agencies would be essentially of two types:

- Dedicated credit facilities, which will supply the local banks towards granting credit to thermal insulation industrialists and enterprises;
- Credit facilities to finance large-scale operations, such as the Tunisian PROSOL for solar panels and PROMO-ISOL for thermal insulation in existing buildings;
- Grants towards the financing of accompanying measures to the implementation of energy efficiency programmes in buildings.

As far as Lebanese banks are concerned, they have an abundance of liquidity and seek to intervene in energy efficiency and renewable energies, but the formulas proposed to date have not met with success.

At present, there is no CDM project in process of implementation in Lebanon. It would be interesting to develop CDM projects following the example of the Tunisian PROSOL. The generated CDM earnings could be recycled in the mechanism proposed in order to reinforce it (communication, training, etc).

The operational implementation of the financing mechanisms requires a certain number of accompanying measures which need to be engaged. Among these measures, it is worth mentioning in particular[51]:

- To sensitize and mobilize the banks in order to enlist their participation, as from inception phase, in the initiatives of establishing the financial mechanisms and their procedures;
- To design and deliver a training and capacity building programme targeted at the actors of the sector. The weakest link in the chain, today, which must be especially targeted, is the network of small enterprises operating in the field of insulation and collective solar water-heater works. The capacity building programme must seek to achieve the following objectives:
  - identify the existing enterprises and reinforce them;
  - foster the emergence of new operators.
- To engage a quality approach, via the establishment of a reliable system of accreditation of insulation works operators and controllers;
- To equip the banks with the means necessary for them to ensure efficient management of the financing mechanism dedicated to energy efficiency in buildings.

[51] " 'Establishing a financial mechanism to promote the regulation and thermal renovation of buildings" (Setting up a Financial Mechanism for Promoting Thermal Regulation and Renovation in Buildings), Rapport conception du mécanisme (Mechanism Design Report), ALCOR/ANME/AFD, Tunisia, 2008.

Annex 2: Tunisia case study

(June 2010)

Tunisia's energy context

The energy situation in Tunisia is characterised by a chronic deficit of its balance, and this, in view of a rapid growth in demand and a depletion of the country's oil resources as from the early 2000s.

The economic impacts of this deficit have been aggravated by the surge in international energy prices starting in 2004. Thus, between 2004 and 2007, the share of energy expenditure in GDP passed from 5.8% to 12%, which significantly affects the competitiveness of the economy. Public subsidy to conventional energies passed from around 110 M€ in 2003 to around 890 M€ in 2007, that is, approximately 4% of GDP at current prices, which increases the pressure on the State budget.

The energy efficiency policy in Tunisia is over twenty years old, but it was largely reinforced in the wake of this new situation. It is based on three key instruments, namely:

- An institutional instrument, which is the National Energy Efficiency Agency (ANME), established in 1986;
- A legal instrument, resting on the energy efficiency framework law and its related application texts;
- A financial and incentive instrument, resting on the National Energy Efficiency Fund (FNME) and on tax benefits.

Current situation of the building sector

The energy consumption of the building sector, comprising the residential and tertiary, accounts for 26% of the final energy consumption and ranks third after industry (36 %) and transport (31 %). This sector has reported the highest growth in demand over the past few years, that is, around 3% per year over the period 2000-2007, as against 2% on average for total final energy consumption.

Unit household consumption reports a rising trend due mainly to an improvement of the standard of living of the households and an increase in their equipment in electric household appliances. Accordingly, unit consumption passed from 0.31toe/household in 1990 to around 0.41 toe household in 2007. For the sake of comparison, unit consumption in Europe ranges between 1.1 and 2.3 toe/household, with an average of 1.7toe/ household/ year. Related to the m², final energy consumption in Tunisia is estimated as 4.9 kgoe/ m² (58 kWh/m²) of occupied housing, as against 17 to 20 kgoe/m² in Europe.

Aware of these stakes, Tunisia has engaged several programmes targeted at demand management in this sector, of which the following are the major ones:

- Thermal regulation of new buildings;
- Certification and labelling of electric household appliances (refrigerators and air-conditioners, in particular);
- The PROSOL programme of dissemination of solar water-heaters;
- Dissemination of efficient light bulbs (ELBs);
- Programme of thermal renovation of buildings;
- Programme of connection to the natural gas network;
- Communication campaigns, etc.

The Tunisian housing stock has reported high growth over the last three decades, boosted by Tunisia's proactive policy in matter of access to housing. The housing stock passed from around 1 million units 1975 to 2.5 million units in 2004, according to the latest national census. This led to reaching a rate of housing ownership of over 83%. Based on a projection of the trends observed over the period 1994-2004, the housing stock would, in 2009, be around 2.65 million units, of which about 1.9 million in urban environment.

From a geographical distribution perspective, approximately half of the housing stock is concentrated in Greater Tunis (24%) and the centre eastern zone (24%), comprising the large coastal cities of Sousse, Monastir and Sfax.

In terms of climatic zoning, most of the housing stock (70%) is located in thermal zone ZT1 which encompasses the coastline extending from the Governorate of Bizerte to that of Gabès.

From a socio-economic point of view, the typology of existing buildings is dominated by stand-alone housing which accounts for around 90% of the housing stock, of which 38% consisting of villas and the remainder consisting of traditional houses. Collective housing accounted for a mere 7.5% in 2005, but is reporting a boom in view of the densification policy adopted by the State.

Average housing size is around 3.1 rooms, with an average area of 100 m² per housing unit.

Energy prospects of the building sector

Identification of consumption scenarios for the building sector

Two scenarios have been examined with regard to the evolution of consumption of the building sector for the time frames 2020 and 2030. The first is a trend scenario which assumes continuation of the recent trends observed with regard to:

- the rate of penetration of efficient energy equipment and renewable energies in buildings;
- improvement of the performance of electric household appliances, in line with international trends (e ;g.: higher efficiency of electric household appliances, etc.).

The second scenario, considered as a break-up scenario, is an alternative proactive energy efficiency scenario. It assumes a massive implementation of energy efficiency measures that are, today, the most technically and economically mature for a large-scale dissemination. In more explicit terms, these measures are the following:

- Generalization of efficient shells for new buildings;
- Gradual elimination of incandescent lamps from the market;
- Thermal renovation of buildings (roof insulation);
- Dissemination of efficient electric household appliances;
- Dissemination of solar water-heaters

The assumptions of evolution of penetration rates of these measures are in Table 19.

Table 19 - Assumptions of the penetration EE measures in the Rupture scenario in Tunisia

	2010	2020	2030
Efficient buildings (as a ratio of the total housing stock)	2%	6%	10%
Rate of thermal renovation of the existing housing stock	8%	22%	70%
Rate of dissemination of efficient appliances	50%	65%	100%
Rate of penetration of solar water-heaters (m²/ 1000 inhabitants)	43	125	192

Source Hypothèses retenues par le groupe Experts/Plan Bleu.

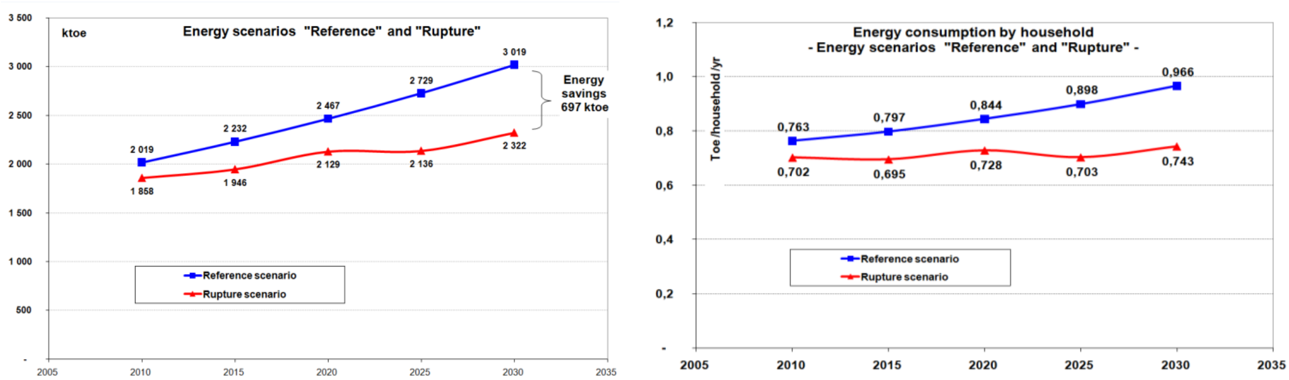
Energy impact of the scenarios

For the time frame 2030, the energy efficiency scenario would allow a reduction of final energy demand from 3020 ktoe to only 2322 ktoe, that is, a saving of around 697 ktoe by 2030.

The aggregate primary energy savings over the period 2010-2030, generated by the energy efficiency alternative scenario, is estimated as 17Mtoe.

As illustrated by the right hand-side graph on Figure 44, the energy efficiency scenario is likely to allow a significant decrease in the ratio of unit consumption per housing unit. It would reach 0.743 Mtoe/unit by 2030, as against 0.966 in the case of the trend scenario.

Figure 44 - Energy consumption by household, according to the scenario in Tunisia

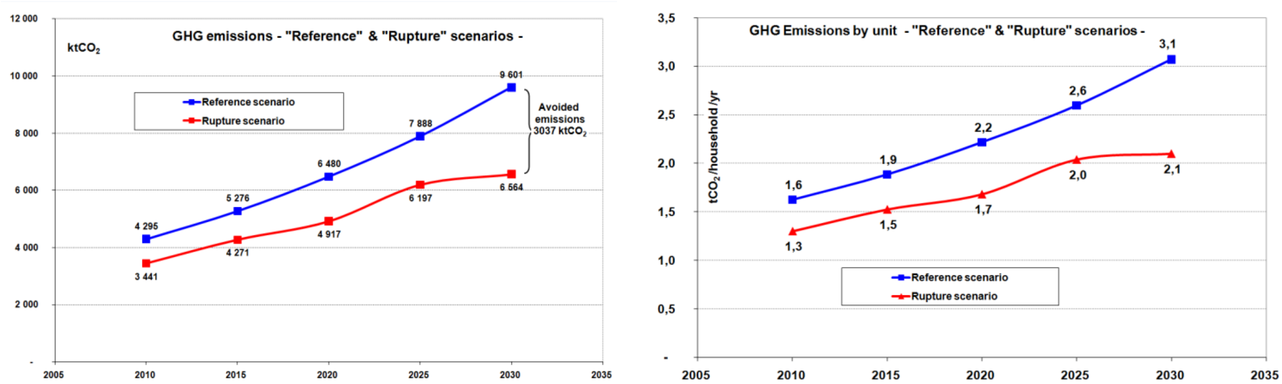


Source: estimations Alcor (Tunisia)

Environmental impact of the scenarios

According to the energy efficiency scenario, GHG emissions would be around 6560 kTECO_2 by 2030, instead of the 9600 kTECO_2 envisioned by the trend scenario. The emissions avoided, for this time frame, would then be around 3037 kTECO_2.

Figure 45 - Total CO_2 Emissions CO_2, and by household, according to scenarios in Tunisia



Source: estimations Alcor (Tunisia)

Over the period 2010-2030, the emissions avoided are estimated as 39 MTECO_2. The unit emissions per household would decrease significantly in case of implementation of the energy efficiency measures, thus passing from 3.1 TECO_2 in the case of the trend scenario to around 2.1 TECO_2 per household.

Socio-economic impacts of the scenarios

The socio-economic impacts may be evaluated at several levels.

For the consumer community, the reduction of the energy bill (considering the current tariffs) is estimated for 2030 as around 490 M€/year. The aggregate savings over the period 2010-2030 would be around 6422 M€. However, under the current conditions, the package of proposed measures remains hardly attractive to the end user, with a average return on investment time of around 10 years.

For the national community, the cost necessary for the implementation of the alternative scenario is estimated as 2678 million €. Thus, the cost of the primary energy TOE avoided is around 156 €/toe, to be compared with a average supply cost on the international market of approximately 650 €/toe in the case of a oil barrel at 120 $. The cost of the $TECO_2$ avoided would be under these conditions of around 68 €/$TECO_2$.

The energy efficiency scenario would help avoid the construction of an additional aggregate power production capacity of approximately 1575 MWe by 2030, which corresponds to avoided investments of around 1000 M€.

In terms of employment, the implementation of this scenario would allow the creation of approximately 6900 additional jobs by 2030 in the sectors developed within this framework.

Climate change impacts and cost of inaction

Simulations of the climatic models show that climate change in Tunisia would result in an average rise in temperature in the order of 2°C in the summer (ranging, according to the regions, from 1.6°C to 2.7°C) and of 1°C in the winter. Accordingly, energy efficiency in the building sector must be considered not only from the perspective of GHG emissions mitigation but also from the perspective of adaptation to climate change (CC) impacts.

The impacts of such a rise in temperature on the energy consumption of the building sector can be considerable. Simulations show that the additional needs in final energy due to CC would be around 259 ktoe per year by 2030. The incremental demand for air-conditioning would result in an additional need for power production capacity estimated as 500 MW by 2030.

The cost of inaction, i.e. the expenditure due to this additional energy demand, must be analysed for the various stakeholders: users, community and State.

For the users, the impact on the annual energy bill would amount to around 122 M€ per year by 2030, by considering the current energy tariffs in Tunisia.

For the community, the cost of inaction corresponds, on the one hand, to the cost of additional primary energy supply (which depends directly on oil prices on the international market) and, on the other hand, to the cost of the investments necessary to meet the additional needs in power capacity. For a barrel of oil at 120 $, the primary energy supply cost can be estimated as 160 M€ per year by 2030. The investments in additional capacity are estimated as 300 M€.

Considering a depreciation of the power plants over 40 years, the cost of the additional TOE of primary energy due to climate change would be around 646 € per TOE, for a barrel at 120 $. This cost will need to be compared to that of the TOE saved in case of adoption of a energy efficiency scenario.

Accompanying measures for an implementation of the alternative scenario

Yet, a few barriers of a economic, technical and organisational order now hinder a large-scale development of energy efficiency (EE) and renewable energies (RE) in the building sector.

At the economic level, the constraints consist mainly in the low return on certain EE and RE measures for the end user in a context of public subsidization of the tariffs of conventional energy. Besides, even in the event of the measure being attractive for the end user, the significant initial investment, compared to the financial capacity of the households, could constitute a barrier to investment decision.

At the technical and organizational level, the barriers rest mainly in a lack of outreach (communication) to the potential consumers who remain today insufficiently sensitized to and informed about EE and RE measures. To this, there must be added the absence of a structured and effective supply capable of carrying forward the development of these measures, except for the solar water heater sector.

To address these economic constraints, it would be advisable to set up dedicated financing mechanisms combining, in a optimal manner, public subsidy towards investment and bank credit under conditions acceptable to the end user, and this, from a perspective of a win-win development between the actors.

The active contribution of the banking sector is crucial for financing the energy efficiency scenario. The latter must mobilize around 1860 M€ over the period 2010-2030. If the State maintains the current level of subsidization of the tariffs of conventional energies, it will be necessary to consider a public finance contribution to the implementation of the scenario by approximately 620 M€, under the form of investment subsidy. Lastly, the contribution of the consumers would be around 655 M€ over the period 2010-2030.

Lastly, the Clean Development Mechanism (CDM), particularly within the framework of its programmatic approach, would be likely to allow the tapping of additional earnings issuing from a valorisation of the GHG emissions avoided. These earnings could be used to partly finance the accompanying measures necessary for the development of sustainable EE and RE sectors.

Annex 3: Morocco case study

(September 2010)

Today, the housing **sector and the energy efficiency and renewable energies sector are listed, justifiably enough, among the national priorities in Morocco**: a partnership agreement between the Ministry for Energy, Mines, Water and the Environment (MEMEE) and the Ministry for Housing, Town Planning and Land Use Management (MHUAE) was signed on 8 July 2008 in presence of H.M. the King in Oujda, thus committing both parties to adopting energy efficiency in the housing sector.

- **In Morocco, the development of the housing sector** is an obvious undertaking in view of the fact that the deficit reported in this sector is estimated as a million housing units: a pressing situation that the public authorities want to definitively control by accelerating the production pace, with the objective of constructing over 200.000 units per year, of which 150.000 in the social housing category, by 2012, implementing programmes targeted at combating indecent housing, and stepping up the **new cities** policy, of which 4 are in development process: Tamansourt, extending over 1200 ha under construction in Marrakech for 300.000 inhabitants; Tamesna, extending over 840 ha under construction in Rabat for 250.000 inhabitants; Chrafate, extending over 2000 ha under construction in Tangiers for 600.000 inhabitants, Lakhyayta extending over 1300 ha under study in Casablanca for 300.000 inhabitants, Tagadirt extending over 1100 ha under study in Agadir for 250.000 inhabitants…

  As a result of this situation, it is predicted by the Demographic Studies and Research Centre (CERED), belonging under the oversight of the Planning Advisory Committee (HCP) that urban population would be multiplied by 1.5 by 2030, passing from 16.43 million in 2004, to 17.73 million in 2008 and 24.41 million city dwellers by 2030, thus raising the urbanisation rate from 55.1% to 64.3%.

  This massive population movement to urban centres will give rise—qnd has already given rise—to enormous challenges for public authorities: to increase the housing, transport and public utility supply -- hospital, community clinic, school … --, which will increase even more the demand on energy. This pressure will be all the stronger as the country has gaps to catch up on, both with regard to housing and to public equipment.

  To the necessary needs in basic energy -- lighting, television sets, refrigerators, running hot water --, other new needs in matter of thermal comfort, such as heating and air-conditioning, have to be added.

  The housing sector is a high potential growth sector which continues to increasingly attract domestic and foreign investment whose average annual increase between 2003 and 2006 was around 9.5% compared with a mere 3.2% between 2000 and 2003. In 2006, investments in the housing sector alone were estimated as 36 MMDH.

  Moreover, in 2008, the real estate tourism sectors claimed around 54% of the Foreign Direct Investments (FDIs) realized in Morocco. The real estate sector alone attracted around

  8.925 billion Dirhams in 2008 compared with 7.59 billion Dirhams in 2007.

  As regards employment, the sector employed over 900 000 people in 2008, as against 813 000 in 2006, that is, 8.9% of the occupied working population.

- **The energy efficiency and renewable energy sources are** equally, justifiably enough, in view of the fact that Morocco presents a quite high energy dependence on foreign resources, standing at around 94.6% in 2009 against 97% in 2008. The total primary energy consumption amounted 15.1 Mtoe in 2009 agaisnt 14.7 Mtoe in 2008.

  The energy bill stood at 54;3 MMDH against 70.6 MMDH in 2008. Crude oil and oil products claimed around 87% of the bill.

  In spite of low energy and electricity consumption per capita, estimated as 0.46 Mtoe and 689 kWh/ year in 2009, Morocco weighs heavily under a energy bill that is likely to worsen in view of the national programmes envisioned and household equipment rates.

Energy consumption in the building sector accounts for 36% of the country's final energy, with 29% in the residential and 7% in the tertiary, respectively.

In view of this situation, **Morocco has set itself the target of 12% achievable energy efficiency potential for the time frame 2020.** By 2020, the share of the solar, wind and hydropower would account for around 42% of the installed power (14 580 MW), as against 26% in 2008 (5 292 MW).

A few striking facts of the Renewable Energy and Energy Efficiency new policy:

- The legal Framework: approved Blue-print law on Renewable Energies.
  - Any individual or entity is allowed to produce energy from the Renewable Energies.
  - Unrestricted installation up to 20 kWe, 8 MWth, for higher power capacity: declaration scheme up to 2MW and beyond that an authorization is needed.
  - Access right to the VHV, HV & MV network.
  - Option of the exportation
  - Electricity marketing through a national electric network towards a consumer or a group of consumers.
- Regulatory management : on-going Blue-print on Energy Efficiency
  - Introduction of the Energy performance : Energy Building Code, Households appliances labeling, Transport, Local authorities
  - Study on energy impact : important development projects
  - Compulsory energy audit : from a consumption threshold
  - Inspection, recording of offenses and sanctions
- Implementation of the Energy Development Fund for $1B
- The creation of a new agency and significant investments:
  - Recent establishment of the Moroccan Solar Energy Agency (MASEN) whose immediate objective is the production of 2000 MW (38% of the current installed capacity) based on concentrated, and PV conversion solar power:
  - Investment of 70 MM DH on 5 sites: Ouarzazat, with 500MW; Béni Mathar, with 400 MW; Foum El Oued, with 500 MW; Boujdour, with 100 MW; and Sebkhart Tah, with 500 MW**.** In total, this will allow a power generation in the order of 4500 GWh.
- Implementation on July 2010 of a wind programme, by the National utility company (ONE), aiming to produce 2000MW dispatched on several high potential sites.
- Implementation of new Moroccan energy agency (ADEREE) for the development of renewable and energy efficiency as an alternative to former CDER. This agency's main missions are : the support to the Energy and Mines department on the development of incentives policies for the renewable energies and energy efficiency, the mapping of the RE and EE resources, the setting and the implementation of the integrated programme for these resources valuation and for the promotion of promising networks, the accompanying to the strengthening of abilities, the consciousness-raising and the communication, the international cooperation…

- **An Energy Efficiency programme on construction sector** is under development by ADEREE (2009-2012), with the objective of setting up and implementing an Energy Efficiency Code. This programme having at its disposal a global budget of $30millions, is respectively supported by the UNDP-GEF with $3millions, The Moroccan Government for $14millions, the European Commission for E10millions, the FFEM/ADEME/FASEP with E1.5million and GTZ. It is centered around the following axes:

- Implementation of a regulatory and normative framework that is operational a the level of:
  - Urban planning : development of Energy Impact Studies for the new cities of Chrafate and Lakhyayta
  - the architectural design and the buildings,
  - Energy facilities : Lighting, Heating, Ventilation, Air-conditioning
  - And for the Energy Services Management
- Implementing a national plan for communication, mobilization and awareness-raising of the administrations, businesses, professionals and the general public,
- Appropriate support of the professionals and the administrations in charge of the EE standards' control enforcement in the Construction sector

- Implementation of a favorable investments atmosphere in the Energy Efficiency area
- Realization of an experimental projects portfolio of a significant scale (equivalent of 5000 to 1000 efficient accommodations)
- Energy labelling and certification of households' energy equipment and appliances.
  - i. Minimal Energy performances standards for fridge, freezer, washing-machine and air-conditioning and Low Consumption Bulb (LCB).

    ii. Test procedures, Energy label design, market control. generalization

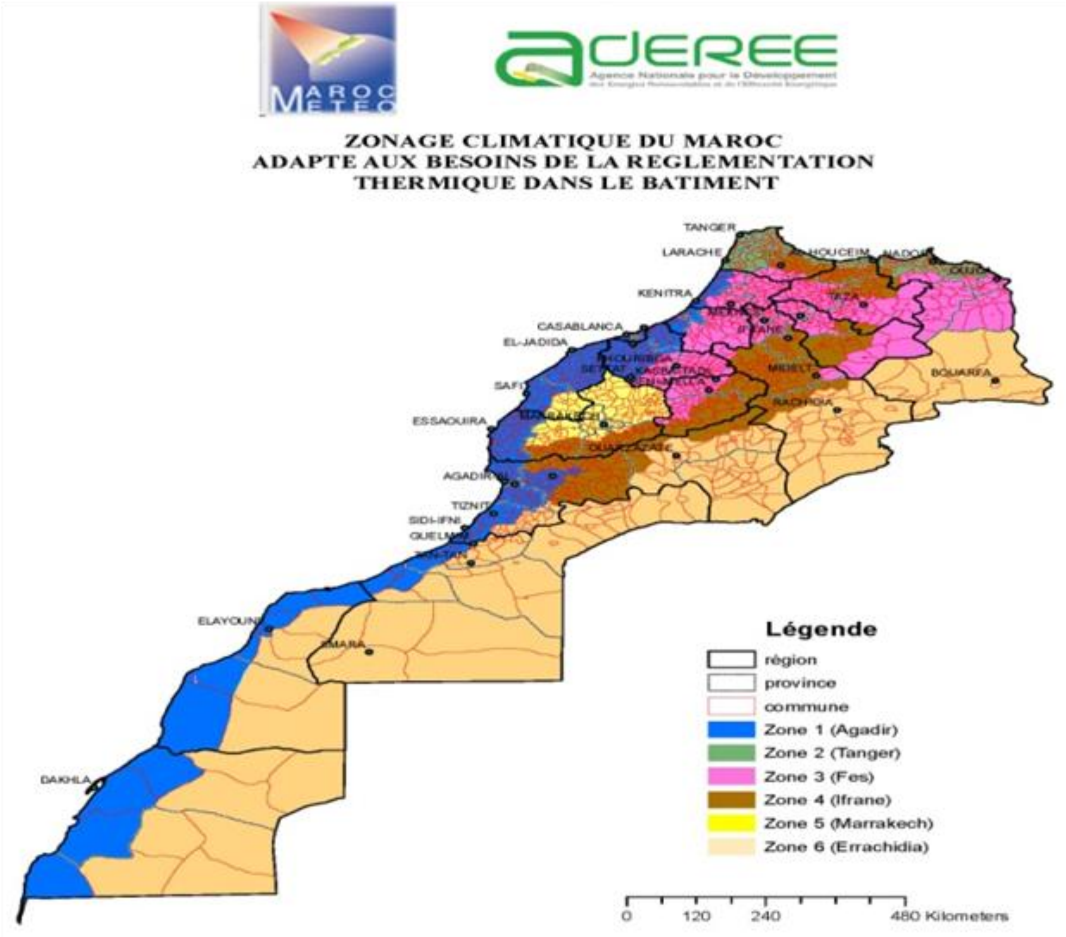
    iii. Low Consumption Bulbs (LCB)

    iv. Increase of customs tariffs for the incandescent lamps and non-efficient energy equipment.
  - Distribution project of 22 millions low consumption bulbs: 700GWh, peak shaving of 300MW, 20% reduction on electricity invoice when the consumption is 20% lower than the reference situation, 5 million lamps replaced up till now.

    Support project under preparation for the renewing of old fridges with high energy consumption

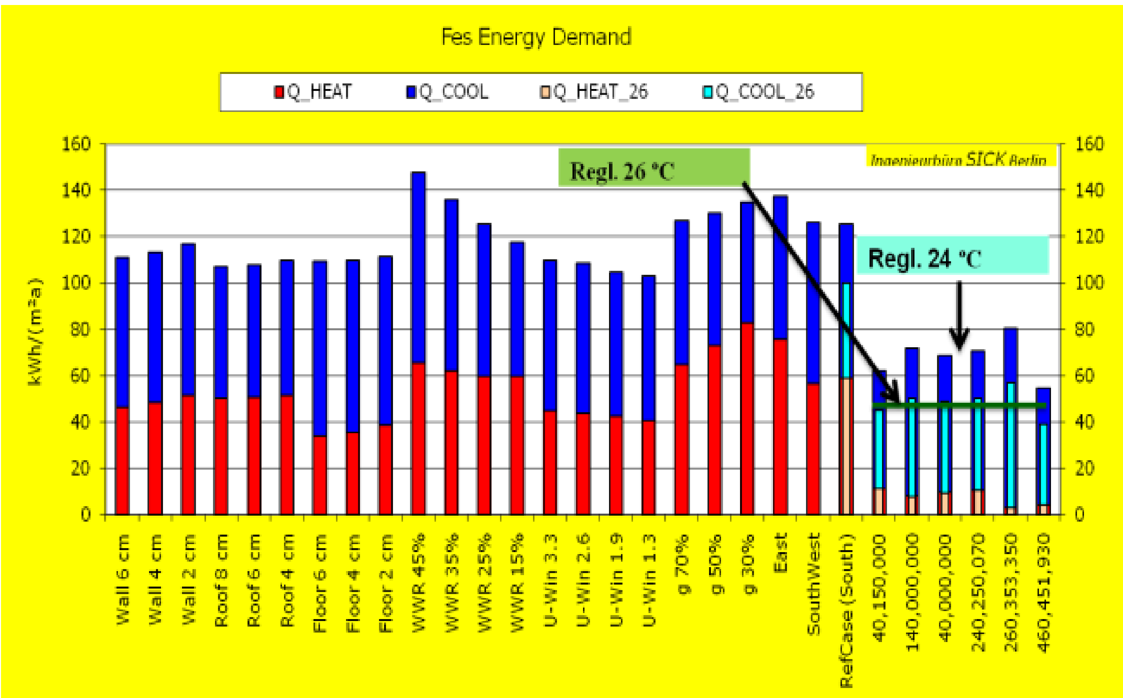
- The sectors commitment towards the Energy Efficiency Programme in the Construction sector is about the progressive integration of the EE measures into the new buildings of the residential and tertiary sector through the development of an "energy chapter" at the new cities' specifications level (Tamesna, Tamansourt, Khiayta, etc…), the hospital facilities development projects, the hotel capacities strengthening, …based on the technical elements of the ongoing Energy Efficiency Code and in order to gradually meet the opportunities and requirements brought by this new regulatory system that is devoted to renewable energies and to energy efficiency for the investment promoting in these areas.
- Can be added to this sectional dimension:
  - **The regional dimension** for the creation of dynamics at the kingdom's regional level through partnerships with experimental Regions (Souss-Massa-Drâa, Meknès-Tafilalet, Oriental, Tadla-Azilal, Rabat- Salé-ZZ) for the local resources valorization.
  - **And the Euro-Mediterranean dimension** : The Mediterranean Solar Plan, within the UfM framework, aims to the implementation of Electricity-producing centrals from Renewable Energy (20GW in 2020) as well as 20% of fossil energy savings in the countries of the Mediterranean southern-rim and the MENA region.
- Regulation development as per the following steps :
  - **Realisation of Morroco's climate zoning**, based on the "heating and air-conditioning" degrees days, as well as on the results of the building energy performance's simulations
  - Energy and economic parametric analyses of following kind of buildings: residential, social, economic, standing, low-cost villa, school, hotel, hospital and public building, including below as an example, the results of energy simulations of Fes buildings and the energy positive impacts gained through various technical measures:

Figure 46 - Climatic zones in Morocco



Source ADEREE

Figure 47 - Building Energy simulations for the city of Fes



Source ADEREE

- **Definition of minimal regulatory standards for standard buildings (**under validation with all the concerned departments and the Construction sector's public and private actors)

Table 20: Maximal Limits for the heating and air conditioning thermal needs *(kWh/m²/y)*

	Residential	Students	Administrative staff	Hospital staff	Hotel staff
Agadir Z1	40	44	45	72	48
TangierS Z2	46	50	49	73	52
Fez Z3	48	61	49	68	66
Ifrane Z4	64	80	35	47	34
Marrakech Z5	61	65	56	92	88
Errachidya Z6	65	67	58	93	88

Source ADEREE

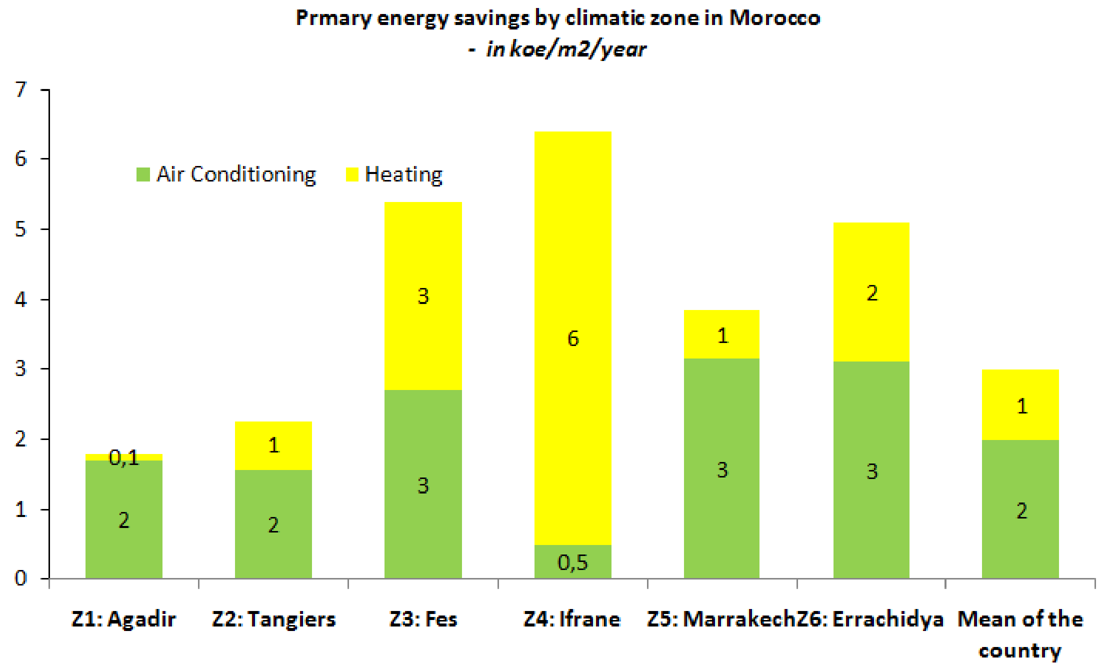
Energy and economy impacts analyses of the regulatory requirements (included the decrease of CO_2 emissions).

In the residential sector, 2 to 7% additional costs, representing a national medium of 112 Dhs/m², permit a reduction of heating and air-conditioning needs from 39 to 64% depending on the climate zone.

The primary energy saving is then 3 kep/m²/year and the CO_2 emissions decrease is estimated to 9 kg equivalent CO_2/m²/year.

Within the context of a large dialogue the whole of the concerned partners, the ADEREE expects the Construction thermal regulation project's finalization by the end of 2010 and the gradual implementation of the advocated measures through a large scale display movement (the equivalent of 5000 housing units between 2011 and 2013), supported by a specific strategy of awareness-raising & communication, as well as the strengthening of political abilities with the concerned training institutions.

Figure 48 - Primary energy savings by climatic zone



Source: ADEREE

Table 21 - Examples on maximal technical specifications for the buildings in Agadir *(Zone 1)*

Window to Wall Ratio WWR (%)	U-value Roof W/m².K	U-value Wall W/m².K	U-value Wind. W/m².K	Solar Heat Gain Coefficient (SHGC)
≤ 15%	0.75	1.2	5.8	North: NR All: NR
16 – 25%	0.75	1.2	5.8	North: NR All: 0.7
26 – 35%	0.75	1.2	3.3	North: NR All: 0.5
36 – 45%	0.65	1.2	3.3	North: 0.7 All: 0.3

Source: ADEREE

- **Development scenarios by 2020 and 2030**

Housing stock development:

When the calculations of housing units' production are considered in the long term, there is necessarily a lack of visibility. By the way, the Ministerial department is financing a study on the housing environment and town planning perspectives by 2030.

Since the actual support measures implemented by the Authorities – so much in the offer as in the demand- are very important (recently being strengthened by the opening of building sites for 130.000 housing units for 140.000 DH/unit for the next 5 years and intended for the lower-class population fringe), the housing stock development within the trend scenario can reasonably be close to the estimated values below:

Table 22 - Projection on the number of dwellings in Morocco by 2030

	2004	2008	2012	2020	2030
Number of unit – x 1000 –	4323	4783	5283	6283	7904
Deficit in unit – x 1000 –	1131	971			

Source: National publications nationales &author estimates

Trend Scenario – extension of the actual situation

Alternative scenario on energy management – achieve the objectives of the Moroccan Ministry MEMEE (respectively in 2020 and 2030: 12% and 15% in EE, and 20% and 25% Renewable Energy in the energy balance).

Table 23 - Energy consumption in the construction sector in Morocco

	2012	2020	2030
Potential of cumulative of energy savings (in %)	-	12	15
Energy demand in the residential sector (Reference scenario, in Mtoe)	5	7,5	10,5
Energy demand in the residential sector (Rupture scenario, in Mtoe)	-	6,5	9
CO_2 emission réduction Réduction with EE scenario (in $MtCO_2$)		1,4	2,2
Net energy called for the country (in TWh)	30	50	70
Residential electricity consumption (TWh)	14	22	30
Share of CO_2 reduction related to electricity in residential, via the introduction of RES (in Mt CO_2)		2,7	4,5
CO_2 total reduction for residential sector, due to EE scenario +more RES according to MEMEE objectives (Mt CO_2)		4,1	6,7

Source: ADEREE, OME, Plan Bleu & estimates of authors

- **Conclusion**

The real potential economy savings in the construction sector lie within the decoupling of the country's economic growth compared to the energy demand growth, more important nowadays.

Starting from a low medium consumption level of 0.46 toe per capita, Morocco will reach – based on the trend scenario- almost 1 toe/capita in 2030. The fossil energy consumption could be decreased up to

35 to 40% if the objectives of the new energy strategies based on Renewable Energy Sources and Energy Efficiency are reached.

The non-action would induce even more important energy consumption than the one on the trend scenario, since the global warming will speed up the process of air-conditioning fitting, having already a significant growth rate, above 15%.

The key to success will lie first within the public authorities' efforts to help change behavior towards energy: awareness-raising, monitoring of the integrated implementation of Renewable Energy and Energy Efficiency regulatory measures – standards and labeling-, strengthening of the industrial and technical abilities, financial and fiscal incentives, innovating funding mechanisms. The additional costs covering the generalization of efficient residential buildings will exceed 6 Billion € by 2030.

The major challenge lies in combining the requisite of housing units' production at high speed with the integration of energy efficiency measures in the building action. The production facilities is based under the constraint of building costs reduction as well as the urgency of the social programme realization, therefore Energy Efficiency ranging in a lower priority position, even if security and quality particularly rhyme with efficiency.

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plan bleu

Blue Plan Notes
Environment and Development in the Mediterranean

N° 18 May 2011

Energy efficiency, building and climate change in the Mediterranean

The Southern and Eastern Mediterranean Countries (SEMCs) are undergoing rapid urbanisation, which is reflected in massive demand for housing. It is estimated that by 2030 a further 42 million housing will be needed. Under the combined effect of demographic pressure and economic growth, demand for energy and electricity is set to increase 1.5-fold by the same date. In the SEMCs this demand is expected to grow 4 to 5 times faster than in the countries on the Northern shores, driving ever-increasing CO_2 emissions.
The building industry, which ranks first in terms of electricity consumption and second- after transport- for fossil fuels, is a key sector, since it allows influence to be brought to bear on both demand (energy efficiency measures) and supply (integration of renewables). Globally speaking, it is estimated that potential energy savings in the construction sector amount to some 40%, largely through economically viable measures. Accounting as it does for one third of total energy consumption in the Mediterranean countries, the building sector could provide for energy savings of up to 60%.

The building sector, the key to controlling energy demand

The Mediterranean basin is home to some 450 million people, who consume almost 1000 million tons of oil equivalent (Mtoe) of energy each year, i.e. around 8.2% of global demand. Cities constitute the hub of energy consumption, particularly in the SEMCs, where « fossil dependency » is in excess of 90%. The building industry accounts for about 38% of final consumed energy, with the residential sector consuming between 21% and 51% of national electricity production, depending on the country.

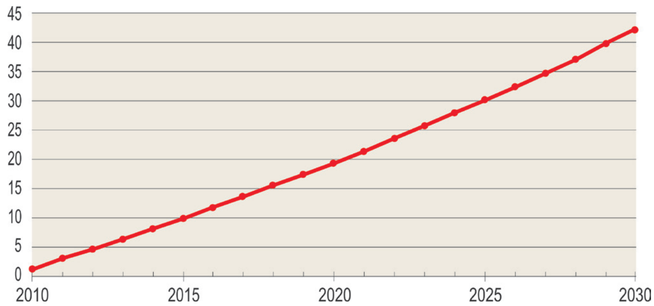
New housing: unpcedented needs

According to Plan Bleu estimates, the population in the SEMCs could grow to over 360 million by 2030 from its current 280 million.

The rate of urbanisation is also on a clear upward trend: 2/3 of all Mediterraneans are town-dwellers, a proportion expected to reach over ¾ by 2030. Almost half the urban population is concentrated in 3000 cities of less than 300 000 inhabitants. Despite the progress made over the past 20 years and more, major imbalances persist in the SEMCs between large and small cities, central urban and outlying areas and privileged and rundown neighbourhoods. Urban expansion often takes the form of unregulated, shanty-type housing. The lack of statutory controls over such housing, its unclear legal status and the low income levels amongst its occupants make this a particularly impervious sector to energy efficiency (EE) measures.

The dual thrust of urbanisation and population boom is set to fuel considerable housing demand. According to the Blue Plan's most recent studies, almost 42 million new housing would need to be built in the SEMCs by 2030, rising from 66 million in 2007 to almost 108 million. Such prospects point to a major increase in energy and electricity consumption in the residential sector, hence the crucial and pressing need to develop the energy efficiency market in the Mediterranean.

Fig 1: Estimate of the number of new housing in the SEMCs (H. 2030) (millions)



Source: Plan Bleu

Implementation of energy management policies

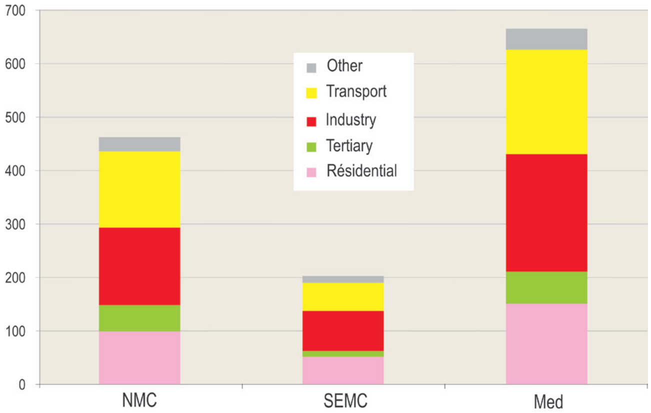
In view of the demand for housing, public policy in the NMCs (Northern Mediterranean Countries) is focused on encouraging the redevelopment of existing stock, whilst vast construction programmes are being rolled out in the SEMCs.

Whilst a patchwork of energy policies exists in the SEMCs, things look different on the Northern shores. Accounting for 40% of the EU's energy consumption and 36% of its greenhouse gas (GHG) emissions, the building and construction sector has long been the focus of community concerns.

Table 1 presents the most salient information regarding the two key European directives on reducing energy consumption. In December 2008, the EU adopted the Climate and Energy Package, which establishes three objectives by 2020 for combating climate change: curbing GHG emissions by 20% compared with their 1990 levels; increasing the share of renewables to 20% of final consumption; reducing energy consumption by 20%. The European Energy Performance of Buildings Directive (EPBD) is also the main community legal instrument which foresees a global approach to the efficient use of energy in the building sector.

These two directives can provide a pointer for the SEMCs-the Arab League, which includes 11 SEMCs, is currently defining its own strategy for drafting an Arab EE Directive based on the European ESD « 2006/32/CE ».

Fig 2: Energy consumption by sector in the Mediterranean for 2007 (Mtoe)



Source: Plan Bleu (based on the IEA Energy Balances, 2009)

The need for a rupture scenario in the SEMCs

This would comprise a pro-active energy management scenario based on integration and the implementation of EE measures alongside the development of the most technically, economically and politically mature renewable forms of energy:

- ➤ Widespread use of efficient envelopes for new buildings (application of periodically revised thermal regulations);
- ➤ Progressive elimination of filament bulbs;
- ➤ Thermal renovation of buildings (insulation, windows);
- ➤ Distribution of efficient domestic, heating and air conditioning appliances;
- ➤ Distribution of solar water heaters.

Priority measures have been defined by climate zone according to their energy saving potential and economic viability. This scenario therefore involves the widespread roll-out of elements which already exist rather than a « technological clean break ».

Impacts of the scenario on the SEMCs

Roll-out of this scenario in the SEMCs points to potential energy savings of about 40 Mtoe by 2030 (Fig 3). In parallel with a 4 Mtoe increase in renewables, estimated energy savings amount to almost 1 Mtoe for coal, 9 Mtoe for oil-based products, 17 Mtoe for natural gas and 14 Mtoe for electricity. The biggest reductions by usage are to be seen in heating and air conditioning at around 60%, followed by

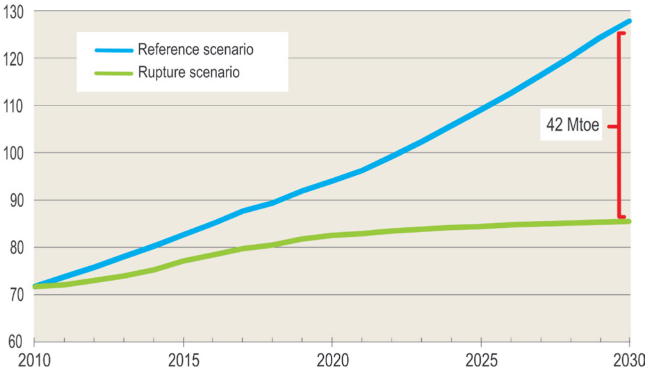
Tab 1: The two key European directives towards reducing energy consumption

European regulatory framework	Objectives and targets	Transposition by Member States
EPBD Directive *« 2002/91/CE »* *Energy performances of buildings*	**Objective**: To reduce energy consumption by imposing measures: thermal regulation, energy performance assessment, certification and checks. According to the European Commission, if correctly implemented the directive will lead to an 11% reduction in the EU's final energy consumption by 2020. **Target** : New and existing buildings in the residential and tertiary sectors (offices, public buildings, etc.)	**Role of States**: Member States are responsible for drawing up minimum standards. They are required to ensure that certification and checks on buildings are conducted by qualified and independent inspectors. **State of progress**: Transposition by Member States is deemed to be inadequate given the range of issues in the building sector. A redrafting of the directive was proposed in 2008 in order to extend its scope of application whilst clarifying and strengthening certain provisions, particularly towards ensuring a driving role for the public sector.
ESD Directive *« 2006/32/CE »* *Energy End Use Efficiency and Energy Services*	**Objective**: The directive requires Member States to set a minimum 9% objective for reducing final energy use in 2016 and to introduce the institutional and legal frameworks and measures needed to remove obstacles to efficient final energy use. **Target**: varied and intersectoral. Concerns moveable equipment such as « domestic appliances » in particular. No requirements are imposed regarding energy efficiency in buildings, although Member States are free to propose measures for this sector.	**Role of States**: In mid-2007 each Member State was expected to submit to the European Commission the improving for its national energy efficiency action plan (NEEAP), revisable every three years. **State of progress**: In 2008 the European Commission assessed the initial versions of several NEEAPs, with rather mixed results: although the proposed strategies would probably make for savings beyond the stipulated 9%, these plans were not particularly ambitious and often simply picked up on planned or already existing measures. Member States are required to submit a more ambitious version of their NEAAPs by 30th June 2011.

Source: From http://www.buildup.eu/

lighting at around 50% and electrical appliances at around 33%. Cumulative potential final energy savings for the period from 2010-2030 are estimated at over 320 Mtoe as shown in the figure below.

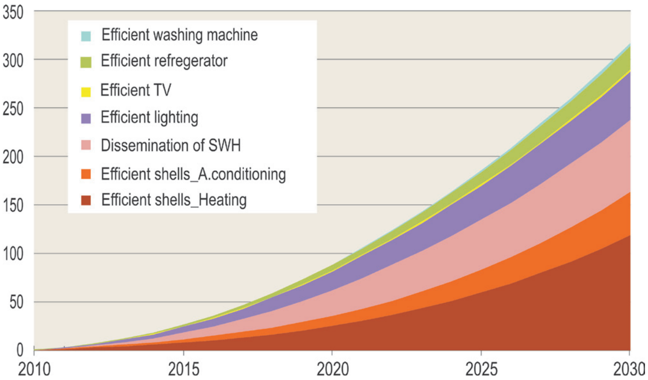
Fig 3: Final energy consumption in the residential sector in the SEMCs. Reference and rupture scenarios (Mtoe)



Source: Calculation Adel Mourtada, validated by the experts group study /Plan Bleu

By 2030 and taking account of changes to the energy mix and an 11% or so penetration of renewables, according to this scenario the annual reduction in CO_2 emissions in the SEMCs would be around 179 $MtCO_2$. Thus the cumulative reduction of CO_2 emissions for the period from 2007-2030 would amount to some 2 $GtCO_2$.

Fig 4: Cumulative final energy savings for the residential sector in the SEMCs- rupture scenario compared with the reference scenario (Mtoe)



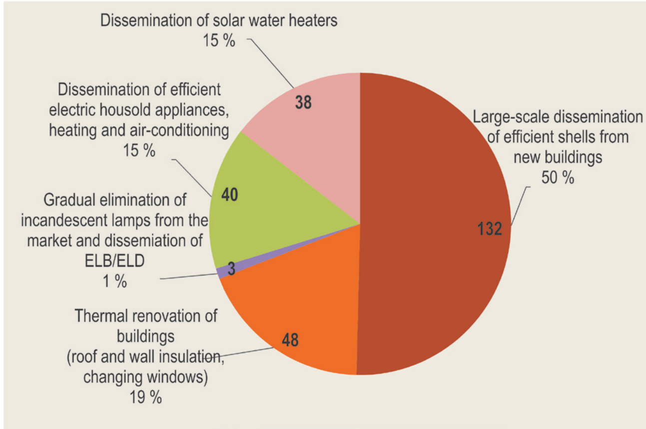
Source: Calculation Adel Mourtada, validated by the experts group study /Plan Bleu

Investment needs

It is estimated that the total investment required to implement this scenario would amount to 262 billion Euros in the SEMCs over the next 20 years (Fig. 5).

These figures should be considered in respect of the cost of « non action », which according to the experts would be very high. As a genuine « hot spot » for climate change, the Mediterranean region will require major investment in order to adapt to the expected rise in temperature (between 2.2 and 5.1°C). Assuming such a temperature increase, the additional primary energy needs for air conditioning would exceed 21% and decreases the heating requirements of 6%. This would be reflected in the need for additional power generation capacity of about 12% compared with the trend scenario in the absence of climate change, and in an 8% increase in primary energy consumption in the housing sector.

Fig 5: Investment needs for EE measures under the rupture scenario, by country (billion €)



Source: Estimates made by the expert group for the study/Plan Bleu

Recommendations towards developing EE in the Mediterranean

The building industry is a key sector in terms of addressing the new energy and climate order in the Mediterranean and substantially reducing GHG emissions. A poorly designed and/or badly constructed building will have inflated heating and air conditioning needs for decades. In the SEMCs, where the building industry basically needs to be shaped from scratch, only concerted action between the various stakeholders will lead to the emergence of a permanent sustainable construction market. It is therefore imperative that the building industry be overhauled in its entirety and within its territorial context.

Efforts should mainly focus on new buildings, for which technical solutions suitable for the Mediterranean context have been identified:

➤ Taking greater account of the architecture « of yore », in line with bioclimatic principles, which leverages the potential of natural factors before those relating to building envelopes: passive solar input, natural ventilation, aspect of the building, etc.

➤ Measures with a good cost/benefit ratio: roof and external wall insulation, solar protection on the most exposed facades, double glazing, low consumption bulbs and apparatus, solar thermal for the production of domestic hot water… The additional cost of all the measures used in the disruptive scenario is estimated at 3300 € for the construction of an average 100 m² housing.

The spread of these solutions and the development of a large scale energy management market in the building sector are being hampered by obstacles of an informational, economic, organisational and technical nature. There is a particular need for capacity building and support programmes for the construction industry through the training of designers and craftsmen (setting up of a company authorisation system).

Fig 5: Representation of the number of cooling degree days (CDD)

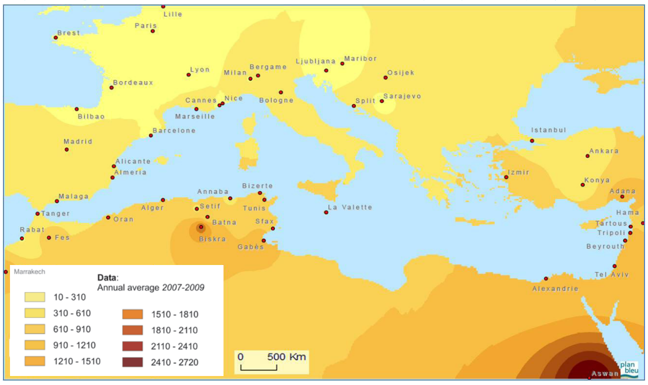
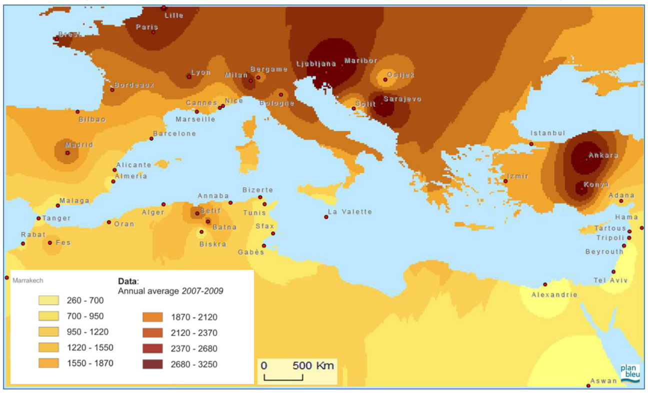


Fig 6: Representation of the number of heating degree days (HDD)



Source: Elaboration Plan Bleu, June 2010 (based on mean data over 3 years from www.degreedays.net)

As such, a sustainable building market can only emerge if driven by the clear will of the States. A proactive approach is needed. It is therefore imperative that a building should be considered from the moment of its design through to its completion and its operational impact factored in for its entire life span.

In specific terms, the sustainable development of this type of market involves the implementation of measures intended to organise the industry, to finance it and to provide it with long term support. The steps to be taken can be classified within the following three categories.

Creating a sustainable building industry

➤ Designing a binding, cross-cutting regulatory framework and monitoring its implementation.

➤ Creating appropriate and lasting institutional back-up.

➤ Overhauling energy policy.

Electricity subsidies which encourage its use for heating water and buildings must be shelved- the funds released thereby could be partly ploughed back in support of EE.

Financing sustainable building

➤ Applying appropriate pricing and offering price incentives.

➤ Bringing the banks on board and adapting loans.

➤ Developing « public-private partnerships ».

➤ Facilitating access to international financing.

Establishing the sustainable building market on a permanent basis

➤ The State should set the example and take the lead.

➤ The quality of equipment and performance should be monitored and professionals trained.

As has been done in the NMCs, the SEMCs also need to develop labels and certification for buildings and domestic appliances. It may seem relatively difficult and expensive to introduce such « labelling » and « training », but they are essential to the building of a permanent EE market in the SEMCs- these two factors are, after all, what will guarantee the quality of the methods and technology deployed.

Basically, the Mediterranean countries are being called upon to take decisive steps in support of the building sector. The renovation programmes being conducted to the North of the Mediterranean and the construction programmes to the South are opening up a wealth of possible futures for the region. It is up to the players involved to select those options which consume the least energy and produce the lowest emissions.

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PLAN BLEU
UNEP/MAP Regional Activity Centre
15 rue Beethoven - Sophia Antipolis - 06560 Valbonne - FRANCE
T. : +33 4 92 38 71 30 - Fax : +33 4 92 38 71 31
e-mail : planbleu@planbleu.org
www.planbleu.org

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