WP 4b - Energy and climate change mitigation

Energy Efficiency: Trends and Perspectives in the Southern Mediterranean

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Abstract

This paper has two objectives. First, it attempts to establish the potential of policies on energy efficiency and energy demand-side management in the southern Mediterranean region. Second, by examining past trends in energy intensity and trends up to 2030, it analyses the prospects and costs of such policies, compared with expected developments in the price of energy resources. Based on both analyses (MEDPRO WP4) and on prospects for growth (MEDPRO WP8), it seems that energy intensity in the Mediterranean should fall perceptibly by approximately 13% in the next 20 years. But given the programmed energy mix, this will not limit emissions of CO_2, which are likely to increase by more than 90%.

The paper first presents the rationale for demand-side management (DSM) policies. After a general discussion of concepts, it tackles the question of instruments and measures for implementing such policies, before posing the question of the cost-efficiency approach for monitoring the measures the authorities introduce. Secondly, the paper assesses energy consumption and energy efficiency in the countries of the southern Mediterranean and the ways in which their main economic sectors have changed in recent decades. The third section outlines the demand management measures introduced and, taking Tunisia and Egypt as examples, estimates the cost of such policies. The fourth and last section offers a forecast analysis of energy consumption in the Mediterranean up to 2030, highlighting probable trends in terms of final consumption, energy intensity, energy mix and emissions of CO_2. The section concludes with estimates in terms of cost, comparing objectives for lower intensity, results in terms of resource savings and the types of costs this approach represents.

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Contents

List of Figures

List of Tables

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1. Demand-side management rationale: improve energy efficiency

1.1 Energy efficiency: effective use of a rare resource

Initially raised in the context of climate change, questions of energy efficiency and demand-side management policies frequently hit the headlines during the second half of the 2000s due to dramatic rises in energy prices.

The concept of energy efficiency is based on a classic economics approach: it is assumed that the existing paradigm of production requires energy in order to supply products. The notion of energy efficiency is thus either to optimise the quantity of energy used for each unit produced or to increase productivity. There are various ways of achieving this, primarily through technology. A supply-side approach mainly seeks to provide agents with the 'desired' quantity at the best possible cost. This approach involves supply and import infrastructures, as well as processing, storage and distribution infrastructures. In an ideal situation in which unlimited energy resources are available at a low or known and stable price, taking action on the supply side would be enough to optimise a country's energy circuit, subject to the limitations imposed by the technology available. History has shown that geopolitics can threaten supply: it is not only a question of price but one of risk over quantities. Therefore, national optimisation strategies have had to take a new notion on board, namely that of security of supply.

More recently a new constraint has been added, that of the environmental impact of the energies we use. Whilst remaining focused on production, an optimal energy mix has to be found between various sources that: i) are reliable in terms of supply and therefore unlikely to be interrupted, ii) have an affordable cost-efficiency ratio both in terms of acquisition of resources and provision to consumers, iii) have little impact on local public health, and iv) have the most easily controllable and moderate environmental impact at a cost that is compatible with general economic operation. It became clear early on that the time-frame for a supply-based approach was incompatible with emergency situations. Given the volatile nature of resources, the technological uncertainties and the time it takes new techonologies to reach the market, a second level of strategic action emerged during the years following the first oil crisis in developed countries. It was based on the demand side and mainly geared towards the notion of a rational use of energy; this provided a second lever for optimising energy efficiency. This action brought down the overall demand for energy without depressing countries' economic capacity. The aim was to ensure that all players adopted rational use – a synonym for the principle of more productive use – performing just as well with fewer resources.

We could, in principle, ask whether there is such a depressing effect. Moreover, in international negotiations about climate change the less advanced countries tend to tell developed countries that they enjoyed the kind of unrestrained access to resources that enabled them to achieve the level of development they currently enjoy. It would be profoundly unjust if developing countries were to be hampered in their catching-up process. Two urgent questions are in conflict here, i.e. economic and

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The countries covered by this study are: **Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Syria, Tunisia and Turkey.**

social development versus putting a brake on damage to the environment, with the first taking precedence. We need to acknowledge this and the fact that it is a rational point of view. However, as prices are volatile and technology changes rapid, we are not currently in an optimal situation where these two aspects can be compatible. As things stand at present, the notion of the rational use of energy and demand-side management policies have positive effects, both economically and socially, as well as in terms of environmental protection… including in the southern Mediterranean countries.

The aim of this paper is to give a forecast analysis of the gains the Mediterranean countries could expect from effective policies on the rational use of energy, economically, socially and in environmental terms.

The paper will first tackle what now defines demand-side management in terms of measures. In the second part it will tackle the question of what is happening in the southern Mediterranean concerning energy use and what is being done to increase its efficiency. The third section tackles questions raised by renewable energy; the last section compares the trends with alternatives based on a variety of options regarding energy demand policies.

1.2 Instruments and measures for managing energy demand

What is striking about energy efficiency policies is that in themselves they enable a country to achieve several fundamental objectives: security of supply, reduced environmental impact, competitiveness, a favourable trade balance, improvement in public budgets that opens the way to social and other progress, and so on. Their advantage is that they can also achieve this at low net cost, particularly because some of the expenses incurred are offset in the long term by the financial savings made. A large part of the attractiveness of such policies depends on states' and agents' preference for the present. While we have to acknowledge that they have not yet reached their full potential, this can largely be explained by the fact that they have not been effectively applied due to difficulties in convincing the relevant decision-makers. Few studies have so far concentrated on the cost-efficiency ratio of energy efficiency policies due to their recent large-scale introduction on a national scale. Most studies are too recent and their lack of hindsight means they are based on a mish-mash of public plans and what has been achieved. By contrast, in the microeconomics field, a large number of case studies have indisputably shown significant financial and environmental impact at very reasonable cost, when the right decisions are taken.

Despite the lack of hindsight it is nevertheless possible to outline the various types of measures and tools provided under these policies. The measures fall into five main types:

i) institutional and planning measures (A)
ii) regulatory measures (B)
iii) financial measures (C)
iv) fiscal measures (D)
v) general measures (E)

The first category (A), institutional measures, includes questions of general organisation, such as the setting up of national programmes that should include quantified objectives and a quantification of the precise measures planned and allocated budgets. In order to deploy these plans, laws and an implementation framework must be passed. National agencies responsible for setting up and monitoring these programmes must also be created. These agencies should be capable of discussing at ministry level and ideally have sub-national and local offices.

Regulatory measures (B) often relate to the sector level. They deal with detailed and technical matters. Here, we could cite those that are most often encountered: i) minimum efficiency standards and labelling of electrical equipment (refrigerators, washing machines, air conditioning units, low-energy light bulbs, water-heaters, engines), automobiles and buildings (new-builds and existing buildings) ii) compulsory regulations for certain consumers: appointment of energy officers, consumption reports and audits, compulsory savings and maintenance, etc. These measures usually only target major companies such as public companies, companies in sectors where energy use is intense, certain activities that use special machines, etc., iii) compulsory energy savings for consumers of energy companies.

Financial measures (C) relate to direct aids and subsidies as well as special interest rates for targeted populations. This generally includes: i) subsidies for carrying out audits of sectors: industry, commerce, the public sector, households, low-income households, transport, ii) subsidies or loans at reduced interest rates for investment and energy efficiency equipment.

Fiscal measures (D) complement financial measures. Generally speaking these are mainly tax credits, fast repayment conditions, reduced taxes for energy efficient investment, for each type of tax (import, VAT, sales, road tax) and for each type of equipment (appliances, vehicles, lamps, etc.). Fuller tax reforms, which might also come under category A, should also be included for various countries. As far as the Mediterranean is concerned (this will be dealt with below), reforming fuel subsidies and taxation constitutes one of the first measures that should be introduced.

There remains the final category of general measures, chief among which are methods of communication, but also promoting voluntary agreements, etc.

1.3 Considerations of the cost-efficiency aspect of demand management policies

After a decade spent setting up the programme, we now have a fairly well-defined conceptual framework for energy efficiency strategies and projects. The main characteristics of this framework are as follows:

- A cost-benefit analysis of energy efficiency is fairly difficult to perform, mainly because a wide variety of actions, players, equipment or sectors is concerned. But every case study finds significant cost-efficiency. A review of more than 450 projects in industrialised countries (Shi, 2007 in Taylor, 2008) estimated the average cost (over a ten-year lifespan) at $76 per saved Ton of Oil Equivalent (hereafter TOE) or approximately $11 per saved barrel. This can be weighed against the current price (in 2006, when the study was carried out, the reference was of $60 a barrel). The study found that in 80% of the projects analysed the time to return on investment was less than 30 months.

- The very nature of 'benefit' does not really argue in favour of such schemes, particularly in developing countries that have rapid growth. Such schemes seem comparatively high-risk with high transaction costs, particularly in financial contractualisations and plans, with high costs in the short term and benefits only in the medium term, usually over the lifetime of equipment that has to be reliable. In terms of opportunity cost of different projects in high-growth economies, energy saving projects are based on deferred profitability of economic capitalisation and may be weighed against projects based on the immediate, visible acquisition of new production assets (Taylor, 2008). Moreover, given the effort needed to set up projects that already have a short time to return on investment, it is perhaps advisable to concentrate on such projects, setting aside for the moment projects with long return times (Taylor, 2008), while improving the framework of the measures (A, C and D) in order to reduce it.

- Institutional and regulatory measures constitute the foundations of energy saving policies, whether they are projects to renovate existing resources or creation projects. They should incite people to use energy more rationally and make good technological and investment choices to render the net gain of the projects as visible as possible.

Concerning action targeting different consumer sectors, the following general observations apply:

- In industrial sectors (excluding energy), even low energy-intensity sectors can benefit from attractive projects. Such schemes should generally relate to heat recovery and gas emissions, upgrading steam and compressed air systems, the renovation of indoor electrical installations, upgrading motorised systems, heating and air conditioning systems and specific machine-tool systems. In high energy intensity industries the same goes for their competitiveness.

- In commercial and residential buildings, a distinction should be made between renovation and new-builds. Where new-builds are concerned, the key points relate to: i) general design (in particular orientation) and materials, ii) design of lighting and ventilation systems, iii) the thermal radiation balance including overall insulation and that of doors/windows, iv) construction methods and v) equipment producing heat, air conditioning and lighting. While this remains the private responsibility of the various firms performing the work, the public authorities have a role in creating incentives to encourage more energy efficient solutions; their usual means of doing this is through use of new building codes. Regarding the renovation of buildings, more intense public support and direct funding are required. As far as public buildings are concerned, the basic package consists of renovating lighting, ventilation and air conditioning systems together with upgrading insulation in line with modern standards. In the residential sector it should be understood that the value of the energy consumed by households is relatively low per unit of time, particularly as the sums required for renovation mean that incentives and times to return on investment are poor. Public pressure through direct financial and fiscal measures should improve incentives, lower the initial cost of investment and reduce the time to return on investment.

- The authorities have less room for manoeuvre in the transport sector (Taylor, 2008). One of the main levers remains the choice of types of transport, and choice is based on the diversity of the offer. The development of clean, high-density, easy-to-access public transport is essential, as are legal codes and urban development choices. The remainder is a question of incentives and therefore relates mainly to measures in categories A and B. As regards certain types of equipment, particularly private vehicles, the adoption of standards and compulsory checks combined with an obligation to bring vehicles into compliance with standards is also an important tool but, particularly in the Mediterranean countries, fuel pricing through a combination of taxes and subsidies remains the most powerful weapon.

Table 1. Advantages/disadvantages of the main incentive measures

Measures	Advantages	Disadvantages
Public investment subsidies	Clear effect on cost reduction Sends a powerful message to the markets Good vector of communication Stimulates supply	Puts pressure on public finances Poor durability Difficult and expensive to manage
Indirect tax advantages	Easily implemented Puts little pressure on public finances	Poor visibility Ineffective where the market is informal Difficult to apply to cost of services
Direct tax reductions	Puts little pressure on public finances	Ineffective in developing countries Complicated to implement in developing countries

Source: Plan Bleu 2011, based on Alcor, Tunisia.

Table 2. Advantages/disadvantages of measures compared with initial investment

Measures	Advantages	Disadvantages
Special credit lines	Solves the problem of upstream resources Involves the banking sector Good vector of communication Possibility of cancelling out reimbursements by reducing bills	Slow to roll out High cost of distributing credit in context of non-specific funding Excludes households without bank accounts
Interest-rate subsidies	Good vector of communication Improves profitability of the measure for end consumers	Exchange rate risk covered Perpetuates use of subsidy resources Distorts the financial markets Puts pressure on state budgets
Credit guarantee system	Facilitates households' access to credit Gives incentive to banks	Complicated to implement in developing countries Open to abuse

Source: Plan Bleu 2011, based on Alcor, Tunisia.

As we have already pointed out, the cost-efficiency analysis raises several concerns. The literature assumes major cost savings, but:

- there is the conceptual conflict between a fairly reliable net cost that is immediate or has a fairly short time-scale and a series of gains constituted by savings achieved over a long period, working on a service-life for an item of equipment (or measure) that is usually calculated on the basis of 'business as usual'.
- several types of measures have been assessed, usually in a given country or group. There is therefore additional uncertainty because transplanting such measures into different economies could prove less positive.
- an energy efficiency policy is by nature made up of a large number of measures and projects, which raises questions about the extrapolation of costs from one type of equipment to other, very different types of equipment.

Below we will list several examples that at least enable us to estimate the cost of a project, its economic efficiency through financial indicators such as internal rates of returns and its energy impact. First, the following section will introduce the actual situation of the Mediterranean from the energy efficiency point of view.

2. Consumption and energy efficiency – the situation in the Mediterranean

This section will examine the question of energy efficiency in the Mediterranean. It first looks at current levels of consumption before exploring overall trends in energy intensity in the major sectors. The third section looks at current levels and major past trends in greenhouse gases. The final section examines overall and in detail a few examples of practices in the Mediterranean in terms of energy efficiency strategy.

2.1 Changes in consumption and energy intensity 1980-2008

Within this region quantities of energy consumed per unit of GDP vary by as much as 100%, indicating the huge variation in the ways in which energy is used. In most countries one unit of GDP now requires around one hundred tonnes of oil equivalent (TOE).

The changes over the past two decades have been relatively similar (see Table 3): little progress between 1990 and 2000 and mainly downward trends since 2000 in seven out of ten countries. It will be seen that with the exception of Turkey, the countries that have seen a rise in energy intensity are those with the largest populations. Comparisons with the EU can also be used to measure changes. While the difference tends to reduce (the speed at which intensity has dropped in the Mediterranean countries is more than 1.6% in the majority of countries as compared with 1.6 in Europe), it remains up to two times higher (up to two times more energy is consumed in some southern countries per unit of GDP PPP, relative to the best performers in the EU).

Table 3. Final energy intensity 1980-2008 (in thousand TOE per $ GDP (PPP) 2005)

	1980	1990	2000	2008	2000-08 change (%)
Algeria	0.055	0.080	0.081	0.100	2.7
Egypt, Arab Rep.	0.112	0.115	0.105	0.112	0.8
Israel	0.080	0.082	0.078	0.069	-1.5
Jordan	0.121	0.207	0.195	0.154	-2.9
Lebanon	0.094	0.090	0.110	0.060	-7.3
Libya	0.134	0.274	0.121	0.106	-1.6
Morocco	0.083	0.072	0.085	0.086	0.2
Syria	0.134	0.215	0.165	0.121	-3.8
Tunisia	0.101	0.113	0.104	0.085	-2.5
Turkey	0.132	0.118	0.119	0.109	-1.1
EU-27	0.135	0.109	0.091	0.080	-1.6

Sources: WEC, Enerdata - Global Energy & CO_2 Data.

In terms of sectors, the industrial sector appears dominant (one-third of consumption), but mainly in two countries (Egypt and Libya). In Turkey, Algeria and Tunisia the residential sector has the highest consumption with transport accounting for one quarter of consumption on average (see Table 6). Industry is also one of the sectors in Europe that has made the greatest contribution to reductions in overall energy intensity, with falls of 50% over 30 years. We should stress the pressure of international competitiveness in this trend, which gives energy bills in periods of rising costs a role as an instrument in corporate productivity. This movement is neither as general nor as significant in the Mediterranean countries and a divide is starting to appear. The southern industry, which consumed less energy in the early 1980s, is starting to consume more even though the magnitudes concerned are still close (0.099 thousand TOE per unit of value added PPP on average in southern countries, compared with 0.092 in European countries – see Table 4). In regional terms arguing the advantages of intense cooperation in sharing good practice will be evident.

The service sector is developing rapidly in southern countries. As it develops its capital investment is increasing, which first results in increased intensity (Table 4). This explains the overall upward trend in energy intensity of the service sector in southern countries.

But the average intensity now appears at the same level as in Europe and the objective for southern countries should now be to keep up with the trends of European countries.

Turning to the transport sector, the trend for the sector’s energy intensity in the Mediterranean is clearly downwards (on average more than 2%); (Table 4). While the average intensity (0.033) remains higher than that of European countries, lost ground is being made up. The sector consumed 1.9 times more in 1990 compared with only 1.4 times more in 2008.

Table 4. Energy intensity in industry, services and transport 1980-2008

	In Industry (based on value-added)					In Services (based on value-added)					In Transport (based on GDP)				
In 000' Toe per unit of Value, $PPP	1980	1990	2000	2008	*2000-08 Changes (%)*	1980	1990	2000	2008	*2000-08 Changes (%)*	1980	1990	2000	2008	*2000-08 Changes (%)*
Algeria	0.026	0.038	0.036	0.045	*2.8*	0.013	0.016	0.016	0.023	*4.6*	0.021	0.028	0.025	0.029	*1.9*
Egypt	0.170	0.207	0.133	0.144	*1*	0.001	0.004	0.009	0.012	*3.7*	0.025	0.028	0.033	0.031	*-0.8*
Israel											0.037	0.033	0.029	0.023	*-2.9*
Jordan	0.122	0.204	0.204	0.136	*-4.9*	0.003	0.008	0.027	0.024	*-1.5*	0.060	0.085	0.069	0.055	*-2.8*
Lebanon			0.150	0.064	*-10.1*	0.020	0.013	0.012	0.011	*-1.1*	0.041	0.041	0.043	0.024	*-7*
Libya											0.067	0.141	0.064	0.046	*-4*
Morocco	0.144	0.113	0.086	0.094	*1.1*	0.003	0.004	0.003	0.005	*6.6*	0.019	0.018	0.028	0.028	*0*
Syria	0.363	0.174	0.141	0.120	*-2*						0.060	0.083	0.069	0.049	*-4.2*
Tunisia	0.116	0.142	0.107	0.084	*-3*	0.011	0.013	0.017	0.015	*-1.6*	0.025	0.025	0.026	0.021	*-2.6*
Turkey	0.153	0.129	0.152	0.108	*-4.2*	0.003	0.004	0.009	0.020	*10.5*	0.029	0.029	0.026	0.027	*0.5*
EU-27	0.184	0.138	0.109	0.092	*-2.1*	0.027	0.020	0.017	0.016	*-0.8*	0.026	0.027	0.026	0.024	*-1*

Source: WEC, Enerdata – Global Energy & CO_2 Data.

The contribution of households to energy consumption (excluding transport) is less influenced by economic than social factors, which implies a very different vision of the ways in which it must change. It is largely related to quality of life and comfort. As it is mainly electrical, its contribution to the deterioration of the environment depends more on the supply side (production of electricity but also electrical equipment intended for households) than on the behaviour of the households themselves (i.e. how energy is produced). However, encouraging behaviour changes that would improve efficiency and a rational use of energy enable progress to be made, ahead of more efficient electricity production units. As can be seen from the data presented below, average consumption in the south is half that of the north. The difference is rapidly disappearing, however: in 1980 consumption in the south was 4.5 times lower than that of the north. Moreover, lifestyle pressure in Europe is continuing to increase the difference and we should maybe expect other trends to start appearing in the south. The major role played by renewable energy production technology will be obvious.

Table 5. Average electricity consumption of households per inhabitant (kWh/inhab)[1]

	1980	1990	2000	2008	*2000-08 Changes (%)*
Algeria	56.4	136.0	210.8	321.3	*5.4*
Egypt, Arab Rep.	104.4	242.0	353.9	574.5	*6.2*
Israel	769.7	1 141.0	1 839.2	2 097.3	*1.7*
Jordan	137.6	275.7	412.9	761.3	*8*
Lebanon			793.4	873.9	*1.2*
Libya	544.2	700.3	1 115.9	1 292.3	*1.9*
Morocco	51.5	88.8	145.6	222.9	*5.5*
Syria	149.0	320.1	474.1	772.0	*6.3*
Tunisia	77.2	134.3	229.1	313.3	*4*
Turkey	78.7	161.3	354.3	507.0	*4.6*
EU-27	977.0	1 283.2	1 479.6	1 633.5	*1.2*

Source: WEC, Enerdata - Global Energy & CO_2 Data.

[1] Ratio between the electricity consumption of households and the number of inhabitants, source WEC.

Table 6. Final consumption by major sector (2009, million ToE and % of total)

	Transport	%	Households	%	Industry	%	Other	%	Total
Algeria	7.741	*32.3%*	9.823	*41.0%*	4.887	*20.4%*	1.838	*7.7%*	23.958
Egypt, Arab Rep.	12.904	*27.3%*	10.021	*21.2%*	21.489	*45.4%*	2.890	*6.1%*	47.304
Libya	4.247	*30.7%*	2.236	*16.2%*	6.171	*44.7%*	1.158	*8.4%*	13.812
Morocco	1.131	*9.7%*	2.595	*22.4%*	2.927	*25.2%*	4.292	*37.0%*	11.607
Tunisia	1.828	*27.4%*	1.986	*29.7%*	1.761	*26.4%*	1.129	*16.9%*	6.680
Turkey	16.504	*21.7%*	23.791	*31.3%*	22.636	*29.8%*	13.073	*17.2%*	76.005
Total	44.355	*24.7%*	50.452	*28.1%*	59.870	*33.4%*	24.381	*13.6%*	179.366

Source: MEDPRO, WP4, Reference Scenario.

These figures indicate the sectors in which the Mediterranean could prioritise their action, in particular to catch up the gap in efficiency with Europe. The services sector and household consumption rank first, in particular with economic development expectations. Concerning the service sectors, commercial and public lightning, heating and cooling systems have the best potential. Concerning households, the pressure of catch-up in living standards gives a huge potential for DSM to labelling and the normalisation of home appliances. In industries, the bulk of action should target SMEs, taking into account the diversity of the nature of production. Transport does not show a high potential in general relative to the European situation, except in terms of fuel taxation.

2.2 Types of measure and demand management plans in the Mediterranean

The notion of energy efficiency (EE) is now acknowledged in Mediterranean countries. As in most parts of the world, the Mediterranean countries have started rolling out plans designed to improve the rational use of energy.

When we observe the national strategies of the region in terms of EE, based on the five types of measures we presented above (institutional and planning (A), regulatory measures (B), financial measures (C), fiscal measures (D) and general measures (E)), we see that:

- Only half the countries have set up a dedicated agency and specific energy efficiency plan. However, more than half have not passed new laws.
- Labelling and standardisation of household electrical equipment is fairly widespread on paper, but only fully deployed in half the countries and effective in maybe fewer than half. Thermal regulation is less developed, being satisfactory in only three countries. Compulsory energy audits only apply in three countries at present (Israel, Tunisia, and Turkey).
- There is a considerable gap with financial-type measures. In virtually all the countries studied tax reductions do not exist and only a few have a system of subsidies. Moreover, the general use of untargeted price subsidies to oil products has an adverse effect on energy efficiency policies (see below).
- On the other hand, communication about energy efficiency seems to be widespread.

Table 7. Types of energy efficiency measures in southern Mediterranean countries

Country	Specific EE Agency	National EE programme	National EE law	Household appliance labels and standards	Thermal regulations	Compulsory audit programme	Funds dedicated to EE	Subsidies and low-interest loans	Tax reductions	Awareness campaign
Algeria	yes, APRUE	yes	yes	in process	incomplete/not applied	yes	yes	incomplete/not applied	no	yes
Egypt	OEP**/Specific Committee*	incomplete/not applied	no	yes	incomplete/not applied	no	yes	no	no	yes
Israel	no	no	no	yes	yes	yes	no	yes	no	yes
Jordan	yes NERC	no	no	incomplete/not applied	incomplete/not applied	incomplete/not applied	Under launch*	no	no	no
Lebanon	Yes, LCEC*	no	no	incomplete/not applied	incomplete/not applied	no	no	no	no	yes
Libya	no	no	no	No	no	no	no	no	no	no
Morocco	Yes, ADEREE*	yes	in process	in process	in process	no	no	no	in process	yes
Syria	yes NERC	yes*	no	incomplete/not applied	incomplete/not applied	no	no	no	no	incomplete/not applied
Tunisia	yes ANME	yes	yes	yes	yes	yes	yes	yes	yes	yes
Turkey	yes EIE	yes	yes	yes	yes	in process	no	in process	no	yes

Source: Based on Plan Bleu 2010, Pascal Augareils, and updated by E. Bergasse (*); ** OEP dissolved recently.

There is therefore room for progress in virtually all sectors measured, with more significant ground to be made up in terms of financing.

Looking at the various points in detail, several other important observations should be noted. National plans are generally long term and target global values that are not necessarily precise. Most also refer to objectives of reducing consumption, except for Tunisia and Jordan that have a more structural energy intensity objective.

Table 8. Mediterranean programmes and objectives targeting energy intensity

	Name of programme/law	Sector	Type of objective	Value of objective	Year of objective
Algeria	National Energy Control Programme (new programme without quantitative objectives)*	All sectors	Energy saving (value)	897,062 TOE	2011
Egypt	National Plan of Energy Efficiency of the Supreme Council of Energy in public sector	The public sector / Residential	Energy saving (Rate)	Sect. Pub.: 20% (10 MTOE)	2016
Israel		All sectors	Energy saving (Rate)	20%	2020
Jordan	National Energy Strategy	All sectors	Reduction of energy intensity	20%	2020
Lebanon*	National Energy Efficiency Action Plan (NEEAP) developed by the Lebanese Center for Energy Conservation (LCEC) 2011-2015			5% decrease in total consumption	2020
Morocco	National Energy Efficiency Plan (2020)	End consumers	Energy saving (Rate)	12 to 15%	2020
Syria	Energy efficiency programme	All sectors	Energy saving (Rate)	10%	2020
Tunisia	Four-Year Energy Control Plan 2008-2011	All sectors	Energy saving (value) Reduction of energy intensity	3.2 MTOE -3%/year 24% savings in primary energy intensity*	2008-2011 2016*
Turkey*	Energy Efficiency Law 2007; regulation on Increased Energy Efficiency in the Use of Energy Resources and Energy, 2009; Energy Strategy Plan	N/A	N/A	-20% in primary energy intensity relative to 2008	2023

Source: WEC database and updated by E. Bergasse (*).

These plans include setting up organisations responsible for advising, programming and setting up various measures.

Table 9. National energy centres in the Mediterranean countries

	Name of centre	Budget (MUS$ or €)	Personnel
Algeria	APRUE	M$ 82.5 (2005)	47
Egypt	Only Committee		
Jordan	NERC (National Energy Research Center)	M$ 0.7 (2009)	35
Lebanon	Lebanese Center for Energy Conservation	M$ 0.8	8
Morocco	CDER (ADEREE)	23 Million Dh or M€ 2 (2009)	150
Syria	National Energy Research Center NERC	2	80
Tunisia	ANME (*Agence Nationale pour la Maitrise de l'Energie)* National Energy Control Centre)	66,682 million DT (2009)	142
Turkey	EIE	M$ 0.95 (2005)	32
EU 27*	(Grand total for all centres) [Average for each national centre]	M€ 3,030.89 [M€ 191]	3 433 [139]

Source: WEC database, Plan Bleu 2010; * author's estimate based on WEC data.

It is difficult to form an opinion on the efficiency of this type of institution or the human and financial resources made available to them, with limited information available. We will limit ourselves to a comparison of the Mediterranean institutional effort relative to the European one. According to the WEC database the total annual budget (mostly programme financing) of energy control organisations set up in European countries exceeds €3 billion and the centres together employ a total of almost 3,500 staff. It therefore appears that means in the Mediterranean need to be increased. Moreover, only a few Mediterranean countries (Jordan, Morocco and Tunisia) plan to create or have already set up a decentralised system with regional and local centres, when the existence of such decentralised systems in other countries has proved useful in disseminating best practices and communications.

If we now focus on more detailed measures (see Tables 10 and 11), those that occur the most often include:

- Lighting using low-energy light bulbs (Algeria, Egypt, Tunisia).
- Setting up renewable energy for consumers (Tunisia, Turkey).
- New building standards and upgrading existing buildings.

Table 10. Energy efficiency regulations in buildings

Country	State of EE regulations in buildings
Algeria	Technical Regulatory Document (DTR) issued in 1996 Compulsory since 2000
Egypt	Thermal insulation standard compulsory in 1998 EE code in buildings for the residential sector compulsory in 2003 EE code in buildings for the tertiary sector optional in 2005
Israel	Thermal regulations for the residential sector compulsory in 1986. Thermal regulations for offices compulsory in 1998. Application: Good. Green Buildings code in 2005; optional application: application poor.
Jordan	Thermal insulation standard in 1990 Compulsory EE code in buildings (currently being adopted)
Lebanon	Thermal insulation standard in 2005, revised in 2010
Morocco	Regulations in process; see National EE Programme for Buildings aimed at introducing a Building Energy Code. In 2010 development of the technical aspects of the thermal regulations project in the residential/tertiary sectors.
Syria	Compulsory EE code in buildings in 2008
Tunisia	Compulsory thermal regulations for offices in 2008 Compulsory thermal regulations for multiple-occupancy dwellings in 2009
Turkey	Thermal insulation standard in 2000. Compulsory standard

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

Table 11. Examples of measures taken by countries in national plans

Algeria	National Energy Control Programme: CFL lighting: 1 million light bulbs and 200,000 in the services in 2011
Egypt	Energy efficiency programme in the residential sector CFL lighting and standards/labels for household appliances
Tunisia	Four-year energy control programme 2008-2011: Improvement of EE in 38,000 new dwellings Compulsory thermal equipping of 21,500 old buildings CFL lighting: 2 million light bulbs a year 480,000 m² of solar water-heaters installed

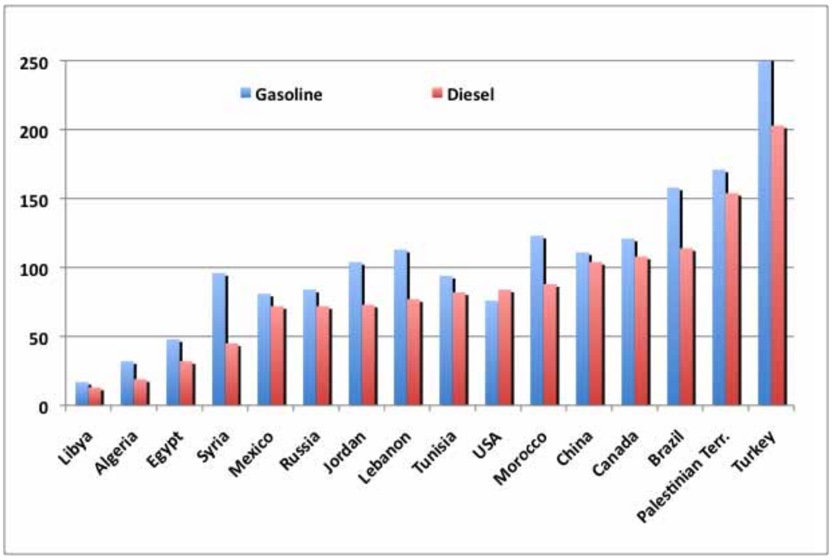
Source: WEC database.

Assessing the state of Mediterranean demand-side management policies would not be complete without mentioning subsidies to domestic fuel prices. This constitutes one of the main concerns raised by Mediterranean policies. The Egyptian case illustrates this well. The cost of subsidising the domestic price of hydrocarbons was 62.7 billion Egyptian pounds in 2008/09 compared with 40 billion in 2006/7, an increase of over 56% in 2 fiscal years (H. El-Deken, et al., 2011). Different estimates even state that the grand total of subsidies has reached around 83 billion for 2010 and the revised 2011/12 budget allocates100.5 billion. In other words, a subsidy that has more than doubled in five years. In 2008/9 this subsidy alone absorbed 18% of total public expenses and 67% of total subsidies. These subsidies had a negative impact at several levels:

1. a considerable cost in terms of unpaid fiscal revenue,
2. a subsidy that affects all producers and consumers alike, without considering levels of income. The gain is therefore the same for everyone for each unit consumed. Assuming the number of units consumed increases with income, it is the highest incomes (in terms of consumers) or the biggest users (in terms of producers) that benefit from the largest transfer. This implies that most of the subsidies go to well-off households. In terms of producers, the least efficient systems also benefit from a greater public transfer. The objective of social stability (to maintain a domestic price lower than the prices of international markets) is therefore only achieved by using most of the subsidies for households that do not need them. The same level of stability would therefore be achieved by direct, targeted transfers at a lower cost (as well as a lower environmental cost), and the level of support given to the poorest households could even be increased while reducing the overall impact on the budget. Moreover, for the producers the investments aimed at reducing their consumption are actually made more costly (and therefore less attractive) because the ratio of investment cost to domestic price of the resource is artificially increased. Inefficiency is therefore rewarded too because the internal rates of return of the projects are lowered by the artificial level of relative prices. The premium is also proportional to the volume consumed, which tends to transfer the largest share to the major companies, to the detriment of small- and medium-sized enterprises.

These prices may be readjusted within a Mediterranean context. Both Turkey – where the domestic prices of hydrocarbons are among the highest in Europe – and Jordan have managed to do so. Tunisia has also set up such measures (a system which, between 2005 and 2007, saved 1.5 times the sums invested in energy-control programmes).

Figure 1. Comparison of the retail price of gasoline and diesel fuel in the Mediterranean and other reference countries – data from mid-November 2011 in $US per litre



Note: On the basis of a price of crude oil at 81 $US per barrel.

Sources: Bassino (2012) according to GIZ (2011).

3. What are the costs of energy efficiency measures?

Every political action has its price. For economic and political decision-makers, price is a determining factor when decisions are taken. Decisions are taken weighing up both cost vs. benefit and present vs. future. This section presents the known aspects of the cost/benefit of demand-side management policies in a few major sectors, including, where possible, the calculation of financial indicators such as Internal Rates of Return (IRR) in the Mediterranean case. The objective is to determine which investments are necessary on the demand side for Mediterranean countries in order to rationalise their energy policies. On the basis of sectoral evaluations resulting from good practice and other analyses targeting Mediterranean countries, particularly Tunisia and Egypt, the objective of this section is to evaluate economic benefit of DSM policies and give a range of unit costs for saving one Ton of Oil Equivalent.

3.1 Building efficiency

Worldwide, the building sector accounts for between 35-40% of the final consumption and approximately one-third of CO_2 emissions. The strategic aspect of dealing with this sector in terms of energy policy is a result, on the one hand, of the long service life of buildings, the influence of which covers several decades, and, on the other, of the fact that the potential energy savings in the sector are estimated to be 40%. The Blue Plan in 2011 focused on the construction of new-builds in the southern Mediterranean countries. The plan estimated that 42 million new dwellings will be required by 2030, at an average annual rate of 2 million each year, when the residential sector accounts for around 33% of final consumption. According to the Blue Plan, the region currently has over 65.7 million dwellings and will have over 107.4 million by 2030. On the basis of the observations of several pilot projects, it was found that with an additional cost of between 3-10%, energy savings of up to 60% would be possible (evaluation by the MED-ENEC project through pilot projects; see Plan Bleu, 2011). Assuming measures of the same type as the European directives were adopted and implemented in the Mediterranean countries, the construction of these 'green' buildings would result in a saving of 42 million TOE in 2030 or a total of over 320 million TOE between 2010 and 2030. The overall total necessary investments would be of the order of 262 billion euros over 20 years, broken down as follows:

- 50% (€132 billion) to create efficient budgets for new-builds,
- 19% (€48 billion) for the thermal renovation of existing buildings (openings included),
- 15% (€40 billion) to distribute efficient household appliances,
- 15% (€38 billion) to set up solar water-heaters,
- 1% (€3 billion) to replace incandescent lighting.

The analysis estimates that the marginal additional cost varies between 2,500 (old property) and €3,300 (new-builds) per 100 m² dwelling.

Based on the figures of this Plan Bleu study, we have calculated indicators to assess the cost efficiency of such a strategy.

Table 12. Cost-benefit analysis of energy efficiency in buildings

		Net Present Value of Net Savings (million euros)		
Discount Rate	Price of one TOE:	600	1000	1500
8%	20 years	-52 192	-6 456	50 713
	50 years	-3 395	102 226	234 254
15%	20 years	-41 942	-20 063	7 284
	50 years	-35 136	-4 263	34 328
20%	20 years	-36 431	-22 218	-4 452
	50 years	-34 408	-17 419	3 818
		Internal Rate of Return (IRR)		
		600	1000	1500
8%	20 years	-17,7%	-1,4%	8,9%
	50 years	0,2%	6,9%	15,3%
15%	20 years	-22,7%	-7,4%	2,3%
	50 years	-5,9%	0,4%	8,3%
20%	20 years	-25,9%	-11,2%	-2,0%
	50 years	-9,8%	-3,8%	3,8%
		Benefit to cost ratio		
		600	1000	1500
8%	20 years	0,6	0,9	1,4
	50 years	1,0	1,6	2,4
15%	20 years	0,4	0,7	1,1
	50 years	0,6	0,9	1,4
20%	20 years	0,4	0,6	0,9
	50 years	0,4	0,7	1,1

Source: Own calculations based on the Plan Bleu (2011) hypothesis and figures.

As can be seen from the table, the economic analysis is sensitive to hypothesis. For such a costly and long-term programme, the discount rate (preference for the present) markedly changes the perception of profitability. However, the time horizon of project evaluation has more importance. The lifetime of buildings is around 50 years and analysing the profitability in a shorter timeframe underestimates the benefit. The future price of oil is the third element that modifies the profitability. Therefore, in the case of a global programme of Energy Efficient Buildings construction, the internal rates of return can vary from -26% to +15%, while the benefit-to-cost ratio ranges from 0.4 to 2.4. Despite the unquestionable (increasing and cumulating) benefit in terms of saved energy consumption, agents may not get the right perception of the interest of such measures.

When financing constraints are heavy, the hierarchy and phasing of programmes will matter. Social acceptance of the initial surplus in cost may be easier if the policy agenda of energy efficiency begins with measures that yield benefits quickly. Such phasing will allow an easing of financial constraints and the possibility to enter into heavier programmes with better take-up by agents.

The building programme also illustrates another important characteristic of energy efficiency projects, in particular relative to supply-side investment projects. Initial investments are not so high at the macro level as a percentage of the total cost. The reason is because the bulk of the cost is usually a percentage of the price of less efficient equipment (for instance concerning the buildings +3% to +10% relative to a standard building). Costs to the economy therefore tend to increase over time as efficient equipment replaces old, inefficient equipment (time of diffusion of more efficient equipment). In this case, higher discount rates lead to a lower net present value of the cost and a lower unit cost of savings. In the case of the building efficiency analysis, the cost of each saved TOE over the lifetime of buildings (see table below) decreases with higher discount rates because the number of buildings to modify or to construct increases over time.

Table 13. Unit Cost of Energy Savings for Energy Efficiency in Buildings

In euros	Cost of Saved Tonne of Oil Equivalent		
Discount rates	8%	15%	20%
Over 50 years	64,47	32,45	23,86

Source: Own calculations based on the Plan Bleu (2011) hypothesis and figures.

3.2 Efficiency of domestic appliances

Meyers et al. (2003) studied the cost-efficiency of the labelling programme set up in the United States between 1987 and 2000 before extrapolating it for the period 2000-2015/2030. They included nine different domestic products, such as refrigerators, washing machines and air-conditioning units. They evaluated the overall cost of the implementation and communication programme at between 200 and 250 million dollars between 1980 and 2000 (therefore between $10-12.5 million per year). They estimated that the net benefits for consumers increased to approximately $17 billion by late 2000 – in 15 years of operation (and should total 150 billion by 2050). For the period 1987 to 2050 they obtained the figure of $150 billion in 2001 on the basis of an operating cost for consumers (equipment) of 95 billion and gross operating costs savings of 245 billion. It should also be noted that the top three appliances in terms of potential savings (refrigerators, washing machines and water-heaters) account for 75-80% of savings. At the same time they estimated that compared to a situation without labelling, in 2020 there would be a saving of primary energy consumption of 2.4 EJ (Exajoule) for a total projected 27 EJ without labelling, i.e. a saving in volume of 8.9%. The volume saved in the residential sector alone is 20%.

In Tunisia a labelling experiment was set up concerning refrigerators with the support of the GEF-World Bank and French Centre for Development (AFD). It must be emphasised that refrigeration represents the largest proportion of household consumption (40% of total consumption), i.e. 10% of total electricity consumption. The project was aimed at introducing a labelling and standardisation system for appliances manufactured or sold in Tunisia. The first phase consisted of setting up compulsory labelling while the second introduced a system of minimum energy performances. According to the project's experts, the expected impacts may be assessed as follows (see GEF, 2004):

i) a reduction in the total consumption of electricity of 8.6TWh between 2005 and 2030, also giving a drop in the emission of greenhouse gases of 3.4 million tonnes CO_2 equivalent; ii) a gain for consumers estimated at 721 million dinars over the same period, which results from the difference between the consumption savings generated of approximately 813 million dinars and the additional 92 million acquisition cost; iii) a net reduction of 277 million of various imports broken down into a reduction of gas imports of the order of 183 million, a saving of 152 million dinars for importing equipment used to generate and distribute electricity and an additional cost of 57 million to import components and equipment to manufacture cooling products; iv) a saving of 254 million dinars of investment costs for Tunisian gas and electricity companies. The overall cost of the project was 1,362 million $US, including a contribution by the Tunisian state of the order of 600,000 dinars (plus 650,000 dinars in kind).

Based on these figures and hypotheses reported in the GEF evaluation of the programme (GEF, 2004), we have calculated some economics indicators to specify the cost-efficiency analysis in the case of Tunisia.

Table 14. Cost-benefit analysis of the efficiency of refrigerators in Tunisia

		Net Present Value of Net Savings (million TND)		
Discount Rate	Price of one TOE (euros):	600	1000	1500
10%	10 years	50	79	108
	25 years	162	235	308
15%	10 years	36	58	80
	25 years	89	132	175
20%	10 years	26	43	60
	25 years	53	81	109
		Internal Rate of Return (IRR)		
		600	1000	1500
10%	10 years	90,7%	206,9%	671,8%
	25 years	90,7%	206,9%	671,8%
15%	10 years	82,4%	193,5%	638,2%
	25 years	82,4%	193,5%	638,2%
20%	10 years	74,8%	181,3%	607,5%
	25 years	74,8%	181,3%	607,5%
		Benefit to cost ratio		
		600	1000	1500
10%	10 years	2,4	3,2	4,0
	25 years	3,8	5,1	6,4
15%	10 years	2,2	3,0	3,7
	25 years	3,2	4,3	5,4
20%	10 years	2,1	2,8	3,5
	25 years	2,8	3,7	4,7

Source: Own calculations based on the GEF (2004) hypotheses and figures.

Relative to the calculations in the case of energy-efficient buildings, the table indicates a better economic efficiency, although cumulated savings are lower. In all cases, internal rates of return are extremely high (from 75% to 90% at the actual oil price level), as well as the benefit-to-cost ratio (from 2.1 to 2.8). With time return ranging from 1 to 3 years, according to GEF such programmes may have a very significant impact at short term and at affordable costs. It is well known that this kind of 'Minimum Efficiency Performance Standards' programme constitutes one very efficient lever for managing a national upgrade of overall energy efficiency. In the Mediterranean, such programmes should become priority.

In terms of unit price of saved energy, the cost range between €20 and 40 per TOE.

Table 15. Unit cost of energy savings of the efficiency of refrigerators in Tunisia

In euros*	Cost of Saved Tonne of Oil Equivalent		
Discount rates	10%	15%	20%
Over 25 years	38,66	26,79	20,09

Source: Own calculations based on the GEF (2004) hypothesis and figures; * Exchange rate used: 1€=2TND.

3.3 Low-energy lamps

Based on their experiences, the GEF (Global Environment Facility) and the World Bank estimated the typical cost of replacing normal lamps with low-energy lamps (CFL). On the basis of replacing 1 million typical 60W incandescent lamps with 15W CFL lamps, the following characteristics were noted over the service life of the lamps (5.5 to 9 years):

- $1 unit purchase cost of lamps, plus $0.50 operating cost (contractualisation, communication, distribution, etc.) and possibly $0.50 management in the participation in CDM. The total cost of the programme is 2 million dollars (of which 0.5 million for participation in CDM).
- 395GWh of cumulated energy saved nationally, corresponding to 31.6 million dollars and 57.5 GWh per year at peak demand, plus 37.9 million dollars of energy-supplier capacity (utilities) including their 44.8 million dollar loss of revenue which also constitutes a saving for the consumers.
- Estimate of 317,000 tonnes of GHG emissions prevented which procured CDM revenue of 3.2 million dollars.

Based on the figures and hypothesis of the World Bank, we have estimated the same kind of economic assessment table as previously. Note that the estimation of the savings value uses a ‘national’ electricity price which is on average of 12 $ cents/kWh.

Table 16. Cost-benefit analysis of standard efficient lighting programme

	Net Present Value of Net Savings (million $)		
Discount Rate	10%	15%	20%
4 years	32,5	29,2	26,4
10 years	48,7	41,5	35,9
	Internal Rate of Return (IRR)		
	10%	15%	20%
4 years	643,1%	610,8%	581,1%
10 years	643,2%	610,9%	581,3%
	Benefit to cost ratio		
	10%	15%	20%
4 years	20,0	18,2	16,7
10 years	27,2	24,0	21,4

Source: Own calculations based on Esmap-Worldbank (2009) hypothesis and figures.

The economic efficiency indicators of such programmes appear very high and less dependent on customer preference for the present. Moreover, the low variation of the figures at different time horizons indicates a very short time of return, and the benefit-to-cost ratio (from 16 to 27) indicates very high profitability. In terms of unit price of saved energy, the cost is around 40 euros per TOE.

Table 17. Unit cost of energy savings of standard efficient lighting programme

In euros*	Cost of Saved Tonne of Oil Equivalent		
Discount rates	10%	15%	20%
Over 10 years	40,99	39,74	38,83

* Exchange rate used: 1€=1.33$.

Source: Own calculation based on the GEF (2004) hypothesis and figures.

3.4 An evaluation of the Tunisian plan

R. Missaouï (2008) evaluated the Tunisian policy for the period 2005-2007. It is particularly interesting since, irrespective of the sources, the results proved positive (a 2.5% annual drop in energy intensity throughout the decade, according to EIA). Between 2005 and 2007, in accordance with the energy plan introduced, approximately 250 million Tunisian dinars were invested (around €140 million) including participation by the Tunisian state of 10%.

The main resources employed were:

- The institutional tool with a law giving resources and missions to the national agency (law 2004-72).
- Regulations establishing obligations: i) compulsory periodic energy audits for industrial centres whose annual consumption exceeds a certain threshold fixed by decree and for energy consumption projects; ii) an obligation on the national grid to buy surplus electricity produced by centres equipped with cogeneration installations; iii) an obligation to display energy-performance labels on household appliances together with a prohibition on the marketing of appliances whose performance levels are under the thresholds fixed by decree; iv) an obligation for new-builds to comply with thermal specifications; an obligation for town councils to use high-performance lighting equipment for new systems; v) compulsory engine diagnoses for automobiles undergoing technical inspections.
- The creation of a national energy control fund (law 2005-82) financed by taxes on high energy-consuming equipment (new saloon cars and air-conditioning units), used to fund the direct financial advantages granted by the law on energy control.
- Introducing fiscal advantages (10% customs duties and VAT exemption) for energy-saving capital goods and consumer goods.

In terms of specific schemes other than regulations and labelling, R. Missaouï (2008) refers mainly to:

- the signing of approximately 500 energy-efficiency contracts (350 in industry and 150 in services),
- the setting up of approximately 15 MW of electrical cogeneration installations in the industrial sector,
- the installation of approximately 1 million low-energy light bulbs for public lighting,
- the installation of approximately 250,000 M² of solar water heaters, mainly in the residential sector (which also included a subsidy of €55 per m²),
- the installation of a 20 MW wind farm,
- and the installation of approximately 1.3MWc of PV solar panels, particularly for solar pumping and electricity.

The main results were:

- a reduction in energy intensity (-2.8% per year)
- twice the penetration of renewable energy other than biomass in primary energy consumption (from 0.5% to 1%),

- the saving of 800 thousand TOE between 2005 and 2007 (equivalent to 3 million TOE over the service life of the equipment),
- the non-emission of greenhouse gases equivalent to 2.4 million tonnes CO_2 between 2005 and 2007 (i.e. 10 million tonnes over the service life of the equipment).
- the saving of €260 million in subsidies for energy products (1.5 times the cost of the measures).

On the basis of the known budgets and estimated consumption figures, R. Missaouï estimated the cost per saved TOE is €50 (of which 10% came out of public funds). The estimate for emissions results in a figure of the order of €20 per tonne.

Tunisia decided to continue the plan over 2008-2011 with an investment budget of €611 million (78 million of which from public funds). The objective was then to reduce its annual energy intensity by 3% while increasing the percentage of renewable energy to 4% of consumption. In terms of objectives, the following was planned:

- an increase in the reduction of energy intensity (-3.0% a year).
- to quadruple the penetration of renewable energy other than biomass in primary energy consumption (from 1% to 4%).
- the saving of 3.2 MTOE over 4 years (equivalent to 15 million TOE over the service life of the equipment), 19% attributed to renewable energy, the remainder to efficiency.
- the non-emission of greenhouse gases equivalent to 9 million tonnes CO_2 in 4 years (i.e. 45 million tonnes over the service life of the equipment).

The concrete actions of the plan (to which regulatory modifications were added) included:

- marketing 2 million low-energy light bulbs each year,
- installing approximately 90,000 m² of solar water heaters in the tertiary and industrial sectors,
- installing 70 MW capacity of wind-powered electricity generation in high-energy consumption industries,
- using waste to produce 40 MW capacity of electricity,
- insulating roofs of over 20,000 existing dwellings and 1, 500 tertiary buildings.

With this approach, the cost per saved TOE is according R. Missaouï, valued at €40 (€5 from public funds) and the cost of a tonne of CO_2 at €14, based on the cost of technologies in January 2008 (€1,700 per nominal wind-power kilowatt, €600 per nominal cogeneration kilowatt, €275 per m² of solar water-heaters).

3.5 Evaluation of Egyptian policies

A similar analysis was carried out for Egypt (Goergy and Soliman, 2008). It found costs per scheme that were of a similar order of magnitude to those in Tunisia described above while the sustainable energy policies there are much more developed and structured than in Egypt. In the current subsidy context, the analysis concluded at a cost of €23-30 per TOE for energy efficiency schemes and €50 for wind-power projects, a total of €70-80 per TOE. These estimates give a ratio of 37.5% of total costs for energy efficiency alone. In terms of emissions, this gives a total of €29 per tonne of CO_2 (€10 per tonne for energy efficiency projects and €19 per tonne of CO_2 for wind-power projects or 34.5% of the overall cost for energy efficiency).

Furthermore, the details of the analysis would appear to confirm that there are benefits for both sides. In the Egyptian plan to install 40 million CFL lamps, the cost of the measure was €102 million, which is less than 0.9% of the projected budget for fuel subsidies in 2011 (1.3% of the subsidies actually paid out in 2009), to be compared with an estimated net present value of €212 million). For the electricity companies the fact that their consumers use this type of equipment has almost no cost, but corresponds to an updated net profit of €78 million. For consumers who use more than 350 kWh per month the additional cost is recuperated in less than one year when the lamps have a service life of more than five years.

Reviewing and assessing case studies of energy efficiency programmes in the Mediterranean confirms the following:

- Energy efficiency programmes are able to significantly decrease the Mediterranean trend of energy consumption and are cost efficient. Both the IRR and benefit-to-cost ratio can be high and the cost of one saved tonne of oil equivalent, around €40 is eight times lower than its market price of oil. Times of return of energy efficiency measures are generally within a few months.
- However, cost efficiency is currently dependent on the preference of agents, of the time horizon, of the price of natural resources and of the national tax and subsidies framework. This has to be taken into account when building a policy agenda in order to maximise benefits and the public perception of gains. The institutional part also matters, notably as the positive outcomes of energy efficiency programmes will partly derive from the establishment of mandatory regulations and from their enforcement. Most DSM outcomes come from the effective use of more efficient equipment. Calculated IRR or benefit ratio rely on technical data and suppose an effective use. If the rate of use of that equipment is not satisfactory, effective returns will be lowered. Therefore, agencies responsible for managing effective use and application are needed to ensure the best results.
- The timing and hierarchy of the measures will be highly significant in dealing with financial constraint and social acceptance. It therefore seems appropriate to target first measures with high visibility, low costs and a high rate of return. The same apply at the sector level, targeting those with a high potential of improvement in the short term, mainly households, SMEs, new building construction, commercial and public lightning. Labelling, minimum performance standards for equipment and appliances and renewable heating systems should constitute the first set of tools.

4. Prospects for 2030: trends and cost/benefits of the alternatives

This final section is devoted to the way the situation should develop in the southern Mediterranean by 2030. This analysis is based on the work of other experts in the MEDPRO consortium for certain basic trends. It mainly consists of data on changes in energy supply in the Mediterranean countries (see Manfred Hafner, WP4a) and on prospects for growth (see WP8). The possible alternatives are generally well known and rather than projecting results based on hypotheses on the investments that the Mediterranean countries might make, this section will conclude on the magnitude of the sums required to have a positive effect on the basic situation.

4.1 Trends

The following estimates of future changes will be based on:

1) changes in GDP (PPP) 2005
2) changes in Total Fuel Consumption (TFC) which will determine the rest of the balance and from which energy intensity trends will be derived. The alternative scenarios base variations in scenario on changes in these intensities.
3) changes in the composition of apparent consumption by primary source including renewable energy. This composition can be used to estimate a CO_2 emissions factor as a function of volume consumed by source. The alternative scenarios vary this factor in order to estimate emissions.
4) changes in the price per barrel that can be used to highlight the updated value of possible gains in terms of savings achieved in sales of primary hydrocarbon sources.

4.1.1 Changes in GDP

In the trends scenario it is assumed that existing trends will be continued. Regarding growth in the southern Mediterranean, although generally fairly resistant to economic crises, countries have seen a slowing down of their economies. The transition to democracy will extend the overall time required to 2015. Turkey is less affected because, despite its relations with Europe, it is also developing its regional leadership role. From 2015 on we assume that these countries will again report growth close to that observed during the decade starting in 2000, i.e. of between 3.5 and 5%.

Table 18. Average annual real growth rates of GDP 1990-2008 and average annual real growth rates of GDP 2009-2030 used for forecasting

	1990/95	95/00	2000/05	20005/08	1990/2008	2000/08	*2009/2015*	*2015/2020*	*2020/2025*	*2025/2030*
Algeria	0.26	3.17	4.77	2.83	2.73	4.04	*3.2*	*3.6*	*3.1*	*2.8*
Egypt	3.41	5.90	3.69	7.03	4.78	4.93	*4.1*	*4.8*	*4.3*	*4.3*
Israel							*3.9*	*4.3*	*4.3*	*4.2*
Jordan							*3.5*	*4.9*	*4.8*	*4.8*
Lebanon							*4.1*	*3.0*	*2.8*	*2.9*
Libya	2.57	1.92	5.66	3.12	3.32	4.53	*5.2*	*5.1*	*4.3*	*3.3*
Morocco	1.38	3.75	4.98	5.33	3.68	5.11	*4.8*	*3.4*	*3.7*	*3.9*
Syria							*2.8*	*4.2*	*3.9*	*3.8*
Tunisia	3.87	5.62	4.47	5.46	4.78	4.84	*4.2*	*4.6*	*4.4*	*4.5*
Turkey	3.23	4.23	4.55	1.79	3.53	3.31	*4.7*	*4.5*	*4.2*	*4.1*

Source: 1990-2008 calculated by the author using data from FMI, IFS; 2009-2030 MEDPRO WP8, based on GDP in $ PPP 2005.

4.1.2 Consumption and energy intensity

According to forecasts on supply and demand from MEDPRO (WP4), the final energy consumption in the southern Mediterranean will more than double by 2030 with an average annual increase of 3.5% during this period. This growth rate will drop towards the end of the period to below 3% in 2020. On this basis the trend is towards falling energy intensity at an increased speed. Changes in intensity in 2009-2015 may be due to two effects of the recession: a reduction in both public and private investment in energy efficiency and a slowing down of households replacing equipment with more efficient versions due to the reduction in growth. On average, energy intensity will have fallen by 13.4% in 2030 compared with its 2009 level.

Table 19. Trends in final consumption 2009-2030 (million tonnes of oil equivalent) and average annual changes in final consumption

	Final consumption (Million TOE)					***Average annual changes in final consumption (%)***					
	2009	2015	2020	2025	2030	*2009-15*	*2015-20*	*2020-25*	*2025-30*	*Global 2009-30*	*Year. 2030*
Algeria	23,958	32,551	39,836	47,91	56,722	*5.2%*	*4.1%*	*3.8%*	*3.4%*	*136.8%*	*42%*
Egypt	47,304	60,555	66,908	74,339	82,285	*4.2%*	*2.0%*	*2.1%*	*2.1%*	*73.9%*	*2.7%*
Libya	13,812	17,1	18,908	20,579	22,3	*3.6%*	*2.0%*	*1.7%*	*1.6%*	*61.5%*	*2.3%*
Morocco	11,607	16,384	19,631	23,042	26,843	*5.9%*	*3.7%*	*3.3%*	*3.1%*	*131.3%*	*4.1%*
Tunisia	6,68	8,558	9,597	10,589	11,587	*4.2%*	*2.3%*	*2.0%*	*1.8%*	*73.5%*	*2.7%*
Turkey	76,005	101,579	122,172	143,671	168,711	*5.0%*	*3.8%*	*3.3%*	*3.3%*	*122.0%*	*3.9%*
Total	179,366	236,728	277,053	320,131	368,447	*4.7%*	*3.2%*	*2.9%*	*2.9%*	*105.4%*	*3.5%*

Source: MEDPRO, WP4.

Table 20. Estimated energy intensity of the Mediterranean countries 2009-2030 and annual changes in energy intensity 2009-2030

	Energy Intensity Level					***Average annual changes in Energy Intensity (%)***						
	2009	2015	2020	2025	2030	*2009-15*	*2015-20*	*2020-25*	*2025-30*	*2009-30*	*1990-08*	*2000-08*
Algeria	0.093	0.104	0.107	0.110	0.114	*1.9*	*0.6*	*0.6*	*0.6*	*1.0*	*1.2*	*2.7*
Egypt	0.111	0.112	0.098	0.088	0.079	*0.1*	*-2.6*	*-2.1*	*-2.1*	*-1.6*	*-0.1*	*0.8*
Libya	0.144	0.131	0.113	0.100	0.092	*-1.5*	*-2.9*	*-2.5*	*-1.6*	*-2.1*	*-5.1*	*-1.6*
Morocco	0.087	0.093	0.094	0.092	0.089	*1.1*	*0.2*	*-0.4*	*-0.8*	*0.1*	*1.0*	*0.1*
Tunisia	0.085	0.085	0.076	0.068	0.060	*0.0*	*-2.2*	*-2.3*	*-2.5*	*-1.7*	*-1.6*	*-2.5*
Turkey	0.091	0.092	0.089	0.085	0.082	*0.2*	*-0.7*	*-0.9*	*-0.8*	*-0.5*	*-0.4*	*-1.1*
Total	0.098	0.100	0.094	0.089	0.085	*0.4*	*-1.1*	*-1.1*	*-1.1*	*-0.7*		

Source: Calculated by the author using data from MEDPRO WP4 and Enerdata WEC.

4.1.3 Energy mix effect: consumption by source and CO_2 emissions

At the present time energy consumption in the southern Mediterranean is dominated by hydrocarbons. With the exception of Morocco, quantities for oil and gas are generally fairly similar. Coal use is negligible, apart from in Morocco and Turkey where it accounts for one third. At an average of less than 4%, renewable energies are marginal and new solar and wind-power technologies are virtually non-existent.

The part played by oil will fall perceptibly in all the countries studied. The use of coal will not increase but will develop in Morocco. The part played by gas will also remain stable. The overall share of renewable energy is only advancing at a moderate pace through the installation of new solar and wind technologies (wind power accounting for 70% of energy produced using both technologies).

Given the forecast changes in consumption this new breakdown nevertheless implies a 63% increase in the volume of oil consumed, a 108% increase in the volume of gas and a 144% increase in the volume of coal.

Table 21. Share of different sources of energy in apparent consumption in 2009 and in 2030

	2009				of which			*2030*				*of which*		
	Coal	Oil	Gas	S/T Hy.Ca.	Renew.	Solar	Wind	*Coal*	*Oil*	*Gas*	*S/T Hy.Ca.*	*Renew.*	*Solar*	*Wind*
Algeria	1.9%	31.5%	66.4%	99.8%	0.1%	0.0%	0.0%	*0.9%*	*26.2%*	*70.0%*	*97.1%*	*2.9%*	*2.7%*	*0.4%*
Egypt	1.3%	44.4%	50.4%	96.2%	2.1%	0.0%	0.1%	*1.0%*	*41.3%*	*48.7%*	*91.0%*	*4.5%*	*0.1%*	*1.5%*
Libya	0.0%	62.8%	36.4%	99.2%	0.8%	0.0%	0.0%	*0.0%*	*46.9%*	*51.0%*	*98.0%*	*2.0%*	*0.6%*	*1.0%*
Morocco	23.1%	66.3%	3.4%	92.7%	5.7%	0.0%	0.2%	*31.8%*	*56.5%*	*3.8%*	*92.1%*	*3.4%*	*1.3%*	*1.1%*
Tunisia	0.0%	45.3%	40.3%	85.5%	14.4%	0.0%	0.1%	*0.0%*	*43.7%*	*42.2%*	*85.9%*	*14.1%*	*1.3%*	*0.6%*
Turkey	30.4%	31.8%	28.9%	91.1%	5.7%	0.0%	0.1%	*30.9%*	*22.4%*	*31.0%*	*84.3%*	*6.1%*	*0.0%*	*2.2%*
Total	13.6%	40.6%	40.2%	94.5%	3.7%	0.0%	0.1%	*16.2%*	*32.3%*	*40.9%*	*89.5%*	*5.0%*	*0.6%*	*1.6%*

Source: Calculated by the author using data from MEDPRO WP4.

Despite amelioration in the energy mix and in energy intensity, levels of emissions are set to almost double by 2030, increasing at an annual rate of 3.1%. This rate will certainly drop during this period but will remain above 2.6% in 2030.

Table 22. Changes in CO_2 emissions 2009-2030 (millions of tonnes)

	2009	2015	2020	2025	2030
Algeria	99,805	126,843	147,331	172,174	199,786
Egypt	190,150	227,132	253,533	280,999	306,688
Libya	60,192	79,169	85,578	89,226	91,947
Morocco	50,030	72,606	88,165	105,127	124,907
Tunisia	29,043	35,091	40,477	44,403	46,235
Turkey	295,002	376,159	445,396	522,036	616,711
Total	724,222	917,000	1,060,479	1,213,965	1,386,273

Source: Author's calculations using MEDPRO WP4 data. Estimates are based on the IPCC method, which uses an emission coefficient for each source and calculates the volume emitted from total consumptions for each source (Blanc, 2008).

However, if we calculate what the emissions would have been if the energy intensity and energy mix remained unchanged, it appears that the results from current policies will have prevented the discharge of 265 million tonnes of CO_2 (19% of the level forecast for 2030). Sixty-two percent of this saving can be attributed to the forecast drop in intensity (10.3%) and 38% to changes in the energy mix.

4.2 The cost of alternatives

In order to assess the scale of investment needed to adopt alternatives to reducing energy intensity, we use the following procedure:

i) we estimate the market price of the raw resources giving an indication of the price of the Tonne Oil Equivalent,

ii) we compare the unit cost of demand management policies observed to date in the Mediterranean countries (or for certain measures) with the market price of the TOE in order to establish the average investment cost needed to reduce consumption and emissions,

iii) we calculate the reduction in energy intensity needed taking account of the energy structure of each country to lower the final consumption by a given TOE value. By comparing the price of the efforts needed in volume of TOE saved with the volume actually saved it is possible to deduce the order of magnitude of the funding required to achieve a given objective.

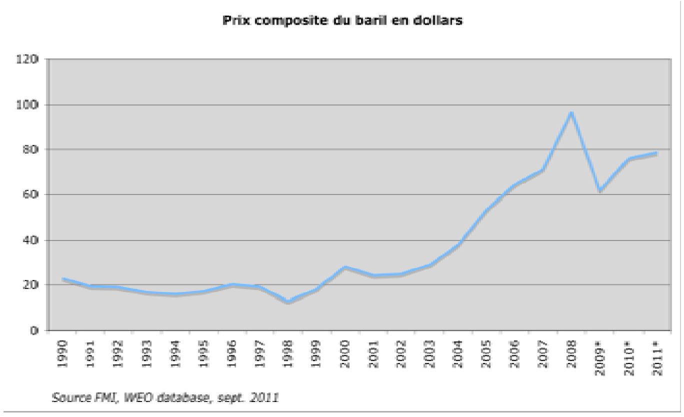
i) Taking the value of the TOE first: we use an average calculated by the IMF based on the price of a barrel of crude oil. The IMF estimate for 2011 gives an average value per barrel of $US 78.75 or a value of $577.24 per TOE. On the basis of the current €/$ conversion rate of 0.694 this gives a value for the TOE of approximately €400.

Table 23. Changes in the price of the TOE 2001-2011

	Prix of one TOE $
2001	178.34
2002	182.88
2003	211.76
2004	276.78
2005	391.06
2006	471.10
2007	521.38
2008	711.30
2009*	452.85
2010*	558.55
2011*	577.24

Source: Calculated by the author using data from the IMF, September 2011.

Figure 2. Changes in the price per barrel 1990-2011



Composite price per barrel in dollars

Crude oil, simple average of 3 spot prices (APSP): Dated Brent, West Texas Intermediate and Dubai Fateh

As a reference, we recall that if over the next few years the price is in the region of \$120, this would give a value for the TOE close to \$900 (€600). This value would exceed \$1,100 (€760) at a price close to \$150 a barrel.

ii) These values should be compared with the various TOE cost ratios of demand management policies that we considered in part III. The following figures are based on the quoted studies (more than 400 projects in various country by Taylor, 2008; US energy efficiency Standard implementation by Meyer et al. 2003, 2008; World Bank-GEF project evaluation for cooling appliances standard in Tunisia, 2004; Tunisia Energy Efficiency plan 2005-2007 and 2008-2011 by Missaoui, 2008; Egypt Energy Efficiency plan by Georgy and Soliman, 2008; World Bank cost effectiveness review on the cost of CFL's in various country). The World Bank review calculated an average cost of \$76 per TOE (i.e. around €53 per TOE). Under Tunisia's energy efficiency plan, investment rose to a figure of the order of €40-50 for each saved TOE (including 10% from public funds). In Egypt the range for energy efficiency is between €25-30 per TOE and €50 per TOE for the installation of wind farms. An own calculation based on other studies for building efficiency (24 to €65), home appliances efficiency (€20-38) and lighting (€39-41) ranges in the same bracket. The ratio between the cost of saving one TOE and its market value can therefore be estimated as 1:8.

These costs are not stable over time, nor do they change in a linear manner. Change is generally exponential: the lower the efficiency level, the lower the cost and the more slowly it rises. Cost increases more rapidly as such efforts produce results. But given the difference between energy efficiency ratios in Europe and the Mediterranean countries (Table 3: average intensity in the Mediterranean is up to two times higher than in Europe), it is virtually certain that the Mediterranean countries are located in the lower, flat section of the curve, indicating that the cost of lowering energy intensity will change slowly over a long period. Moreover, given that Tunisia is more advanced from this point of view than Egypt, with an intensity nearly 25% lower, the cost in Tunisia constitutes the best long-term approximation. Therefore, in the following, we will use a basic cost for demand management policies of **€40 per TOE** in the southern Mediterranean countries. It is possible to give an order of magnitude for the investment required for a range of objectives by country.

iii) The sums given in the following table give the probable cost of the investments required for each country to lower energy intensity to give:

- a 20% drop in final consumption in 2030 if current trends continue,
- a stabilisation of CO_2 emissions at 2009 levels in every country by 2030 (i.e. of the order of 720 million tonnes per year) by modifying energy intensity alone.

Table 24. Investment required in DSM to lower final consumption 20% by different dates

	By 2030				
-20% for final consumption in 2030 or an annual drop of 1.06% of EI	average annual investment (million €)	Cost of one 5-year plan	Overall cost at 2009 prices (values not updated)	Million TOE saved per year on average	
Algeria	195.1	975.6	4,292,8	-4.9	
Egypt	324.7	1,623.5	7,143,2	-8.1	
Libya	88.8	444.0	1,953,6	-2.2	
Morocco	97.4	486.9	2,142,2	-2.4	
Tunisia	46.2	231.0	1,016,5	-1.2	
Turkey	608.0	3,040.1	13,376.4	-15.2	
For 6 Mediterranean countries.	1,360.2	6,801.1	29,924.7	-34.0	
	By 2030				
Stabilising $C0_2$ emissions at 2009 levels	Average annual investment (million €)	Cost of one 5-year plan	Overall cost at 2009 prices (values not updated)	Million TOE saved per year on average	Average annual drop in EI
Algeria	502.4	2,512.1	11,053.4	-12.6	3.15%
Egypt, Arab Rep.	599.3	2,996.7	13,185.3	-15.0	2.10%
Libya	150.6	752.9	3,312.7	-3.8	1.90%
Morocco	300.7	1,503.3	6,614.5	-7.5	4.00%
Tunisia	81.8	408.9	1,799.2	-2.0	2.00%
Turkey	1,623.4	8,116.9	35,714.3	-40.6	3.30%
For 6 Mediterranean countries.	3,258.2	16,290.8	71,679.5	-81.5	-

Source: Author's calculations.

Thus for all six countries presented ('total' line), an average annual variation of -1.06% in energy intensity would, over 20 years, lower consumption by 20% giving a total for the region of nearly 750 million TOE (34 million TOE per year). The average annual cost would be of the order of €1.4 billion, at 2009 prices. On this basis this would give five-year energy efficiency plans with average budgets of €1.1 billion. The distorting effect of Turkey, however, should be underlined as it accounts for nearly half of this investment. For the five other countries the annual average is of the order of €150 million per year or €750 million over five years. We should also add that this would give total annual CO_2 emissions of less than 300 million tonnes in 2030. On the other hand, given the current energy mix in which hydrocarbons and coal play a disproportionate part, the stabilisation of CO_2 emissions on the basis of energy efficiency alone would cost something of the order of €1.6 billion per year (excluding Turkey), requiring an average annual reduction of nearly 3%. From this point of view, a combined programme including plans to install production of alternative energies could improve the cost/benefit ratio.

5. Conclusion

When we calculate trends in the southern Mediterranean countries in terms of final consumption and emissions, taking account of the various supply-side scenarios, we find that there is a risk that the energy situation will become even more challenging. Although some progress has been made, energy needs are set to increase under pressure from demographic and economic factors. Taking the six main economies of the region, apparent consumption will virtually double over the next 20 years, rising from 256 million TOE to 523 million TOE, even though energy intensity should drop by around 0.7% a year to achieve an overall drop of 13% in 2030. At the same time changes in the energy mix should give a reduction of 6.4%in CO_2 emissions per unit of TOE consumed; an average annual drop of 0.3%. Despite this, given the increased consumption, emissions will nevertheless have risen by 91% in 2030 compared with 2009. An additional demand-side effort may reduce the impact of development in the next 20 years provided investment is forthcoming to roll out effective policies. Given current fuel prices and the plans already in place in the Mediterranean, the ratio of the investment cost of savings through DSM/benefits achieved in value of resources saved is of the order of 1:8. On the basis of figures from six countries, in order to achieve a reduction in consumption of 20% by 2030, if current trends continue, it will be necessary to reduce energy intensity by a further 1.06% per year. This is the equivalent of a total TOE saved in the order of 750 million Tonne Oil Equivalent, or the equivalent of an investment budget of €30 billion 2009 over 20 years. The order of magnitude will be an average €150 million per country per year (excluding Turkey).

Achieving an objective of accelerating gains in energy efficiency will require thorough modifications in the southern Mediterranean policy agenda around the following priorities: i) to assess energy efficiency programmes so systematically as to be able to achieve cost-effectiveness, effective and durable savings, in order to convince financial decision-makers of the overall interest of DSM programmes (at ministry level but also at agent level (SMEs and household); ii) to reshape the institutional framework of energy agencies in order to mainstream efficiency and demand-side management at decision-maker level; iii) to design and enforce overall EE action plans with a well-defined timing and hierarchy of measures[2] in order to maximize financial impacts, rate and time of returns, especially when financial constraints increase; iv) to revisit some national policies that act against energy efficiency, in particular, a national subsidies scheme that would have to be revisited; v) to target first sectors and agents offering the highest potential (service sectors, household, SMEs) with well known and efficient tools (labelling, mandatory regulations on consumption, on products specification and composition …) vi) to work in a regional and Euromed perspective so as to benefit from best practices and technical experiences.

[2] The southern Mediterranean countries could consider following the template developed by the RCREEE and the MED-EMIP project and endorsed by the Arab League: "The Arab Guideline for Improving Electricity Efficiency and Rationalizing its Consumption at the End User", Appendix D: "A Template for national energy efficiency action plan"), The Arab League, 2011.

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About MEDPRO

MEDPRO – Mediterranean Prospects – is a consortium of 17 highly reputed institutions from throughout the Mediterranean funded under the EU's 7th Framework Programme and coordinated by the Centre for European Policy Studies based in Brussels. At its core, MEDPRO explores the key challenges facing the countries in the Southern Mediterranean region in the coming decades. Towards this end, MEDPRO will undertake a prospective analysis, building on scenarios for regional integration and cooperation with the EU up to 2030 and on various impact assessments. A multi-disciplinary approach is taken to the research, which is organised into seven fields of study: geopolitics and governance; demography, health and ageing; management of environment and natural resources; energy and climate change mitigation; economic integration, trade, investment and sectoral analyses; financial services and capital markets; human capital, social protection, inequality and migration. By carrying out this work, MEDPRO aims to deliver a sound scientific underpinning for future policy decisions at both domestic and EU levels.

Title	MEDPRO – Prospective Analysis for the Mediterranean Region
Description	MEDPRO explores the challenges facing the countries in the South Mediterranean region in the coming decades. The project will undertake a comprehensive foresight analysis to provide a sound scientific underpinning for future policy decisions at both domestic and EU levels.
Mediterranean countries covered	Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, Syria, Tunisia and Turkey
Coordinator	Dr. Rym Ayadi, Centre for European Policy Studies (CEPS), rym.ayadi@ceps.eu
Consortium	Centre for European Policy Studies, **CEPS**, Belgium; Center for Social and Economic Research, **CASE**, Poland; Cyprus Center for European and International Affairs, **CCEIA**, Cyprus; Fondazione Eni Enrico Mattei, **FEEM**, Italy; Forum Euro-Méditerranéen des Instituts de Sciences Economiques, **FEMISE**, France; Faculty of Economics and Political Sciences, **FEPS**, Egypt; Istituto Affari Internazionali, **IAI**, Italy; Institute of Communication and Computer Systems, **ICCS/NTUA**, Greece; Institut Europeu de la Mediterrania, **IEMed**, Spain; Institut Marocain des Relations Internationales, **IMRI**, Morocco; Istituto di Studi per l'Integrazione dei Sistemi, **ISIS**, Italy; Institut Tunisien de la Compétitivité et des Etudes Quantitatives, **ITCEQ**, Tunisia; Mediterranean Agronomic Institute of Bari, **MAIB**, Italy; Palestine Economic Policy Research Institute, **MAS**, Palestine; Netherlands Interdisciplinary Demographic Institute, **NIDI**, Netherlands; Universidad Politecnica de Madrid, **UPM**, Spain; Centre for European Economic Research, **ZEW**, Germany
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