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Outlook for Electricity and Renewable Energy in Southern and Eastern Mediterranean Countries

Manfred Hafner, Simone Tagliapietra and El Habib El Andaloussi

MEDPRO Technical Report No. 16/October 2012

Abstract

The aim of this report is to elaborate the MEDPRO Energy Reference Scenario for electricity demand and power generation (by energy source) in the southern and eastern part of the Mediterranean (MED-11 countries) up to 2030. The report assesses

- the prospects for the implementation of renewable energy in the MED-11 countries over the next decades. The development of renewable energy is a cornerstone of the MED-11 countries' efforts to improve security of supply and reduce CO_2 emissions;
- the prospects for regional renewable-energy plans (the Mediterranean Solar Plan, DESERTEC and Medgrid); and
- the development of electricity interconnections in MED-11 countries and the possible integration of Mediterranean electricity and renewable markets (both south–south and south–north).

This paper was produced in the context of the MEDPRO (Mediterranean Prospects) project, a three-year project funded under the Socio-economic Sciences & Humanities Programme of DG Research of the European Commission's Seventh Framework Research Programme. MEDPRO Technical Reports give an indication of work being conducted within MEDPRO thematic Work Packages (WPs) and aim at stimulating reactions from other experts and academics in the field.

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Executive Summary

The aim of this report, mainly based on research carried out in 2011 and updated in 2012, is to elaborate the MEDPRO Energy Reference Scenario for electricity demand and power generation (by energy source) in the southern and eastern part of the Mediterranean (MED-11 countries)[†] up to 2030. The report also assesses:

- the prospects for the implementation of renewable energy in MED-11 countries over the next decades (in the MEDPRO Energy Reference Scenario for renewable energy);
- the prospects for regional, large-scale, renewable energy projects (the Mediterranean Solar Plan, DESERTEC and Medgrid); and
- the development of electricity interconnections in MED-11 countries and the possible integration of Mediterranean electricity and renewable energy markets (both south–south and south–north).

The MEDPRO Energy Reference Scenario presented in this report is based upon a critical assessment of the ongoing and committed energy projects and the official plans, targets and objectives officially announced by MED-11 countries. As practically all MED-11 countries have in recent years introduced ambitious policies related to more sustainable development of the energy sector, this Energy Reference Scenario cannot be called a 'business-as-usual' scenario. Rather, it aims at providing a scenario of most likely development, taking into account the latest development plans as of the end of 2010 (as well as the realities and inertia) of the individual MED-11 countries.

The MEDPRO Energy Reference Scenario is thus based on a 'bottom-up' approach and uses a disaggregation by sub-sector and source of energy. The data come mainly from national sources (government ministries, energy utilities and other energy agencies) and international organisations such as the UNEP Plan Bleu, with which the MEDPRO team has closely coordinated in developing this Reference Scenario. The report also includes information gathered during 2012 by the EU-funded project "Paving the Way for the Mediterranean Solar Plan".

In the MEDPRO Energy Reference Scenario, the energy demand in the Mediterranean (overall region) is expected to grow 43% between 2009 and 2030, with oil continuing to dominate the energy mix. Regarding the MED-11, energy demand will double between 2009 and 2030 to reach about 610 Mtoe in 2030, with electricity demand expected to almost triple over the same period. Yet thanks to a strong commitment related to sustainable development and in particular energy efficiency, as well as the renewable energy development visible in all countries, this Energy Reference Scenario differs markedly from past trends. This is a fundamental new element compared with similar exercises carried out in the past.

[†] Algeria, Egypt, Libya, Morocco, Tunisia, Turkey, Israel, Jordan, Lebanon, Palestine and Syria

Outlook for Electricity and Renewable Energy in Southern and Eastern Mediterranean Countries

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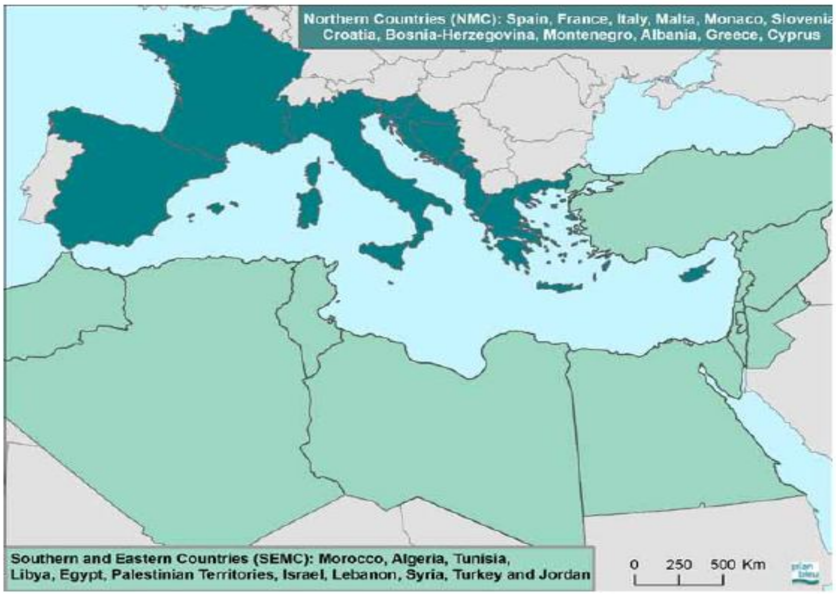
Introduction

This report has been prepared in the framework of the MEDPRO (Mediterranean Prospects) project[1] funded under the European Commission's Seventh Framework Programme, and is based on research carried out in 2011 and updated in 2012.

In this report we divide the Mediterranean basin into two areas (e.g. Figure 1):

- northern Mediterranean countries (NMCs), composed of EU countries (Cyprus, France, Greece, Italy, Malta, Portugal, Slovenia and Spain) and non-EU Mediterranean countries (Albania, Bosnia and Herzegovina, Croatia, Macedonia and Serbia); and
- 11 southern and eastern Mediterranean countries (MED-11), comprising Algeria, Egypt, Libya, Morocco, Tunisia and Turkey along with 5 other south-eastern Mediterranean countries (collectively referred to as OSE), which are Israel, Jordan, Lebanon, Palestine and Syria.

Figure 1. Mediterranean basin



Source: El Andaloussi (2010).

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[1] The MEDPRO project website is at http://www.medpro-foresight.eu/.

MEDPRO MEDITERRANEAN PROSPECTS

Because of the combined effect of demographic pressure[2] and economic growth,[3] the energy systems of the MED-11 are facing severe constraints, whether of supply, transportation, distribution or consumption.

To date about 94% of the energy consumption of MED-11 countries has been covered by hydrocarbons. In fact, the total MED-11 primary energy consumption reached a level of 311 Mtoe in 2009, of which 44% was covered by oil, 36% by natural gas, 14% by coal (mainly in Turkey and Morocco) and 6% by renewables. By comparison, the whole Mediterranean region (north and south) consumed about 1,000 Mtoe in the same year, of which about 41% was covered by oil, 26% by natural gas, 13% by nuclear, 13% by coal and 7% by renewables.[4]

MED-11 countries are endowed with a huge potential for renewable energy (RE), but their energy mix is still CO_2-intensive. Moreover, problems of security of energy supply exist in most countries. Despite the significant energy resources of Algeria, Libya and Egypt, the MED-11 region remains generally characterised by a high level of energy dependence (indeed, all countries except these three are net energy importers), and this trend is likely to grow in the future.

According to the MEDPRO Energy Reference Scenario developed in the framework of this study, the primary energy demand will increase in the MED-11 countries at an annual rate of 3.1%, and the electricity consumption at a rate of 4.6% per year by 2030.

The MEDPRO Energy Reference Scenario developed for this report is based upon a critical assessment of the ongoing and committed energy projects and the official plans, targets and objectives officially announced by MED-11 countries. As practically all MED-11 countries have in recent years introduced ambitious policies related to more sustainable development of the energy sector, this Energy Reference Scenario cannot be called a 'business-as-usual' scenario. Rather, it aims at providing a scenario of most likely development, taking into account the latest development plans as of the end of 2010 (as well as the realities and inertia) of the individual MED-11 countries.

The MEDPRO Energy Reference Scenario is thus based on a 'bottom-up' approach and uses a disaggregation by sub-sector and source of energy. The data come mainly from national sources (government ministries, energy utilities and other energy agencies) and international organisations such as UNEP Plan Bleu, with which the MEDPRO team has closely coordinated in developing this Reference Scenario. Some of information published in this report was also obtained through confidential contacts with experts, who agreed to provide it as part of this research in exchange for being granted anonymity.

In the MEDPRO Energy Reference Scenario, the energy demand in the Mediterranean (overall region) is expected to grow by 43% between 2009 and 2030. In particular, the MED-11 energy demand is expected to double between 2009 and 2030, to reach about 610 Mtoe in 2030 (e.g. Figure 2). The MED-11 electricity demand is set to almost triple over the same period. Yet thanks to the commitment related to energy efficiency and renewable energy visible for the most part in the MED-11 countries, this Energy Reference Scenario differs markedly from past trends. This is a fundamental new element compared with similar exercises carried out in the past.

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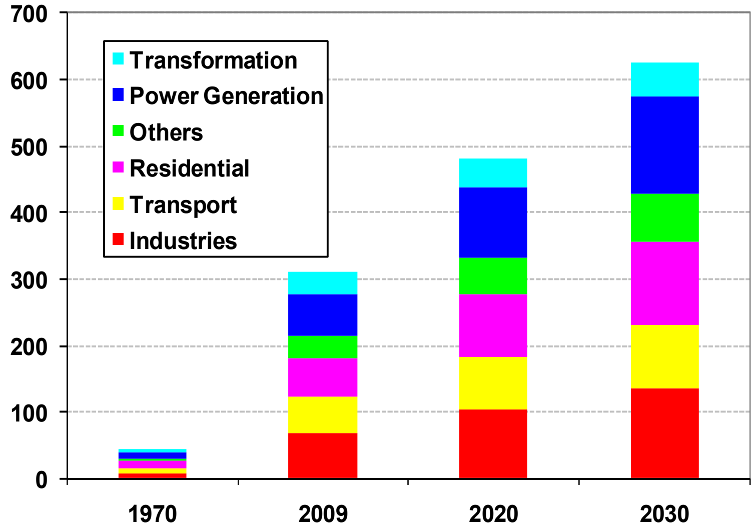
[2] The population of the MED-11 grew by 2.2% between 1971 and 2009 (from 120 to 276 million). Data source: World Bank, World Development Indicators Databank (http://databank.worldbank.org/).

[3] The GDP of the MED-11 grew by 4.5% per year between 1971 and 2009 (from $335 billion to $1,849 billion). Data source: IMF World Economic Outlook Database (www.imf.org/external/pubs/ft/weo/).

[4] Data source: BP Statistical Review of World Energy (www.bp.com/statisticalreview).

Figure 2. MED-11 energy consumption by sector (Mtoe)

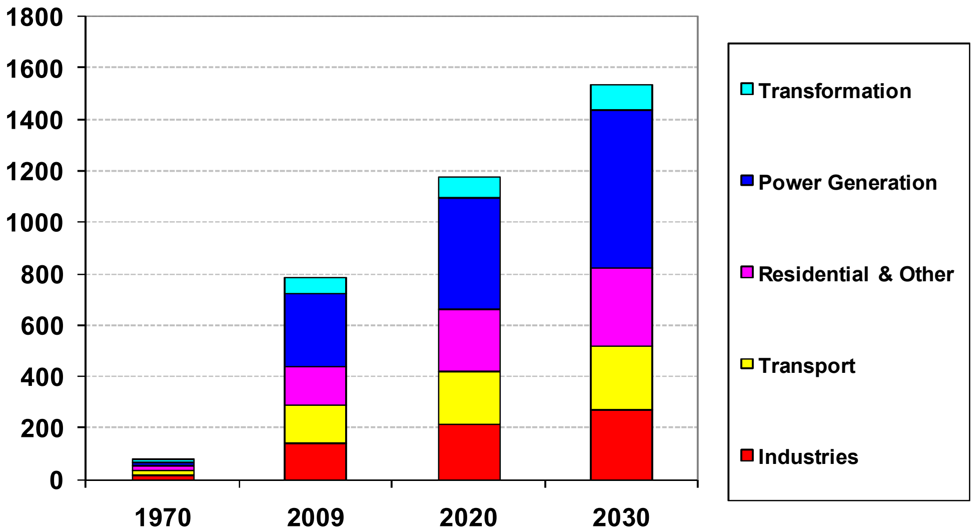


Source: Own elaborations for the MEDPRO Energy Reference Scenario.

In this Energy Reference Scenario, the transport, buildings and electricity production sectors continue to be largely based on fossil fuels. The increasing consumption requires an increase in production of finite fossil fuels. It thus becomes essential to undertake an evaluation of the development of renewable energy, energy efficiency and new energy infrastructures.

The greenhouse gas emissions produced in the Mediterranean region were estimated at 2,174 billion tons of CO_2 in 2009, of which about two-thirds stem from the NMCs and one-third from MED-11 countries (e.g. Figure 3).

Figure 3. CO_2 emissions in the MED-11 (Mt CO_2)



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

According to the MEDPRO Energy Reference Scenario, while emissions in the Mediterranean are expected to grow by 1.5% per year between 2009 and 2030, they are expected to grow twice as fast (3% per year) in MED-11 countries (e.g. Table 1).

Table 1. CO_2 emissions in the Mediterranean

Reference scenario	CO_2 emissions in Mt CO_2			
	1970	**2009**	**2020**	**2030**
Overall Mediterranean	950	2174	2600	2968
MED-11	107	794	1154	1490
NMCs	843	1380	1425	1478

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

In this context the use of renewable energy and the implementation of energy efficiency policies will be essential to meet the challenges of energy security and climate change mitigation. All the different alternative scenarios developed by the different actors in the Mediterranean region (national governments, Plan Bleu, the Observatoire Méditerraéen de l'Energie, etc.) give a significant place to projects aimed at developing renewable energy projects in the region, such as the Mediterranean Solar Plan, Medgrid and DESERTEC. The development of large-scale renewable energy projects in MED-11 countries would have a wide variety of advantages:

1) Large-scale renewable energy projects could initially be primarily devoted to satisfying the rapidly increasing domestic demand for power, thus freeing up natural gas alternatively used in the domestic power generation sector for additional exports to Europe. Considering that the gas infrastructure connecting North Africa with Europe is already in place, this choice would have an immediate and significant economic return for MED-11 countries, just because of the growth in the export value of gas stocks.

2) Some of the renewable electricity could be exported to Europe via HVDC electricity interconnections. This would allow MED-11 countries, through their renewable electricity, to take advantage of European feed-in tariffs.

3) Large-scale renewable energy projects could help develop a major new industry, leading to local job creation and manufacturing developments.

4) Large-scale renewable energy projects could promote economic cooperation among MED-11 countries, which present low levels of intra-regional trade.

5) The economic development consequent to the implementation of large-scale renewable energy projects in MED-11 countries could have several positive spillovers for the EU, such as preventing migratory flows towards Europe, creating new markets and securing the existing energy infrastructure in the Mediterranean.

Yet the core challenge to the production and trade of renewable energy (RE) in the MED-11 is that the development of the electricity supply system is limited by the absence of a regional market. The rigidities this imposes mean that existing infrastructure is not used optimally, investment in new infrastructure is distorted and probably hindered, and the development of renewable energy is delayed. For renewable energy to contribute most effectively to the development of the MED-11, it must be embedded in a functioning regional market for electricity that permits the exchange of power in substantial volumes, that has no barriers to trade and that is friendly to private investment. Exchange of energy is to the benefit of both buyer and seller; it enables both parties to balance portfolios of generating assets; it can alleviate some of the disadvantages of non-dispatchable and intermittent supplies and it can permit joint ventures to share risks. Such a market does not yet exist across the MED-11, and to date, there is neither the infrastructure nor the regulatory and legislative framework that would be necessary for a regional market to function correctly. As explained in the report, the EU could greatly contribute to the development of a better market environment in the MED-11 area, in terms of institutional support (e.g. the regulatory and policy context), public finance and transfer of technological know-how.

Table 2. Summary of MED-11 energy data

MED-11 Reference Scenario					**Average annual growth**	
	1970	**2009**	**2020**	**2030**	**1970–2009 (%)**	**2009–30 (%)**
Total primary energy supply (Mtoe)	*45*	*311*	*462*	*609*	*5,1*	*3,3*
Total final consumption (Mtoe)	*35*	*213*	*322*	*418*	*4,8*	*3,3*
Transport	10	57	78	95	4,6	2,5
Residential	12	58	95	127	4,1	3,8
Industry	9	66	99	127	5,3	3,2
Other	4	33	50	69	5,7	3,6
Electricity output (TWh)	*32*	*556*	*981*	*1501*	*7,6*	*4,8*
RE+hydro (TWh)	11	61	186	354	4,6	8,7
Installed capacity (GW)	–	*118.8*	*200.4*	*311.9*	–	*4,7*
RE+hydro (GW)	–	22.5	53.6	93.9	–	7,0
Indicators						
GDP (billion 2005 $ using ppp)	107	794	1154	1490	5,3	3,0
Population (millions)	336	1849	2697	3674	4,5	3,3
CO_2 emissions (Mt)	120	276	328	363	2,2	1,3
kWh/cap	266	2018	2995	4135	5,3	3,5
koe/cap	372	1127	1409	1679	2,9	1,9
toe/$1,000 ppp	0,133	0,168	0,171	0,166	0,6	-0,06

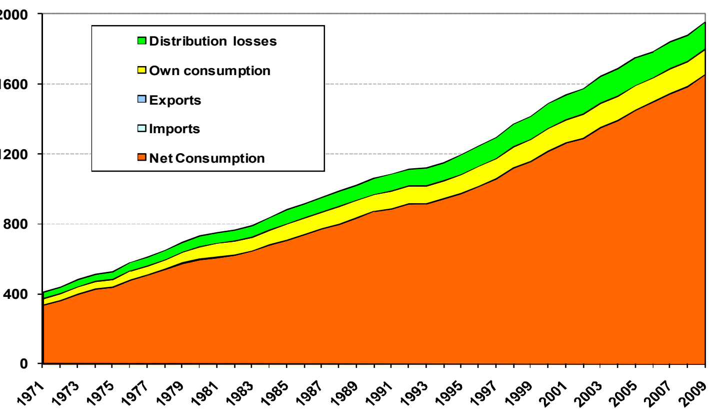
Sources: Plan Bleu and International Energy Agency (IEA) for the 1970–2009 data, and the MEDPRO Energy Reference Scenario for 2020–30.

1. Electricity

1.1 Electricity consumption

The electricity consumption of the NMCs reached a level of 1,400 TWh in 2009, representing nearly 2.5 times the consumption of the MED-11 (556 TWh) (see also Figure 4 and Table 3). Among MED-11 countries, Turkey, Egypt, Tunisia, Algeria and Morocco are (in declining order) the largest electricity consumers.

Figure 4. Electricity in the Mediterranean (TWh)



Source: Authors' update, p. 11, El Andaloussi (2010).

Table 3. Electricity consumption by sector in the MED-11 (TWh)

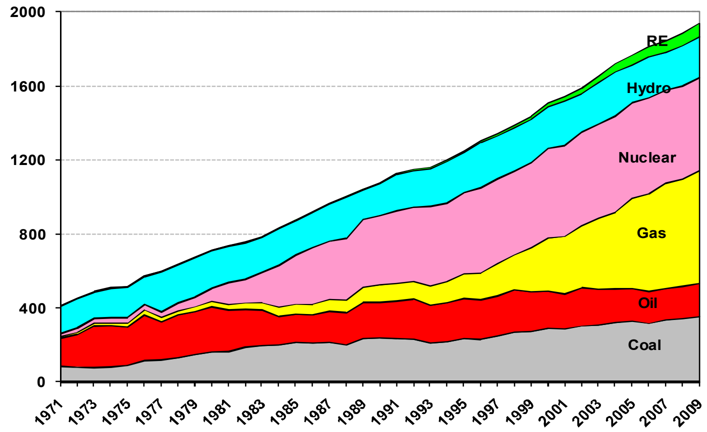
				% Share	
	1970	**2009**		**1970**	**2009**
Industries	13,1	168,7	Industries	50,5	37,8
Transport	0,3	2,0	Transport	1,2	0,4
Residential	6,3	162,1	Residential	24,4	36,3
Others	6,2	113,4	Others	24,0	25,4
Total final consumption	26	446	Total final consumption	100	100

Source: Plan Bleu and IEA for the 1970–2009 data.

1.2 Power production: Snapshot of the current situation

The total power production in the Mediterranean region was estimated at about 1,940 TWh in 2009. Natural gas dominated the power generation facilities (48%), followed by oil (19%), renewable energy (18.6%, mainly due to hydropower) and coal (14%) (e.g. Figure 5).

Figure 5. Power production by source in the Mediterranean (TWh)



Source: Authors' update, p. 11, El Andaloussi (2010).

This situation is the result of an evolution that, during the last decades, has changed the power production mix in the Mediterranean region, as summarised in Table 4.

Table 4. Evolution of power production by source (1971–2009) (%)

	Coal	Oil	Gas	Nuclear	Hydro	RE (no hydro)	Total
NMCs	3,6	-0,7	9,2	11,2	0,4	7,2	3,9
MED-11	9,5	4,6	16,8	–	4,4	4.6	7,6
Total	4,4	0,9	10,9	11,2	1,1	7,3	4,5

Source: Authors' update, El Andaloussi (2010).

As pointed out by Chouireb (2011), the significant growth of natural gas in the MED-11 energy mix over the period 1971–2009 (+17% per year, for a total of 291 TWh in 2009) was mainly due to the low use of this fuel during the 1970s. In the MED-11 the power production based on coal also grew significantly, at an annual rate of 9.5%, rising from 3 to 101 TWh between 1971 and 2009, mainly in Turkey and Morocco. Hydropower rose from 11 to 57 TWh during the same period (mainly in Turkey and Morocco), even if its share in total power production decreased from 30 to 10%. Power production based on renewable energy (excluding hydro) began during the 1990s with various projects in Morocco and Egypt, but it did not really take off before 2007, accounting for only 0.3%. In the following two years (up to 2009), renewable energy (excluding hydro) doubled its market share to 0.6%, which is still extremely low. To meet the electricity demand of the region, the installed power capacity has reported a significant growth over the past three decades. The quadrupling of the total power production between 1971 and 2009 had required about 250 GW of new power generation capacity from the whole Mediterranean basin, of which over 37% (94 GW) was in the MED-11. The losses due to distribution networks and to the own consumption of the power generation sector constituted around 300 TWh (approximately 16% of the total production). The power capacity installed in the north was around 350 GW in 2009 (about three times as much as in the MED-11: 119 GW). The capacity installed in France, for instance, with its 116 GW, is almost equivalent to the entire MED-11 area (Chouireb, 2011) (see also Table 5).

Table 5. Power plant capacity installed in the MED-11 in 2009 (MW)

	Coal	**Oil**	**Gas**	**Hydro**	**RE (excl. hydro)**	**Total**	**% RE + hydro**
Algeria	0	239	10858	228	28	11352	2,3
Egypt	0	2316	18213	2842	441	23812	13,8
Libya	0	3843	2430	0	1,5	6274	0,0
Morocco	1785	1701	850	1748	286	6370	31,9
Tunisia	0	1090	2269	66	59	3484	3,6
Turkey	10459	3115	14204	14553	1017	43348	35,9
OSE	4840	10115	7958	1176	69	24158	5,2
MED-11	17084	22419	56782	20613	1901	118798	19,0
% Share	14	19	48	17	1,6	100	19,0

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

With regard to the electricity sector, the final consumption of 446 TWh in the MED-11 remains concentrated in the industrial sector (38%), followed by the residential sector (36%) and the tertiary sector (25%).

Table 6. Power generation in the MED-11 in 2009 (TWh)

	Coal	**Oil**	**Gas**	**Hydro**	**RE (excl. hydro)**	**Total**	**% RE + hydro**	**RE + hydro**
Algeria	0	0,7	41,8	0,3	0,01	43	1	0,4
Egypt	0	25,8	89,6	15	1,0	131	12	15,7
Libya	0	20,7	9,8	0,0	0,1	31	0,4	0,1
Morocco	10,9	3,5	3,1	3	0,4	21	16	3,3
Tunisia	0	1,4	13,4	0,1	0,1	15	1,2	0,18
Turkey	55	6,6	94,4	36	2,2	194	20	38,0
OSE	35,4	44,2	38,8	3	0,01	122	3	3,3
MED-11	**101**	**103**	**291**	**57**	**4,0**	**556**	**11**	**61**
% Share	18	19	52	10	0,6	100	–	11

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

1.3 Power production outlook: Reference scenario

The total power production in the MED-11 is forecast to almost triple between 2009 and 2030, increasing from 556 TWh to 1,500 TWh (e.g. Table 7). The installed capacity is expected to increase from 119 GW in 2009 to 312 GW in 2030. Of the additional 193 GW, some 71 GW are expected to come from renewable sources (including hydro).

According to the MEDPRO Energy Reference Scenario, in 2030 renewable energy (including hydro) is to reach a level of 354 TWh, obtaining a market share of 24% (up from 11% in 2009). Between 2009 and 2030, hydro is to increase its market share from 10 to 13%, while renewables – excluding hydro – are projected to increase their market share from 0.6 to 17%, thus representing the largest, average annual increase by far (19%/year) of all the power generation sources (e.g. Figure 6).

In 2030 renewables – including hydro – would thus represent the second most important source of power generation after natural gas, which would still represent a market share of 45%. In 2030 coal would generate some 263 TWh and thus keep its overall market for power generation constant at around 18%. In the same year oil would see its market share fall from 19 to 10%, though overall production would increase from 103 TWh to 155 TWh.

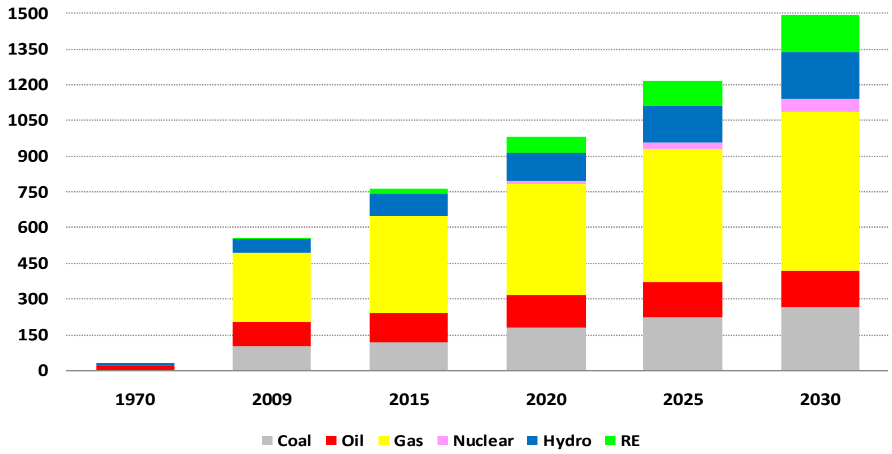
Some MED-11 countries, notably Turkey and Egypt, expect to include nuclear in their power generation mix over the next decades. With 9 GW installed, nuclear is expected to represent a market share of 3% of the overall power generation in the MED-11 by 2030 (e.g. Table 8).

Table 7. MEDPRO Energy Reference Scenario for power generation in the MED-11 (2009–30) (TWh)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	101	118	182	221	263	162
Oil	103	121	136	147	155	52
Gas	291	409	464	562	670	379
Nuclear	0	0	13	27	59	59
Hydro	57	93	118	152	196	139
RE (excluding hydro)	4	22	67	109	158	154
Electricity output (TWh)	**556**	**763**	**980**	**1218**	**1501**	**945**
of which RE+hydro	61	115	185	261	354	293

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Figure 6. MED-11 power generation by source (2009–30) (TWh)



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

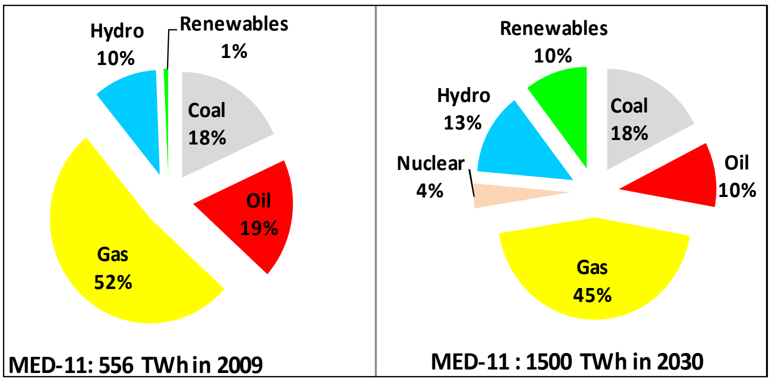
The total installed capacity in the MED-11 reached a level of 119 GW in 2009, while the total electricity production reached a level of 556 TWh (e.g. Table 8 and Figure 7). The average annual growth rate of electricity production between 1970 and 2009 was about 7.6%.[5] It is expected that this growth rate will decline over the next two decades, on average to 4.8% per year (e.g. Table 8).

Table 8. MEDPRO Energy Reference Scenario – MED-11

MED11 - REFERENCE SCENARIO	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**32**	**556**	**981**	**1501**	**7,6%**	**4,9%**	**4,8%**
Coal	3	101	182	263	9,5%	4,8%	4,7%
Oil	18	103	136	155	4,6%	3,0%	2,0%
Gas	1	291	464	670	16,8%	4,0%	4,1%
Nuclear	0	0	13	59			
Hydro	11	57	118	196	4,4%	5,6%	6,0%
Renewables	**0**	**4**	**68**	**158**		30,7%	19,4%
Installed Capacity - MW		**118798**	**200389**	**311919**		**4,5%**	**4,7%**
Coal		17084	26524	43838		3,3%	4,6%
Oil		22419	31185	35700		2,1%	2,2%
Gas		56782	87256	129224		4,3%	4,0%
Nuclear		0	1800	9221			
Hydro		20613	28600	36330		2,8%	2,7%
Renewables		**1901**	**25025**	**57606**		30,5%	17,6%

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Figure 7. Power generation mix in the MED-11



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

According to the MEDPRO Reference Scenario, MED-11 electricity generation will reach 1,500 TWh by 2030 (average annual growth of 4.8% for the period 2009–30) with installed capacity of 312 GW by 2030 (Figure 8).

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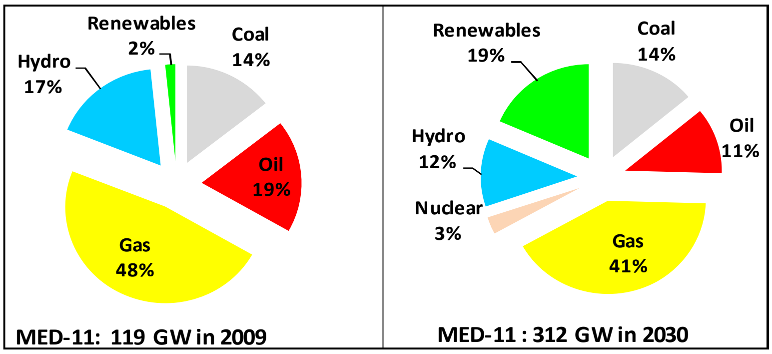
[5] IEA, *Energy Balances of Non-OECD Countries*, OECD/IEA, Paris, 2012(b).

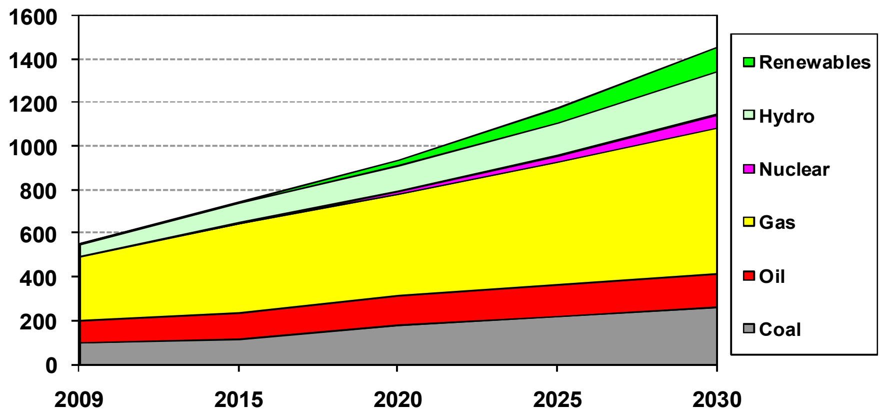
Figure 8. Installed power capacity mix in the MED-11



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

The installed renewable energy capacity in the MED-11 (including hydro) reached 22.5 GW in 2009 and is expected to reach 94 GW by 2030 (an additional capacity of about +72 GW, of which 16 GW is projected to be hydro and 55 GW other renewable energy excluding hydro) (Table 9). In 2009 about 92% of the power capacity from renewable energy including hydro came from hydropower: 20.6 GW hydro versus 1.9 GW from other renewable sources excluding hydro. By 2030, hydropower will only represent 39% and renewable excluding hydro will represent 61% of the total installed capacity of renewable power (e.g. Table 9).

Figure 9. MED-11: Power generation by source, by 2030 (TWh) (about 23% renewable energy, with hydro)



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 9. MEDPRO Energy Reference Scenario for power generation in the MED-11 (2009–30) (MW)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	17084	21486	26524	33927	43838	26754
Oil	22419	28100	31185	34171	35700	13282
Gas	56782	74653	87256	107485	129224	72442
Nuclear	–	–	1800	3700	9221	9221
Hydro	20613	23582	28600	31318	36330	15717
RE	1901	8227	25025	40432	57606	55705
Installed cap. (MW)	**118798**	**156048**	**200389**	**251033**	**311919**	**193120**
of which RE+hydro	22514	31809	53624	71750	93936	71422

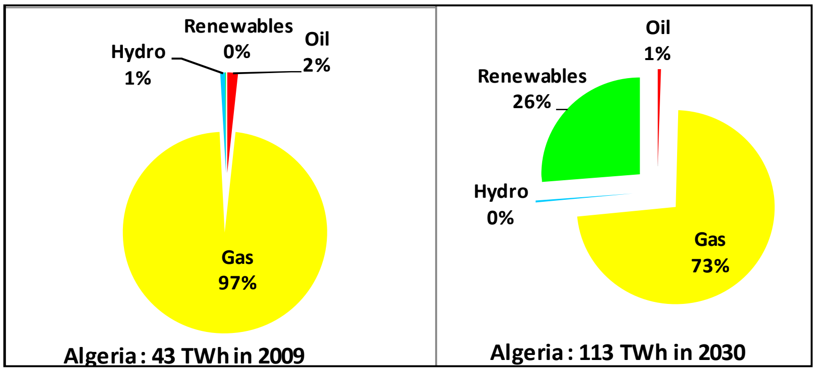
Source: Own elaborations for the MEDPRO Energy Reference Scenario.

1.4 Electricity situation and forecasts in MED-11 countries

1.4.1 Algeria

According to the Sonelgaz Annual Report 2011 (published in June 2012),[6] Algeria's total installed power capacity and electricity generation in 2009 reached the levels of 11,352 MW and 42,771 GWh, respectively. Natural gas is the primary energy source for electricity generation (e.g. Figure 10) and one of the country's most important export commodities. Hydrocarbon exports account for 98% of Algeria's foreign account income.

Figure 10. Power generation mix in Algeria



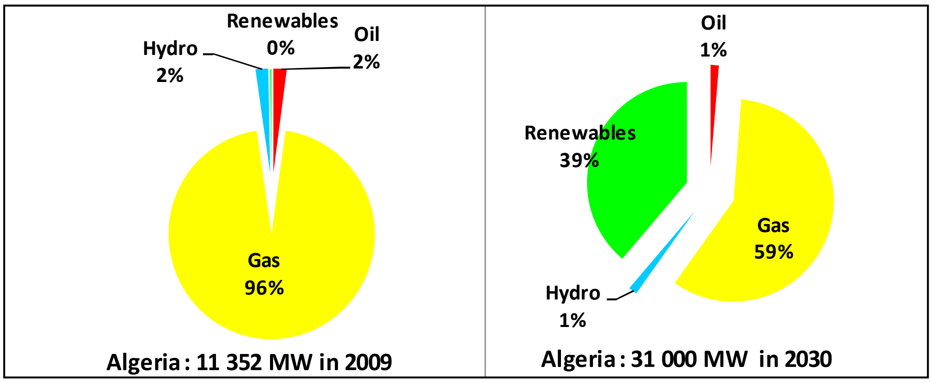
Source: Own elaborations for the MEDPRO Energy Reference Scenario.

According to Chouireb (2011), the 42,771 TWh of electricity production in 2009 was provided by Sonelgaz–SPE (26,772 GWh, or a contribution of nearly 63% with 8,438 MW of installed capacity) and by other producers (15,999 GWh or 37% with 2,886 MW of installed capacity). In 2009 an emergency plan with a production capacity of 2,000 MW was realised, to ensure the coverage of energy demand during winter 2009 and summer 2010. During 2009, six gas turbine power stations were commissioned, for a total capacity of nearly 1,852 MW, which were added to the 1,227 MW of the combined cycle plant in Hadjret Ennouss. Additional capacity for electricity generation (around 3 GW) comes from the following plants: the combined cycle plant in Hadjret Ennouss (1,227 MW); the gas turbine power stations in Arba, Relizane, Ain Djasser, M'sila, Annaba and the Port of Algiers (1,852 MW); and Tindouf (4 x 5 MW), Beni Abbes (2 x 2.5 MW), El Golea (2 x 2.5 MW), Bordj El Haoues (6 x 0.25 MW) and Talmine (1 x 0.46 MW) and the diesel plant in Tamanrasset (5 x 8 MW).

The global investment programme for the period 2010–20 has been divided into two five-year subperiods, for a total additional capacity of over 10 GW. To achieve this objective, the total financial effort is estimated at around $18 billion. Eight new power plants, totalling capacity of nearly 5,000 MW by 2015, will consolidate the northern interconnected system (extensions of central F'kirina, Djasser Ain, Ras Djinet of Messerghine, Hassi R'Mel-hybrid, Sharikat Kahraba Terga (1,200 MW) and Sharikat Kahraba Koudiet Eddraouech (1,200 MW)). And additional capacity of about 4,500 MW will be added over the period 2016–20. By 2020, the installed capacity of generating facilities in the south will rise from 465 MW to 768 MW (Chouireb, 2011).

[6] Sonelgaz, "Rapport d'activités et comptes de gestion consolidés 2011 du Groupe Sonelgaz", *Newsletter*, presse n°17, Algiers, June 2012(a).

Figure 11. Installed power capacity mix in Algeria



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Regarding renewables, additional capacity of about 441 MW by 2015 and 4,219 MW from renewable energy power will be installed by 2020: 1,228 MW photovoltaic (PV), 2,475 MW concentrated solar power (CSP) and 516 MW wind.[7] Moreover, a major manufacturing plant of PV panels will be launched by the company Rouiba by 2013–14, with the aim of realising 141 MW/year capacity from manufacturing solar panels in Algeria.

Table 10. MEDPRO Energy Reference Scenario – Algeria

ALGERIA - REFERENCE SCENARIO	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**2**	**43**	**71**	**113**	**7,7%**	**6,2%**	**4,7%**
Coal	0		0	0			
Oil	2	0,7	1	1	-1,8%	-1,8%	-1,4%
Gas	1	41,7	59	82	11,4%	4,6%	3,3%
Nuclear	0		0	0			
Hydro	0	0,3	0,3	0,3	1,1%	1,9%	-0,7%
Renewables	**0**	0,01	**12**	**30**		93,9%	47,9%
Installed Capacity - MW	**0**	**11352**	**19082**	**30975**		**7,7%**	**4,9%**
Coal			0				
Oil		239	396	405		3,0%	2,5%
Gas		10858	13471	18150		5,0%	2,5%
Nuclear			0				
Hydro		228	394	418		4,1%	2,9%
Renewables	**0**	**28**	**4821**	**12002**		96,9%	33,5%

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

[7] Sonelgaz, "Synthèse des plans de développement du Groupe Sonelgaz 2012-2022", *Newsletter,* presse n°18, Algiers, June 2012(b).

Table 11. Algeria – MEDPRO Energy Reference Scenario for power generation (2009–30) (TWh)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	0	0	0	0	0	0
Oil	0,7	1	1	1	1	-0,2
Gas	41,7	49	59	70	82	41
Nuclear	0	0	0	0	0	0
Hydro	0,3	0,3	0,3	0,3	0,3	0
RE	0,01	1,4	12	20	30	30
Electricity output (TWh)	**42,8**	**51**	**71**	**91**	**113**	**70**
of which RE+hydro	0	2	12	20,3	29,9	29,5

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 12. Algeria – MEDPRO Energy Reference Scenario for power generation (2009–30) (MW)

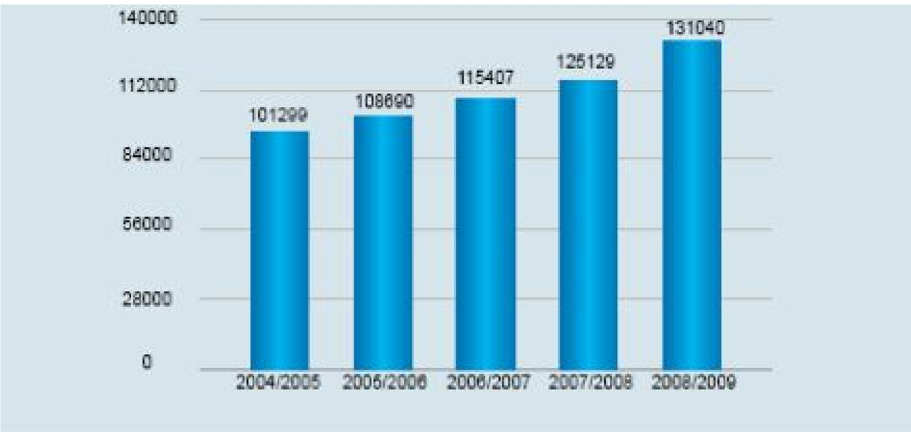
	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	0	0	0	0	0	0
Oil	239	395	396	400	405	166
Gas	10858	12076	13471	15997	18150	7293
Nuclear	0	0	0	0	0	0
Hydro	228	387	394	406	418	190
RE	28	650	4821	8001	12002	11974
Installed cap. (MW)	**11352**	**13508**	**19082**	**24804**	**30975**	**19623**
of which RE+hydro	256	1037	5215	8407	12420	12164

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

1.4.2 Egypt

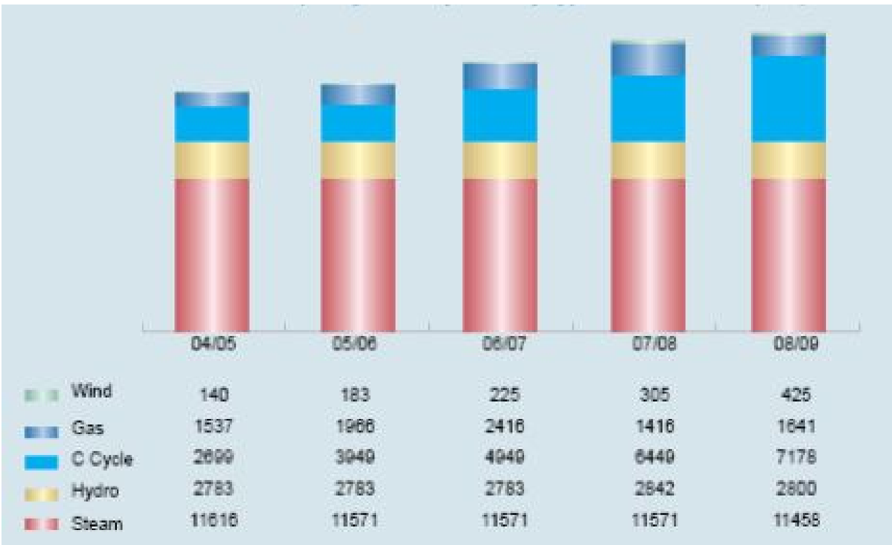
Over recent years, the Egyptian Electricity Holding Company (EEHC) has faced increasing difficulties in meeting the growth in electricity demand, which has resulted in repeated power blackouts. In 2009 peak demand reached 21.3 GW and the energy generated 131 TWh (e.g. Figures 12 and 13).

Figure 12. Generated energy development (GWh)



Source: EEHC (2010).

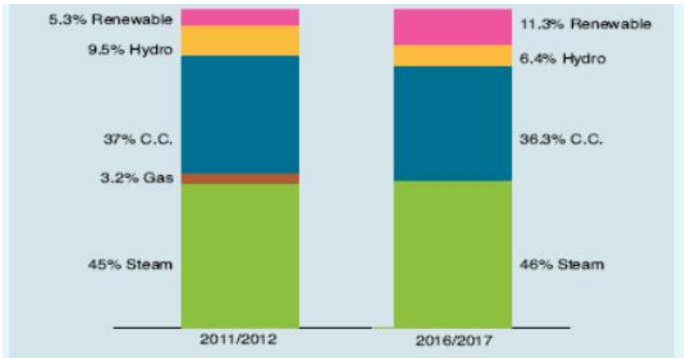
Figure 13. Installed capacity development by type of generation (MW)



Source: EEHC (2010).

The sixth five-year plan (2007–12) includes implementation of thermal power projects for 7,750 MW as follows: i) 3,750 MW combined cycle and ii) 4,000 MW steam units, from which 1,950 MW at the Abu Kir and El Sokhna sites will be commissioned during the years 2012–13 and 2013–14. The seventh five-year plan (2012–17) is based on an expected, average annual growth rate for energy and peak demand of about 6%. This requires additional generation capacity of about 11,100 MW (5,250 MW combined cycle and 5,850 MW steam) of which 10,450 MW are supposed to be operational during the plan period (2012–17) in addition to 650 MW to be commissioned during 2017–18 (e.g. Figure 14).

Figure 14. Share of the installed capacity of each type of power generation at the end of Egypt's sixth and seventh five-year plans (%)



Source: EEHC (2010).

The country's total installed power capacity was 23,912 MW in 2009. Table 13 aggregates the different energy sources by their share in Egypt's total installed power capacity. Fossil fuels represented 86% and renewables 14% (divided between 12% of hydro and 2% of mostly wind). Steam turbines and combined cycle technologies represented the main technologies used for electricity generation. The installed capacity of renewable energy mainly stemmed from hydropower and wind power.

Table 13. Power generation in Egypt (GWh)

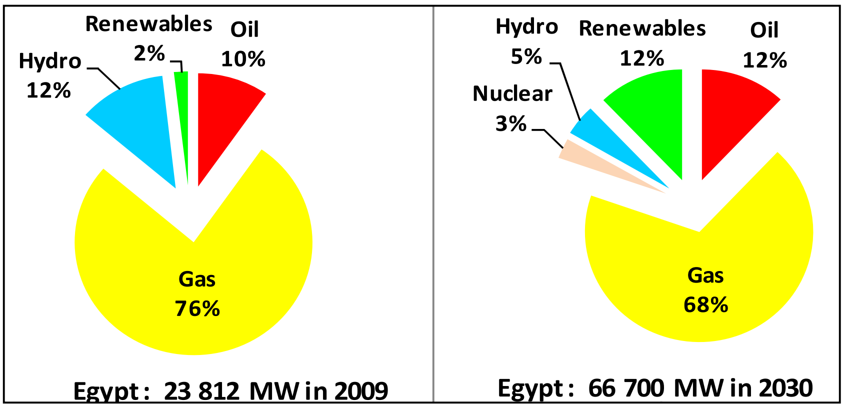
Item	2008/2009	2007/2008	Variance %
Production Companies			
Steam	56165	53076	5.8
Gas	2767	9361	(70.4)
Comb. Cycle	42966	33345	28.9
Total Thermal*	101898	95782	6.4
Hydro	14682	15510	(5.3)
Total Production Companies	116580	111292	4.8
Wind (Zafrana)	931	831	12
Isolated Plants (th)	271	350	(22.6)
Puchased from (IPP's) (th)	17	14	21.4
BOOTs (th)	13241	12642	4.7
Grand Total	131040	125129	4.7

* Energy produced includes commissioning tests

Source: EEHC (2010).

In terms of new installed capacity of renewable energy, wind and solar power are expected to grow most, while the hydropower capacity potential has almost been reached. In February 2008, the Supreme Council of Energy adopted a plan to cover 20% of the country's total generated electricity by renewable energy by 2020. According to this plan, wind energy would provide 12% (7,200 MW) of the total renewable energy target. The remaining renewable power would come from hydro, solar and biomass sources. Egypt's New & Renewable Energy Authority expects the solar contribution to be in the order of 120 MW (100 MW CSP and 20 MW PV) by 2020.[8]

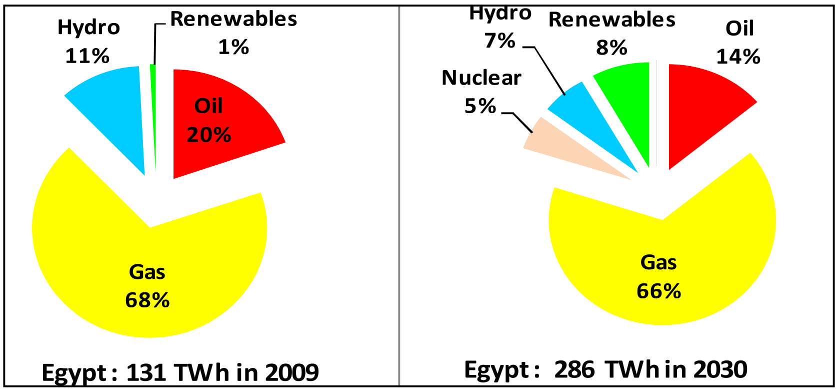
Figure 15. Installed power capacity mix in Egypt



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

[8] PWMSP Project Consortium, *Benchmarking of existing practice against EU norms: Country Report Egypt,* 2011(b) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/Egypt.pdf).

Figure 16. Power generation mix in Egypt



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 14. MEDPRO Energy Reference Scenario – Egypt

EGYPT - REFERENCE SCENARI	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**8**	**131**	**208**	**286**	**7,4%**	**4,7%**	**3,8%**
Coal	0		0	0			
Oil	3	26	27	40	5,6%	1,2%	2,1%
Gas	0	90	156	188		5,6%	3,6%
Nuclear	0		0	15			
Hydro	5	15	18	18	2,8%	1,6%	1,1%
Renewables	**0**	1	**7**	**23**		20,7%	16,4%
Installed Capacity - MW	**0**	**23812**	**45470**	**66684**		**6,6%**	**5,0%**
Coal			0				
Oil		2316	5300	8000		7,8%	6,1%
Gas		18213	34724	45591		6,6%	4,5%
Nuclear			0	2000			
Hydro		2842	3071	3071		0,7%	0,4%
Renewables	**0**	**441**	**2376**	**8022**		20,2%	14,8%

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 15. Egypt – MEDPRO Energy Reference Scenario for power generation (2009–30) (TWh)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	0	0	0	0	0	0
Oil	25,8	22	27	35	40	14,2
Gas	89,6	141	156	174	188	99
Nuclear	0	0	0	7,65	15,3	15
Hydro	14,7	16	18	18	18	4
RE	1,0	3,4	7	13	23	22
Electricity output (TWh)	**131**	**183**	**208**	**247**	**286**	**154**
of which RE+hydro	16	20	25	30,9	41,9	26,2

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 16. Egypt – Baseline scenario of power generation (2009–30) (MW)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	0	0	0	0	0	0
Oil	2316	4045	5300	6900	8000	5684
Gas	18213	28840	34724	40330	45591	27378
Nuclear	0	0	0	1000	2000	2000
Hydro	2842	2970	3071	3071	3071	229
RE	441	1208	2376	4314	8022	7581
Installed cap. (MW)	**23812**	**37063**	**45470**	**55615**	**66684**	42872
of which RE+hydro	3283	4178	5446	7385	11093	7810

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

1.4.3 Libya

In 2009 Libya had installed capacity of electrical power production of 6.3 GW and produced 30.6 TWh (Tables 17–19, Figures 17–18). Libya's power demand was growing rapidly (around 6 to 8% annually)[9] up to the civil war of 2011 and the country was regularly hit by widespread blackouts, as power plants could not keep up with demand.

To prevent such blackouts and to meet surging power consumption, Libya's state-owned General Electricity Company (GECOL) had plans to build several new combined cycle and steam cycle power plants. This programme experienced tremendous delays in implementation, in part because GECOL has serious financing issues as a result of, among other things, the low, subsidised electricity prices and the fact that only 40% of Libyans pay their power bills.[10]

Two-thirds of Libya's existing power stations are still oil-fired, though several had already been converted to natural gas during the last decade. A country producing both oil and gas always has an interest in maximising its domestic gas consumption in order to free up oil for export; indeed, owing to the much higher transport costs for gas netback, margins for oil exports are much greater than netback profits for gas exports.

*Table 17. Libya – MEDPRO Energy Reference Scenario for power generation (2009–30) (TWh)**

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	0	0	0	0	0	0
Oil	20,7	23	21	16	10	-11
Gas	9,8	15	22	30	40	30
Nuclear	0	0	0	0	0	0
Hydro	0	0	0	0	0	0
RE	0,1	0,7	2,0	5,3	6,4	6,3
Electricity output (TWh)	**30,6**	**39**	**45**	**51**	**56**	26
of which RE+hydro	0	1	2	5,3	6,4	6,3

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

[9] See M. Ekhlat, REAOL presentation at the UN-ECA Conference in Rabat, 12 January 2012.

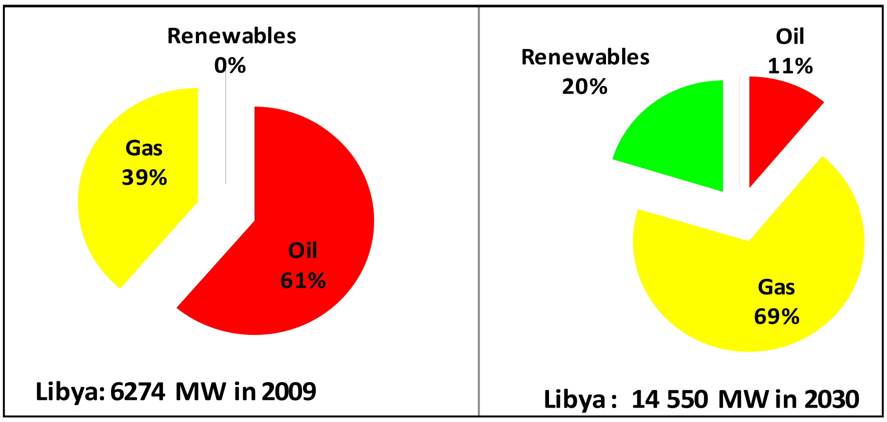
[10] Ibid.

*Table 18. Libya – MEDPRO Energy Reference Scenario for power generation (2009–30) (MW)**

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	0	0	0	0	0	0
Oil	3843	3800	3330	2600	1600	-2243
Gas	2430	3750	5500	7500	10000	7570
Nuclear	0	0	0	0	0	0
Hydro	0	0	0	0	0	0
RE	1,5	320	900	2450	2950	2949
Installed cap. (MW)	**6274**	**7870**	**9730**	**12550**	**14550**	8276
of which RE+hydro	1,5	320	900	2450	2950	2949

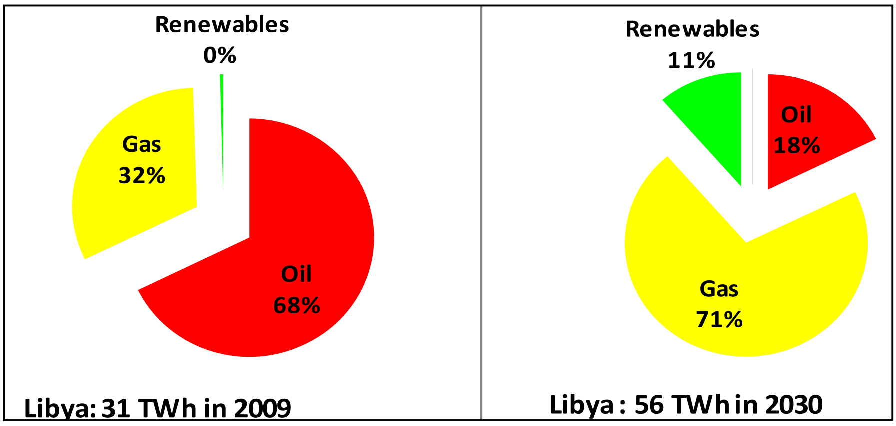
Source: Own elaborations for the MEDPRO Energy Reference Scenario.

*Figure 17. Installed power capacity mix in Libya**



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

*Figure 18. Electricity generation mix in Libya**



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

*Table 19. MEDPRO Energy Reference Scenario – Libya**

LIBYA - REFERENCE SCENARIO	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**0**	**31**	**45**	**56**	**11,4%**	**5,3%**	**3,0%**
Coal	0		0	0			
Oil	0	21	21	10	10,3%	3,1%	-3,4%
Gas	0	10	22	40		7,0%	6,9%
Nuclear	0		0	0			
Hydro	0		0	0			
Renewables	**0**	0	**2**	**6**		28,3%	20,4%
Installed Capacity - MW	**0**	**6274**	**9730**	**14550**		**3,8%**	**4,1%**
Coal		0	0	0			
Oil		3843	3330	1600		-3,2%	-4,1%
Gas		2430	5500	10000		11,4%	7,0%
Nuclear			0	0			
Hydro			0	0			
Renewables	**0**	**1,5**	**900**	**2950**		79,3%	43,7%

* The MEDPRO Energy Reference Scenario presented here for Libya corresponds to the picture as we knew it at the end of 2010 before the start of the Arab Spring, which in Libya led to a bloody civil war.

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

1.4.4 Morocco

In 2009, the total installed capacity and the electricity generation in Morocco reached the levels of 6,370 MW and 21 TWh, respectively (Figures 19 and 20, Tables 20-22). Because power demand in 2009 was 25 TWh, some 4.6 TWh had to be imported,[11] mainly from Spain through the submarine interconnection across the Strait of Gibraltar. Morocco has a significant share of renewable energy in its total installed capacity of electricity. Hydro is the largest renewable energy source in Morocco, with a share of 32.7% in the country's total installed capacity. In the period 2002–09, the consumption of electricity experienced annual growth of 7.5%.[12] Noteworthy in particular is Morocco's successful Global Rural Electrification Program (PERG), which has dramatically raised the electrification rate over the last two decades. While in 1996 only 18% of Moroccans had access to electricity, the electrification rate has today reached the level of 97%.[13] The installed capacity totalled 6,135 MW at the end of December 2009 against 5,292 MW in 2008, reflecting an increase of 15.9% due to the partial commissioning of the Ain Beni Mathar power plant (300 MW), the Tangier wind farm (107 MW), the Tan Tan diesel plant (116.5 MW), the Mohammedia gas turbines (3 x 100 MW) and the hydroelectric Tanafnit plant (18 MW). The partial commissioning of the Tangier wind farm in 2009 raised wind power generation to 233 GWh, an increase of 60% compared with the previous year.

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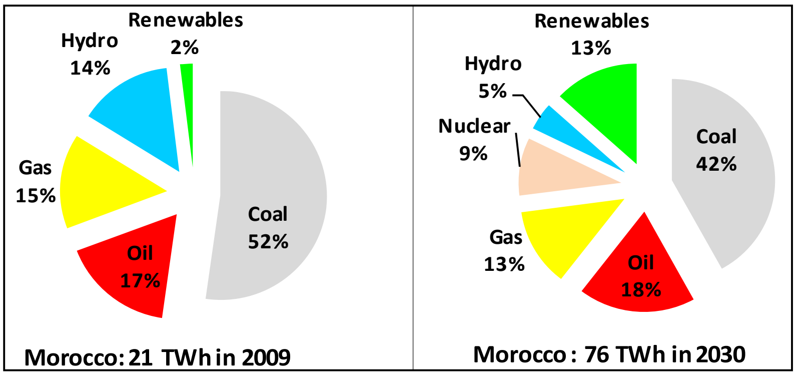
[11] IEA, *Energy Balances of Non-OECD Countries*, OECD/IEA, Paris, 2012(b).

[12] Ibid.

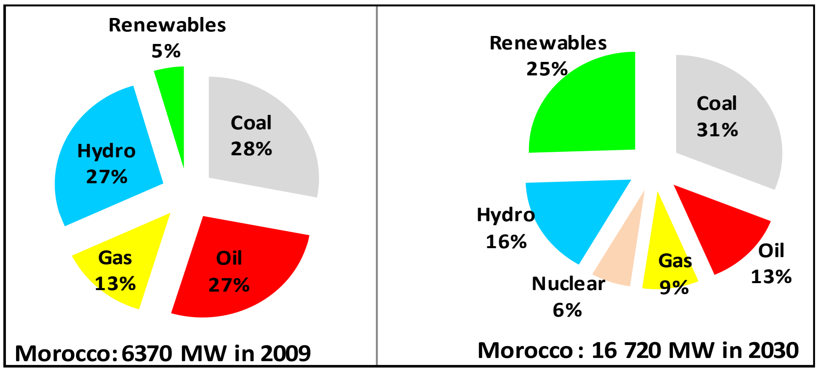
[13] Ibid.

Figure 19. Electricity generation mix in Morocco



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Figure 20. Installed power capacity mix in Morocco



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 20. MEDPRO Energy Reference Scenario – Morocco

MOROCCO - REFERENCE SCENARIO	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**2**	**21**	**46**	**76**	**5,9%**	**7,8%**	**6,4%**
Coal	0	10,9	23	32	11,8%	7,1%	5,3%
Oil	1	3,5	9	14	4,6%	7,4%	6,8%
Gas	0	3,1	6	10		5,8%	5,6%
Nuclear	0		0	7			
Hydro	1	3,0	2	3	1,8%	4,6%	0,6%
Renewables	**0**	0,4	**5**	**10**		29,2%	16,7%
Installed Capacity - MW	**0**	**6370**	**11326**	**16726**		**7,3%**	**4,7%**
Coal		1785	4065	5195		7,8%	5,2%
Oil		1701	1700	2100		3,1%	1,0%
Gas		850	1132	1450		10,4%	2,6%
Nuclear			0	1021			
Hydro		1748	2369	2700		2,9%	2,1%
Renewables	**0**	**286**	**2060**	**4260**		30,1%	13,7%

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 21. Morocco – MEDPRO Energy Reference Scenario for power generation (2009–30) (TWh)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	10,863	18,1	23,4	29,6	32	21
Oil	3,5	7	9	11	14	10,5
Gas	3,1	5	6	8	10	6
Nuclear	0	0	0	0	7	7
Hydro	3,0	1,7	2,2	2,7	3,4	0
RE	0,4	2	5	8	10	10
Electricity output (TWh)	**21**	**34**	**46**	**59**	**76**	55
of which RE+hydro	3	4	7	10	13	10

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 22. Morocco – MEDPRO Energy Reference Scenario for installed capacity (2009–30) (MW)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	–1785	3765	4065	4365	5195	3410
Oil	1701	1395	1700	1800	2100	399
Gas	850	1132	1132	1250	1450	600
Nuclear	0	0	0	0	1021	1021
Hydro	1748	1769	2369	2700	2700	952
RE	286	860	2060	3102	4260	3974
Installed cap. (MW)	**6370**	**8921**	**11326**	**13217**	**16726**	10356
of which RE+hydro	2034	2629	4429	5802	6960	4926

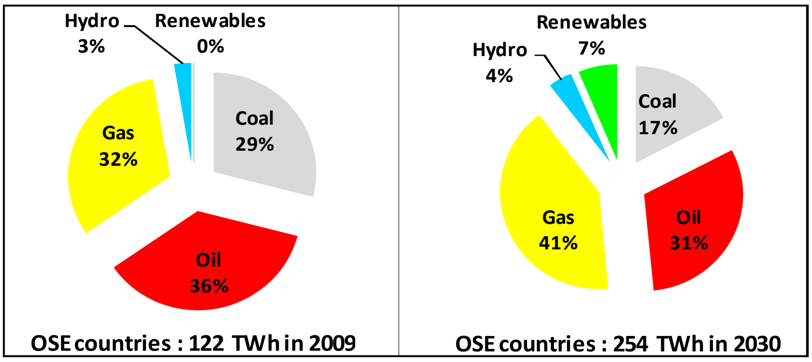
Source: Own elaborations for the MEDPRO Energy Reference Scenario.

1.4.5 OSE countries

The other southern and eastern (OSE) Mediterranean countries (Syria, Jordan, Lebanon, Palestine and Israel) had total installed capacity of 24 GW and electricity production of 122 TWh in 2009 (Figure 21). Electricity generation had grown strongly between 1970 and 2009, at an average annual rate of 7%.[14] According to the MEDPRO Reference Scenario, OSE electricity generation will reach 254 TWh by 2030 (average annual growth of 3.5% for the period 2009–30) with installed capacity in 2030 of about 60 GW, representing an increase of 34 GW compared with 2009 (Table 23). The OSE's installed renewable energy capacity has reached 1,245 MW (including hydro), a level expected to rise to about 9,550 GW by 2030 (Table 24).

[14] IEA, *Energy Balances of Non-OECD Countries*, OECD/IEA, Paris, 2012(b).

Figure 21. OSE electricity generation mix



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 23. OSE countries – MEDPRO Energy Reference Scenario for power generation (2009–30) (TWh)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	35,4	37	40	42	44	9
Oil	44,2	57	65	72	79	35,1
Gas	38,8	65	78	91	105	66
Nuclear	0	0	0	0	0*	0
Hydro	3,3	7	8	9	10	7
RE	0,0	1	8	12	16	16
Electricity output (TWh)	**122**	**167**	**198**	**226**	**254**	132
of which RE+hydro	3	8	16	21	26	23

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 24. OSE countries – MEDPRO Energy Reference Scenario for installed power capacity (2009–30) (MW)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	4840	6632	7577	8531	9600	4760
Oil	10115	13988	15982	17994	19500	9386
Gas	7958	11000	13000	17000	20000	12042
Nuclear	0	0	0	0	0*	0
Hydro	1176	2390	2731	3075	3075	1899
RE	69	380	3210	4756	6473	6404
Installed cap. (MW)	**24158**	**34391**	**42500**	**51356**	**58648**	34491
of which RE+hydro	1245	2770	5941	7831	9548	8303

* Nuclear capacities have been announced in Jordan and Syria for the 2020–30 decade, but owing to the many uncertainties associated with nuclear power in these two countries, they have not been included in the MEDPRO Reference Scenario.

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

1.4.5.1 Israel

Israel's installed capacity and electricity generation in 2009 reached the levels of 11,664 MW and 53,177 GWh, respectively. With a population of less than 3% of MED-11 countries, Israel generates about 9% of MED-11 electricity, reflecting its higher standard of living. Per capita electricity demand

– which is about 6,200 kWh – is three times higher than the MED-11 average. Starting from a higher and more mature level, Israel's electricity demand grew over the past decade (from 1999 to 2009) at an average annual rate of 3.6%, which is much lower than the MED-11 average but which is close to the average annual growth rate of GDP in Israel during the same period of 3.75%.

Israel's power generation is based on imported coal (mainly from South Africa, South America and Australia) for 65% and on gas imported from neighbouring Egypt for 33%. About 2% was based on oil products, while renewable energy sources represent about 0.1% of the country's total electricity generation. Israel's renewable electricity sources are mainly hydro and wind power.[15]

1.4.5.2 Gaza/West Bank

According to a FEMIP study published by the European Investment Bank, no renewable energy capacity is currently installed in Gaza/West Bank (FEMIP, 2010). Almost all (98%) of the electricity to meet demand is imported from Israel, with the remaining coming from Egypt and Jordan. There is only a 62.5 MW power plant. The plant is fuelled by diesel, generating about 410 GWh annually. No institutional plans for renewable energy were identified, although some renewable energy projects exist at different stages of implementation. The following paragraphs identify the major stakeholders in Gaza/West Bank and describe their main responsibilities:

- The Gaza Electricity Distribution Corporation (GEDCo) is the local electricity provider, distributing electricity to all the areas under the control of the Palestinian National Authority. The company is owned by the Palestinian National Authority and its decision-makers are the Palestinian Energy and Natural Resources Authority, the Ministry of Finance, the Gaza Governorate, municipalities and local councils.
- The Palestinian Energy and Natural Resources Authority (PENRA) is responsible for the development and rehabilitation of the internal electricity networks as well as the main electricity lines. PENRA is also in charge of the development of the rural electricity project and the rehabilitation of Gaza's electricity generation station.
- The Palestinian Energy & Environmental Research Centre (PEC) is a national R&D institution responsible for the study of renewable energies and energy efficiency in Gaza/West Bank. PEC has independent financial management, which is audited by both the Palestinian Energy Authority and the Ministry of Finance. The new electricity law, passed in May 2009, does not give strong support to renewable energy. There is only one disposition stating the importance of renewables in Gaza/West Bank. No annexes to or implementation directives for the law have been issued. Neither feed-in tariffs nor third-party access are currently available. Moreover, the electricity network is rather limited. There is just a medium and low voltage grid. Nevertheless, an EU project to reinforce the network is under consideration by the PEA. This agency expects the project to be completed within 36 months from the contract's initiation day (FEMIP, 2010).

1.4.5.3 Jordan

Jordan's installed capacity and electricity generation reached the levels of 2,749 MW and 14,272 GWh respectively in 2009, with growth of about 4% compared with 2008 (Table 25). Electricity from renewable energy sources represented less than 0.5% (and 0.1% excluding hydro) of the country's total generation. Jordan's renewable energy sources are hydro, wind power and biogas. The total renewable capacity is about 17 MW (12 MW hydro, 4 MW biogas and 1 MW wind) (Table 26).

For the future, NEPCO (National Electric Power Company) is preparing a master expansion plan for electricity generation for the period 2010–40 and is taking into consideration the utilisation of local resources, especially oil shale and uranium, in addition to renewable energy resources. Jordan is

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[15] IEA, *Energy Balances of Non-OECD Countries*, OECD/IEA, Paris, 2012(b).

seeking to build a nuclear power plant and export electricity by 2030, but this has not been included in the MEDPRO Energy Reference Scenario.

Table 25. Significant figures for the electricity sector in Jordan

	2008	2009	(%)
Peak load (MW)	2260	2320	2.7
Available Capacity (MW)	2670	2749	3.0
Generated Energy (GWh)	13838	14272	3.1
Consumed Energy (GWh)	11509	11956	3.9
Energy Exported(GWh)	323	139	(57.0)
Energy Imported (GWh)	547	383	(30.0)
Loss Percentage (%)	17.75	17.47	-
Average(kWh) Consumed Per Capita	2403	2427	1.0
Electricity Fuel Consumption*	3275	3431	4.8
No. of Consumers(Thousands)	1352	1426	5.5
Population Under Supply(Thousands)	5846	5978	2.3
Average No. Of Employees	8010	8009	(0.01)

* T.T.O.E

Source: Electricity Regulatory Commission (Jordan) (2010).

Table 26. Installed capacity of generating plants in Jordan (MW)

Year	Steam	Diesel Engines	Gas Turbines		Combined Cycle	Hydro Units	Wind Energy	Biogas	Total
			Diesel	N.Gas					
2006	1013	43	193	210	600	12	1	4	2076
2007	1013	43	193	310	600	12	1	4	2176
2008	1013	43	193	658	600	12	1	4	2524
2009	1013	4	179	410	980	12	1	4	2603

Source: Electricity Regulatory Commission (Jordan) (2010).

Table 27. Electrical energy production by type of generation in Jordan (GWh)

	2006	2007	2008	2009	(%)
1. Electricity Sector	**10646**	**12609**	**13507**	**14009**	**3.7**
Steam Units	5731	6525	5726	5424	(5.3)
Gas Turbines / Diesel	67	32	41	57	39.0
Gas Turbines / Natural Gas	943	916	2622	3065	16.9
Diesel Engines / HFO	4	1	1	1	--
Hydro Units	51	61	62	59	(4.8)
Wind Energy	3	3	3	3	-
Biogas	6	10	9	7	(22.2)
Combind Cycle	3841	5061	5043	5393	6.9
2. Industrial Sector	**474**	**392**	**331**	**263**	**(20.5)**
Steam Units	446	379	331	263	(20.5)
Diesel Engines / HFO	28	13	-	-	-
Total	**11120**	**13001**	**13838**	**14272**	**3.1**

Source: Electricity Regulatory Commission (Jordan) (2010).

1.4.5.4 Lebanon

Lebanon's total installed electricity capacity and electricity generation are, respectively, 2,304 MW (2008) and about 10,624 GWh. Lebanon is an energy importer, receiving 99% of its primary energy from external sources. The remaining 1% comes from renewable energy (mainly hydro).[16]

The Ministry of Energy and Water (MEW) manages the energy sector in Lebanon, even if some decisions need the approval of the Council of Ministers. Policy design is the responsibility of the MEW, which is in charge of electricity, petroleum products and water sectors. The Directorate-General for Petroleum has an important role in regulating the petroleum products market and the state-owned oil installations company operates part of the non-electricity energy infrastructure.

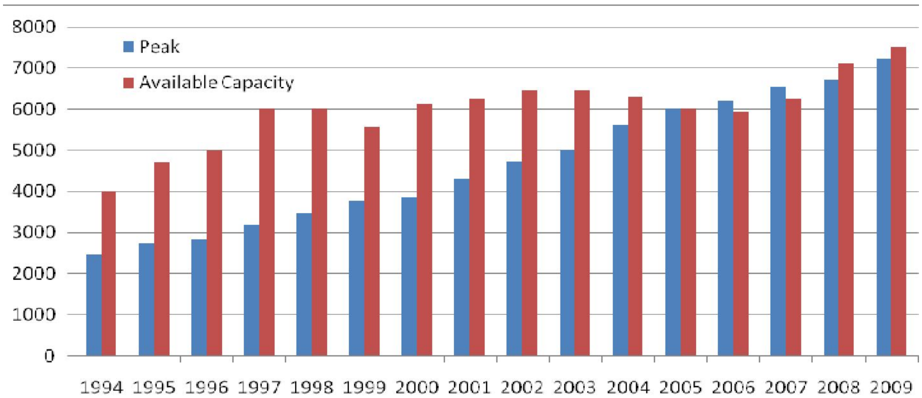
Some private companies' participation is present in the import and distribution of petroleum products. Electricité du Liban (EDL) is the state-owned, vertically integrated electricity monopoly. EDL is incurring significant losses due to its high generation costs and insufficient revenue. Load shedding is practised in all areas outside Beirut and self-generation is common.

1.4.5.5 Syria

The electricity sector in Syria comes under the responsibility of the Ministry of Electricity (MoE), which manages the Public Establishment of Electricity for Generation and Transmission (PEEGT) and the Public Establishment for the Distribution and Exploitation of Electrical Energy. These two agencies are the main operators in the Syrian electricity sector. A new electricity law (No. 32 of 14 November 2010), however, reorganised the policies of the electricity sector. Based on this law the transmission duty will be transferred to a newly created establishment called the Public Establishment for Transmission. Furthermore, the new law allows the private sector to invest in electricity generation and distribution.

The total installed power generating capacity in Syria was about 8,359 MW in 2009, of which 7,518 MW was actually available with an average system load factor of 67% (Figure 22). Although available capacity increased by 5.6% from 2008 to 2009, it is projected that in the period 2011 to 2020 there will be a shortfall in available capacity due to growing demand (Tables 28 and 29). The shortfall is expected to continue to rise during 2011 to 2020 owing to the retirement of an estimated 2,476 MW of older generating units. According to the Ministry of Electricity, a forecast of base case demand projects a 67% increase in electricity demand during 2009–20.

Figure 22. Syria: Peak load and available installed capacity



Source: Ministry of Electricity (Syria) (2009).

[16] FEMIP, *Study on the Financing of Renewable Energy Investment in the Southern and Eastern Mediterranean Region,* European Investment Bank, Luxembourg, 2010.

Table 28. Total electrical energy production with fuel consumed in 2005–09 (GWh)

Years	Total production (GWh)	Growth percentage per year	Import (GWH)	Export (GWH)	local consumption (GWH)	fuel needed (million TOE)
2005	34653.40		101	926	33828.4	8.75
2006	37503.60	8%	310	1099	36714.6	9.47
2007	38644.50	3%	1480	1006	39118.5	9.76
2008	41023.40	6%	607	1064	40566.4	10.36
2009	43317.20	5.6%	557	617	43257.2	10.94

Source: PEEGT (2009).

Table 29. Energy demand planned for 2010–25

Years	Total production (GWh)	Growth percentage per year	Fuel needed (Mtoe)	Fuel available (Crude +Gas)	Deficit in fuel (Mtoe)	Total cost of deficit M US$
2010	45916	6%	10.3	13.725	-	-
2011	48671	6%	11.0	13.725	-	-
2012	51591	6%	11.6	13.725	-	-
2013	54687	6%	12.3	13.725	-	-
2015	61446	6%	13.8	13.725	0.1	49.7
2020	82227	6%	18.5	13.725	4.8	2062.4
2025	107200	6%	24.1	13.725	10.4	4481.1
2030	136817	6%	30.8	13.725	17.1	7349.7

Source: PEEGT (2009).

The fuel needs for the Syrian thermal power stations are covered up to 65% by oil and to 35% by natural gas. Further movement towards the use of natural gas is to be expected. Hydropower contributed 6% to electricity generation in 2009. Hydro is currently the only renewable energy source developed in Syria and represents a fifth of the country's total installed power capacity. Before the Arab Spring uprisings, the Syrian government had developed its long-term development scenario. The scenario has the following main assumptions:

i) installing 1,000 MW of nuclear power before 2030 (this has not been included in the MEDPRO Reference Scenario);

ii) using wind farms to generate electricity in some promising windy areas in Syria and using solar PV power plants;

iii) having a power plant reserve margin of 5% in 2010 and 10% later; and

iv) importing and exporting electrical energy through the electric grid interconnection according to the available capacity with neighbouring countries, which was 300 MW in 2005 and is expected to be 500 MW in 2030.

According to the government's energy reference scenarios developed before the Arab Spring uprisings, the electricity generation would increase from 34.9 TWh in 2005 to about 148.4 TWh in 2030, equivalent to an increase of 6% per year.[17] This implies an increase of installed capacity from 6,200 MW to 29,600 MW during the period 2005–30. The distribution of the additional new capacity is to be as follows: 14,360 MW from combined cycle, 12,200 MW from heavy fuel oil, fired steam power plants, 900 MW from gas turbines, 300 MW from wind turbines and 1,600 MW from two nuclear power plants that will enter the system in 2020 and 2025 with 600 MW and 1,000 MW respectively.

1.4.6 Tunisia

Tunisia's total installed capacity and electricity generation were, respectively, 3,484 MW and 14,149 GWh (2009), and 3,598 MW and 14,866 GWh (2010). Electricity from renewable energy sources is around 2% of total electricity generation; half of this percentage belongs to hydro and the other half to wind. The country's primary source of electricity generation is natural gas, of which Tunisia is a net importer (Figure 23). The domestic production of electricity fed into the transmission system (Société Tunisienne d'Electricité et du Gaz (STEG), independent power producer (IPP) and purchases from independent producers) amounted to 14,866 GWh in 2010 and 14,149 GWh in 2009 against 13,757 GWh in 2008, registering an increase of 2.8% over 2008 (Figure 24). Since 2009, installation has been underway on the second extension (35 MW) of the wind farm of Sidi Daoud and the extension of wind power plants and Metline Kechabta in the Bizerte (69 MW).

Figure 23. Installed capacity by type

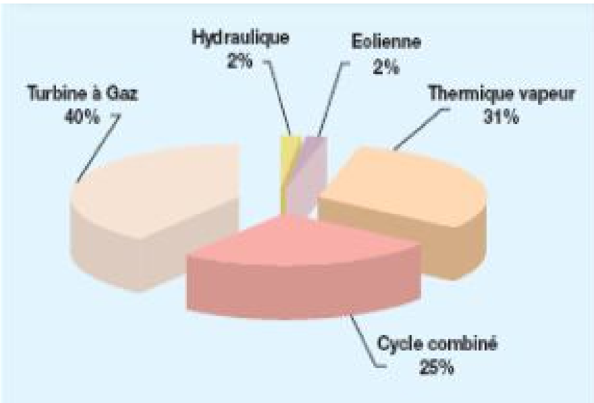
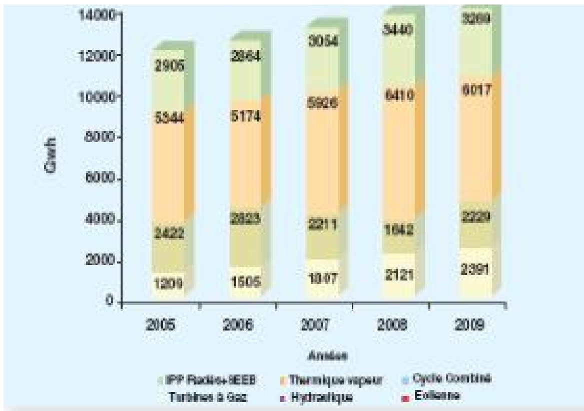


Figure 24. Evolution of production by technology



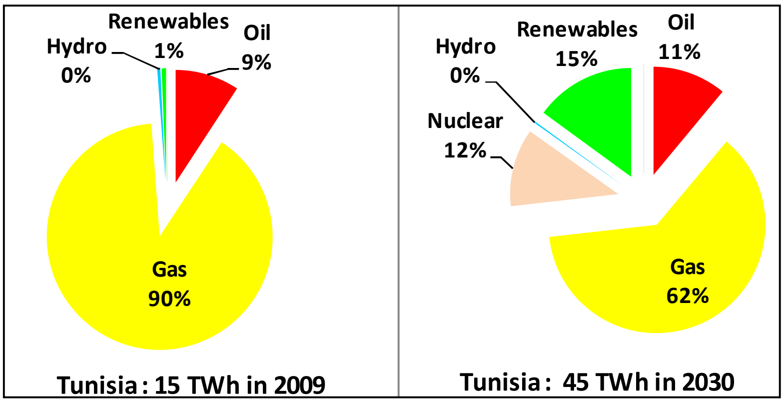
Source: STEG (2009).

Moreover, the joint Tunisian–Italian "ELMED Studies" have been launched for the construction of a plant for central independent production of 1,200 MW and the completion of an interconnection project between the Italian and Tunisian power systems.

Whereas in 2009 some 90% of Tunisia's power generation was produced from natural gas imported from Algeria, the share of gas for power is by 2030 expected to shrink to 62%, while nuclear is expected to reach a market share of some 12% and renewable energy sources some 15% of the power generation mix (Figure 25).

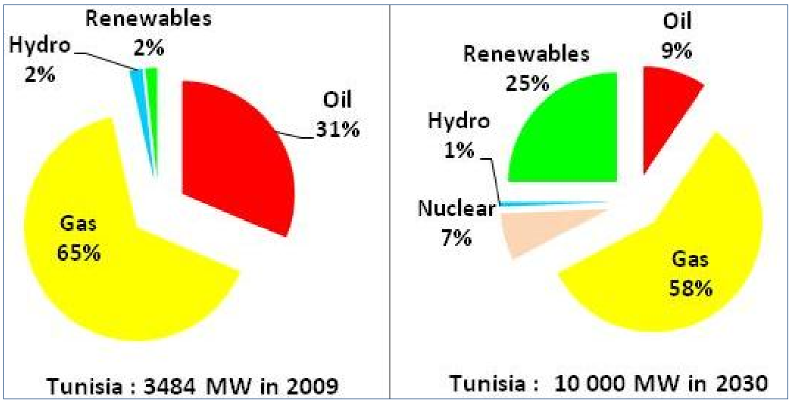
[17] IEA, *Energy Balances of Non-OECD Countries*, OECD/IEA, Paris, 2012(b).

Figure 25. Electricity generation mix in Tunisia



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Figure 26. Installed power capacity mix in Tunisia



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 30. Tunisia – MEDPRO Energy Reference Scenario for power generation (2009–30) (TWh)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	0	0	0	0	0	0
Oil	1,4	3	6	6	5	3,6
Gas	13,4	20	21	25	28	15
Nuclear	0	0	0	0	5	5
Hydro	0,1	0,1	0,1	0,1	0,1	0
RE	0	1	2	5	7	7
Electricity output (TWh)	**15**	**23**	**29**	**36**	**45**	30
of which RE+hydro	0,2	1	2	5	7	7

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 31. Tunisia – MEDPRO Energy Reference Scenario for installed power capacity (2009–30) (MW)

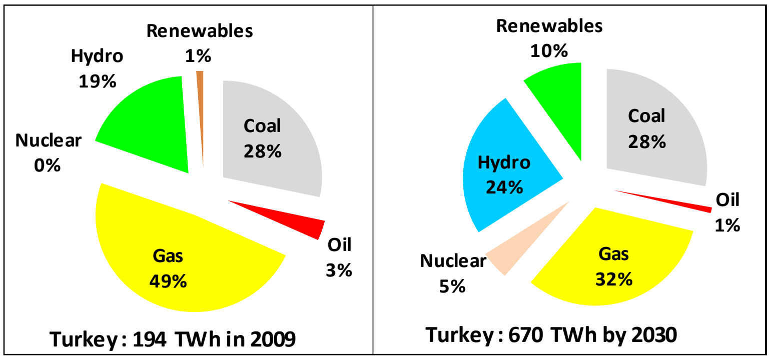
	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	0	0	0	0	0	0
Oil	1090	1342	1342	1342	960	-130
Gas	2269	3348	4048	4250	5787	3518
Nuclear	0	0	0	0	700	700
Hydro	66	66	66	66	66	0
RE	59	169	836	1741	2504	2445
Installed cap. (MW)	**3484**	**4925**	**6292**	**7399**	**10017**	6533
of which RE+hydro	125	235	902	1807	2570	2445

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

1.4.7 Turkey

Turkey's primary energy sources include coal, oil, natural gas, hydraulic, geothermal, wood, waste, solar and wind. Turkey is heavily dependent on imported oil and gas. Utilisation of renewable energy as an indigenous source in electricity generation is important for Turkey in terms of both security of energy supply and environmental concerns. Turkey's total installed capacity reached 43 GW in 2009 and the total electricity produced was 194 TWh, growing at an average annual rate of 8.4% between 1970 and 2009 (7.1%/year in the period 1990–2009)[18] (Figure 27). According to the MEDPRO Reference Scenario, it is expected that consumption of electricity will reach about 390 TWh by 2020 and 670 TWh by 2030 (an average annual growth rate of 5.6% in the period 2009–30) (Table 32). In 2009, 80% of Turkey's power generation was covered by fossil fuels (mainly gas at 49%, followed by coal at 28% and some minor consumption of oil at 3%) and 20% by renewable sources (mainly hydro). The MEDPRO Reference Scenario expects that by 2030, the power generation mix will be much more diversified: the share of fossil fuels will fall to 61% (32% from gas and 28% from coal), while the renewable share will rise to 34% (24% from hydro and 10% from other renewables) and nuclear power, which is to be introduced, will by then reach a level of 5%.

Figure 27. Electricity generation mix in Turkey



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

By 2030, electricity generation will reach some 670 TWh (average annual growth of 5.5%) with an installed capacity of about 114 GW (Table 33). Turkey will thus build an additional capacity of +70 GW by 2030. Turkey's installed wind capacity has increased tremendously in the few last years

[18] IEA, *Energy Balances of Non-OECD Countries*, OECD/IEA, Paris, 2012(b).

(doubling or tripling every year): it has risen from 50 MW in 2007 to 1,523 MW at the beginning of 2011.

Table 32. Turkey – MEDPRO Energy Reference Scenario for power generation (2009–30) (TWh)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	55,0	63	118	149	187	132
Oil	6,6	9	8	7	6	-0,3
Gas	94,4	115	122	165	217	123
Nuclear	0	0	13	19	32	32
Hydro	35,9	68	89	121	164	128
RE	2,2	13	33	49	65	63
Electricity output (TWh)	**194**	**267**	**383**	**510**	**671**	477
of which RE+hydro	38	81	122	170	229	191

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 33. Turkey – MEDPRO Energy Reference Scenario for installed power capacity (2009–30) (MW)

	2009	2015	2020	2025	2030	Additional (2009–30)
Coal	10459	11089	14882	21031	29043	18584
Oil	3115	3135	3135	3135	3135	20
Gas	14204	14507	15380	21158	28246	14042
Nuclear	0	0	1800	2700	4500	4500
Hydro	14553	16000	19969	22000	27000	12447
RE	1017	4640	10823	16068	21396	20379
Installed cap. (MW)	**43348**	**49371**	**65990**	**86092**	**113320**	69971
of which RE+hydro	15570	20640	30792	38068	48396	32826

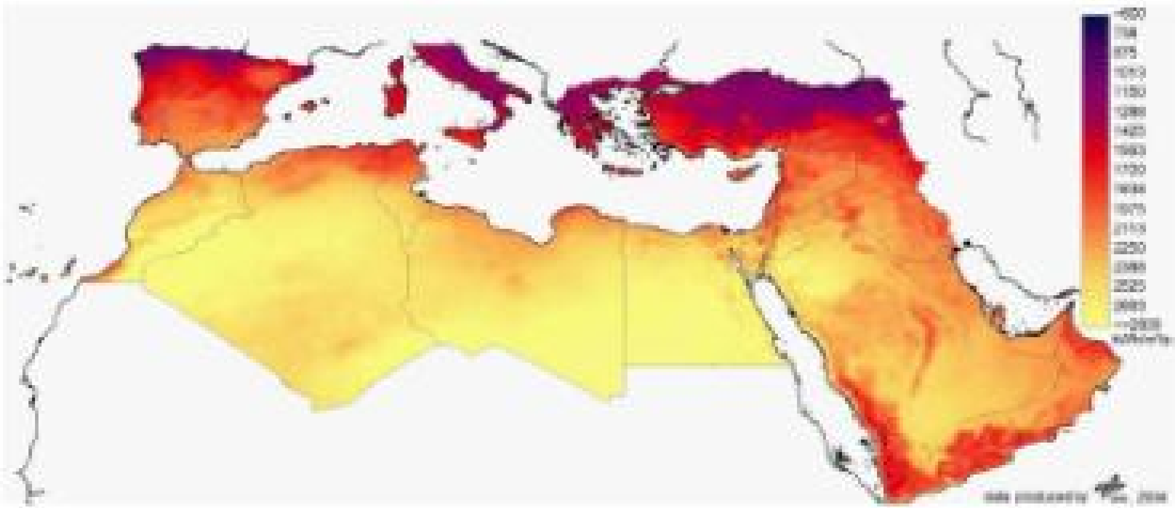
Source: Own elaborations for the MEDPRO Energy Reference Scenario.

2. Renewable energy

2.1 Renewable energy: Snapshot of the current situation

The MED-11 area is endowed with huge potential for renewable energy, particularly in terms of solar and wind energy. The sunshine duration ranges between 2,650 and 3,600 hours/year. Solar radiation is estimated at between 1,300 kWh/m²/year on the coast and 3,200 kWh/m²/year in the Saharan desert (e.g. Figure 28). As for wind energy, several sites have potential where the mean wind velocity largely exceeds 7 m/s (being up to 11 m/s for certain sites) and is likely to be tapped on a large scale (e.g. Figure 29). Egypt has one of the highest mean wind velocities in the world (11 m/s), which makes it possible to operate a wind farm in some areas during 3,900 hours/year, as against the average of 1,900 hours/year in Spain and Greece.

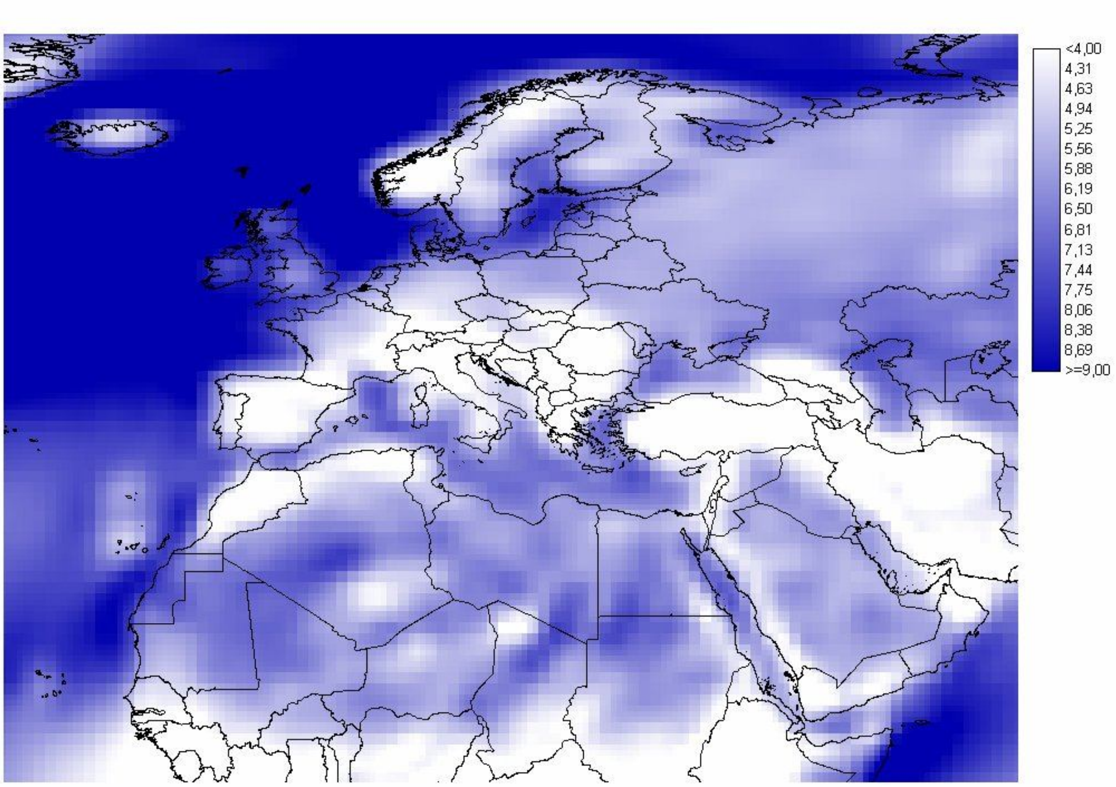
Figure 28. Map of annual, direct solar radiation



Source: DLR (2005), p. 9.

Certain zones in Tunisia, in the northern Cap Bon zone, in Egypt, in Morocco, in Gibraltar and in the southern zones of Tan Tan, Laayoune and Tarfaya also have great potential for the development of wind energy.

Figure 29. Map of mean wind velocity

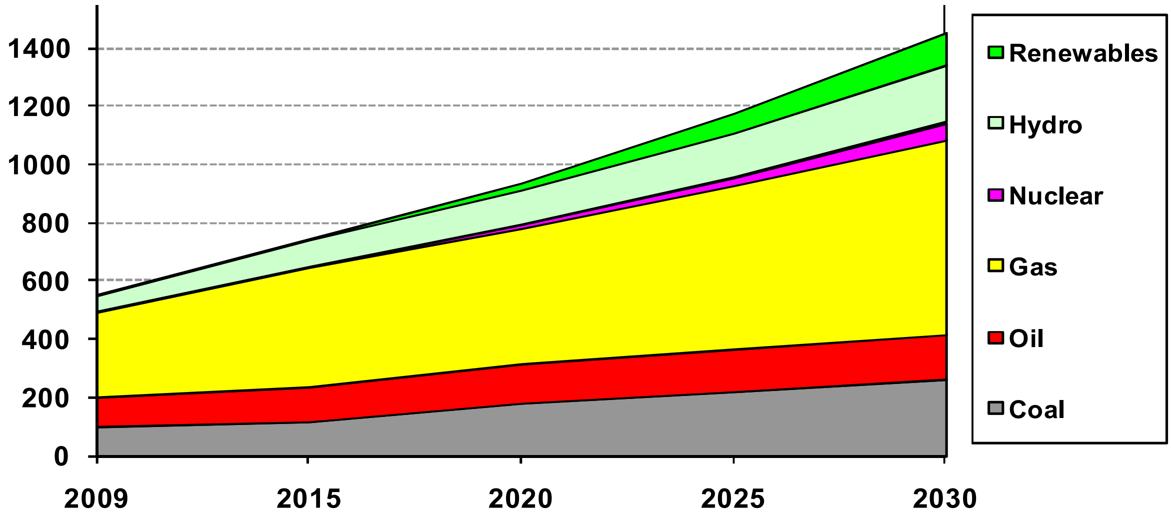


Source: DLR (www.dlr.de).

The installed renewable energy capacity (excluding hydro) has strongly increased since 2000, with average annual growth of over 42%, totalling 1.9 GW in 2009. This trend is due to the spectacular increase in wind power capacity principally in Turkey, Egypt, Morocco and Tunisia. In 2009, total wind power installed in the MED-11 countries accounted for 1.3 GW.

About 11% of the total electricity production in the MED-11 (556 TWh) is currently generated from renewable sources (for a total of 61 TWh) (Figure 30). Hydropower represents its largest share (93.4%) at 57 TWh. The other renewable sources (4 TWh) are wind (4.9%), geothermal (0.7%), solar (0.1%) and biomass (0.1%).[19]

Figure 30. MED-11: Power generation by source by 2030 (TWh)



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Concerning the installed capacity, 19% of the total installed electricity capacity in the MED-11 (119 GW) is generated from renewable sources (for a total of 22.5 GW) (Table 34). Hydropower represents the largest share (93.5%). The other renewable sources are wind (5.7%), geothermal (0.4%), solar (0.2%) and biomass (0.2%) (Table 35).

Among the MED-11 countries, Turkey has the largest percentage of renewable energy. In fact, Turkey has 42% of the total installed wind capacity of the region and 66% of the total hydropower capacity. Renewable energy in Turkey is largely due to its hydropower capacity (14,553 MW out of a total renewable energy capacity of 15,570 MW in 2009) (Table 36). Turkey is followed by Egypt, which has 30% of the MED-11 installed wind capacity and 13% of the MED-11 hydropower capacity, Morocco (9% of the hydropower and 20% of the wind power currently deployed in the region) and Syria.[20]

With the exception of hydropower, the diffusion of renewable energy in the total installed capacity of the region is still marginal (Figures 31 and 32). It started to spread during the 1990s with the development of solar PV for rural electrification purposes. Wind energy projects have been implemented since 2000 in Turkey (483 MW), Egypt (425 MW), Morocco (280 MW) and Tunisia (57 MW).

[19] IEA, *Energy Balances of Non-OECD Countries*, OECD/IEA, Paris, 2012(b).

[20] Ibid.

Table 34. Renewable energy in the MED-11 – Power plants installed in 2009 (MW)

	Coal	Oil	Gas	Hydro	RE (excluding hydro)	Total	% RE + hydro
Algeria	0	239	10858	228	28	11352	2,3
Egypt	0	2316	18213	2842	441	23812	13,8
Libya	0	3843	2430	0	1,5	6274	0,0
Morocco	1785	1701	850	1748	286	6370	31,9
Tunisia	0	1090	2269	66	59	3484	3,6
Turkey	10459	3115	14204	14553	1017	43348	35,9
OSE	4840	10115	7958	1176	69	24158	5,2
MED-11	**17084**	**22419**	**56782**	**20613**	**1901**	**118798**	**19,0**
% Share	14	19	48	17	1,6	100	19,0

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 35. Renewable energy in the MED-11 – Installed power generation capacity (MW)

	2009	2015	2020	2030	Additional by 2030
Hydro	20613	23582	28600	*36330*	15717
Renewables	1901	8227	25025	*57606*	55705
RE + hydro	22514	31809	53624	*93936*	71422

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

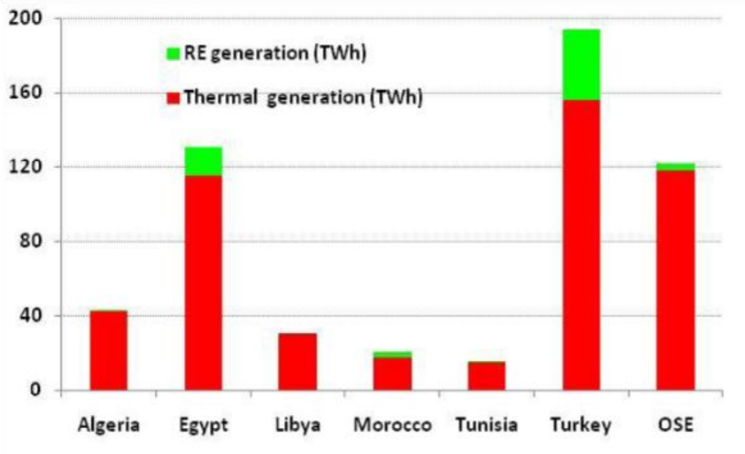
Table 36. MED-11 Renewable energy power capacity by country in 2009 (MW)

Country	Renewable energy (including hydro)	Total
Algeria	256	11353
Egypt	3283	23812
Libya	1,5	6274,5
Morocco	2034	6370
Tunisia	125	3484
Turkey	15570	43348
Other S&E	1245	24158
MED-11	**22515**	**118799**

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

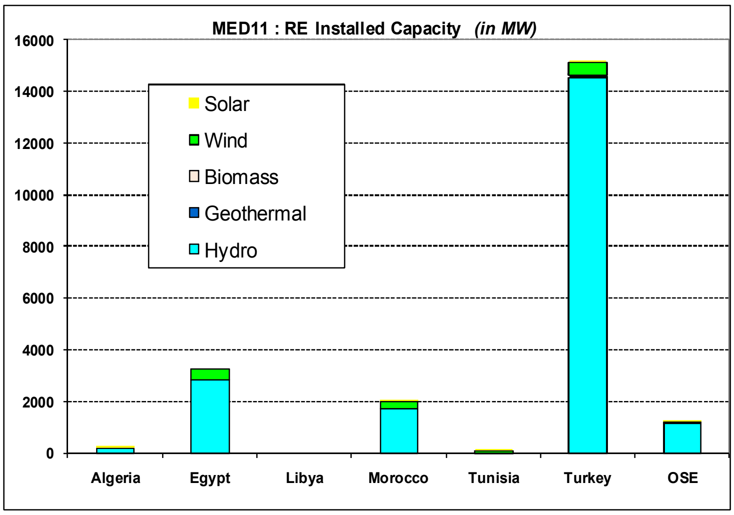
Most recently, projects on CSP (integrated with combined cycles) have been developed in some countries of the region. Integrated solar combined cycle plants have recently been commissioned in Algeria (a 150 MW plant with a solar component of 30 MW, Hassi R'Mel, commissioned in 2011), Egypt (a 150 MW plant with a solar component of 30 MW, El-Kureimat-Borg El Arab, commissioned at the end of 2010), and Morocco (472 MW in Ain Beni-Mathar in 2009). Other projects are still under development in Algeria (150 MW in El Oued and 150 MW in Beni Abbes), in Egypt (100 MW in Kombo Ombo) and in Morocco (500 MW in Ouarzazate, 500 MW in Al Oued Foum, 100 MW in Boujdour and 500 MW in Sabkhat), which are planned to be commissioned during the second half of this decade.

Figure 31. Renewable energy generation and thermal generation in the MED-11 (2009)



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Figure 32. Renewable energy installed capacity in the MED-11 by country (2009)



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

There is a marked diversity among MED-11 countries in terms of their initial benchmarking for the development of investment climates favourable to renewable energy sources. This is seen in key indicators, such as the imposition of national targets for renewable energy penetration of the respective energy balances over the period to 2020. Some MED-11 countries have fairly unambitious targets (e.g. 10% for Israel and Jordan), while others are aiming at a significant contribution from renewable energy sources and the attendant potential for renewable-based exports (e.g. 42% for Morocco).

In many cases, however, there appears to be a lack of clarity as to whether the targets are binding or merely indicative. Some MED-11 countries maintain that a government target that is contained in a policy statement has the force of a binding target. Algeria is such a case. Legal and regulatory bases that range from adequate to good for renewable energy exist in Israel, Morocco, Jordan and Algeria, but for instance in Palestine there remains much scope for development. Still, even in this case there is a regulatory organisation, which is proceeding well in establishing a sound regulatory basis for the promotion of renewable energy.

The most prevalent support mechanism, feed-in tariffs (FITs), are operated in some MED-11 countries (e.g. Israel) while not yet in others (e.g. Morocco, Algeria, Jordan). Tunisia provides access to the grid for renewable energy autoproducers. In all MED-11 countries the imposition of a FIT regime is under active consideration by the governments and regulatory organisations. There is no clear regional pattern in the preferred mechanisms for renewable energy support (e.g. tariff support, fiscal incentives, premium FITs, etc.) and in some cases various other support options are under consideration, but so far without decision (e.g. Algeria and Jordan). In certain cases, some regulatory gaps are found to exist, e.g. there is no priority access and treatment for renewable energy sources in Morocco or in Israel, although in some countries, for instance Algeria, such promotional regulatory mechanisms are well advanced. There appears to be a region-wide lack of soft support schemes, information and public awareness in almost all the MED-11 countries. These appear to have a low priority although high quality information and informing citizens of the benefits of renewable energy sources is an essential component for gaining public acceptance.

In summary, while MED-11 countries in general share common objectives to promote renewable energy sources, there is a proliferation of national approaches and targets that the national roadmaps are designed to harmonise according the EU's best practice, based on the 2009 Renewable Energy Directive (2009/28/EC), thus preparing the ground for enhanced regional interaction. Detailed proposed activities at a country level are contained within the national roadmaps to address such harmonisation.

2.2 Renewable energy: Future scenario

MED-11 countries have set different renewable energy targets (Table 37). The MEDPRO Energy Reference Scenario, which is based on identified announced and committed projects and targets by the countries, assumes that the region could gain 31.5 GW of additional renewable energy capacity by 2020, thus reaching an installed capacity of 54 GW (29 GW hydro and 25 GW of other renewable energy systems excluding hydro). By 2030, projecting into the future the targets announced by individual countries, we assume in our Energy Reference Scenario that MED-11 countries would have approximately 36 GW (+16 GW compared with 2009) of hydro and 58 GW (+ 56 GW) of other renewables. The total installed capacity of renewable energy would thus reach 94 GW (+71 GW).

Table 37. MED-11 national targets on renewable energy

Country	National targets
Algeria	By 2020, 15% of total electricity will be generated from renewable energy sources (RES) by 2020. This share is expected to increase to 40% by 2030.
Egypt	It is envisaged that 20% of total electricity generated will be from RES in Egypt by 2020. These targets were approved, supported and mandated by the Supreme Energy Council of Egypt.
Israel	According to Resolution No. 4450 dated 29 January 2009, 10% of total electricity generated is to come from RES by 2020, and a progressive 5% target by 2014 has been established by an additional Resolution (No. 3484) dated 17 July 2011. The stated targets do not present legally binding obligations but have a declaratory non-binding nature.
Jordan	There is a target of 7% for the share of renewable energy in primary energy by 2015 and 10% by 2020. To achieve this target, by 2020, the Ministry of Energy and Mineral Resources expects to develop 600 MW from wind power, 600 MW from solar power and 30–50 MW from waste.
Lebanon	By 2020 a total of 12% of electricity and thermal energy is to be produced from renewable energy in Lebanon. The stated target has been declared formally by the government and reconfirmed in the National Energy Efficiency Action Plan that was developed by the Lebanese Center for Energy Conservation and approved by the government in 2011 as the main roadmap for energy efficiency and renewable energy for the years 2011–15.

Table 37. cont'd

Morocco	According to the National Energy Strategy, 42% of total installed capacity is to come from RES by 2020. The targets are defined per RES source. In addition, there are targets for 12% of energy efficiency by 2020 mainly in the building, industry and transportation sectors and 1.7 million sq of solar water heating by 2020.
Syria*	Two scenarios are being updated. In the alternative scenario, the share of the installed renewable energy will be 15% in 2030 compared with 1% for the energy reference scenario. Also, 5,000 MW of RE installed capacity is expected by 2030 (2,000 MW for wind, 2,000 MW for PV and 1,000 MW for CSP).
Tunisia	By 2016, 16% of total power generation capacity is to come from RES and 40% in 2030. The defined targets are not binding. Specific targets have been defined for different RES sources (for details see the next section).
Libya**	The share of renewable energy in installed power generation capacity is to be 6% in 2015 and 10% by 2020.

* Data for Syria derived from the 'MEERE Report' by GTZ and NERC (2010).

** Data for Libya derived from Ekhlat (2012) and from UNECA & General Secretariat of the Arab Maghreb Union (2012), p. 26.

Sources: Except where otherwise specified, data derived from the *National Road Map[s] for Legal and Regulatory Reform* (PWMSP, 2012a).

In absolute terms, Turkey, Algeria, Egypt and Morocco are planning the largest increases of renewable energy capacity. Renewable energy excluding hydro is expected to increase by 2030 in Turkey by some 21 GW, in Algeria by some 12 GW, in Egypt by some 8 GW and in Morocco by some 4 GW (Tables 38 and 39). In relative terms, Israel shows the most ambitious increase of renewable energy capacity in the region. Israel's goal of an additional 2.25 GW of renewable energy capacity would represent a hundred-fold increase, compared with the last available data of 2007. Syria also has a strong commitment to increase its renewable energy capacity, with a target to triple its current installed capacity by 2020.[21] All the countries focus mainly on wind and solar energy.

Table 38. Renewable energy power plants to install by 2030 (MW)

	2009		**2030**		
	Hydro	**RE (excl. hydro)**	**Hydro**	**RE (excl. hydro)**	**RE additional by 2030**
Algeria	228	28	418	12002	12164
Egypt	2842	441	3071	8022	7810
Libya	0	1,5	0	2950	2949
Morocco	1748	286	2700	4260	4926
Tunisia	66	59	66	2504	2445
Turkey	14553	1017	27000	21396	32826
OSE	1176	69	3075	6473	8303
MED-11	**20613**	**1901**	**36330**	**57606**	**71422**

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

[21] Information on Syria derived from the 'MEERE Report' by GTZ and NERC (2010) and PWMSP Project Consortium, *Report on the infrastructure requirements by 2020, Country Report: Syria*, 2011(b) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/Country_report-Syria-activity_1_4-1.pdf).

Certain countries could install more significant capacities of renewable sources, such as Turkey (20 GW), Algeria (>10,000 MW), Egypt (>7,000 MW), Morocco (>4,000 MW), Syria (potential of 5,000 MW), Libya (3,000 MW), Tunisia (2,500 MW), Israel (>200 MW) and Palestine (110 MW).

Table 39. MED-11 by 2030: Power plants installed in 2030 (MW)

	Coal	Oil	Gas	Nucl.	Hydro	RE (excl. hydro)	Total	% RE + hydro	RE + hydro
Algeria	0	405	18150	0	418	12002	30975	40	12420
Egypt	0	8000	45591	2000	3071	8022	66684	17	11093
Libya	0	1600	10000	0	0	2950	14550	20	2950
Morocco	5195	2100	1450	1021	2700	4260	16726	42	6960
Tunisia	0	960	5787	700	66	2504	10017	26	2570
Turkey	29043	3135	28246	4500	27000	21396	113320	43	48396
OSE	9600	19500	20000	1000	3075	6473	59648	16	9548
MED-11	**43838**	**35700**	**129224**	**9221**	**36330**	**57606**	**311919**	**30**	**93936**
% Share	14	11	41	3	12	18	100	79,3	79

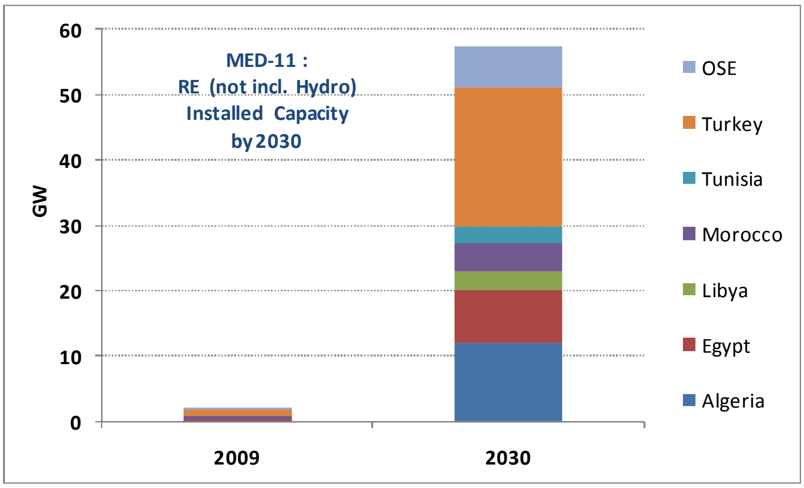
Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Table 40. MED-11 installed power generation capacity (MW)

	2009	2015	2020	2030	Additional by 2030
Coal	17084	21486	26524	43838	26754
Oil	22419	28100	31185	35700	13282
Gas	56782	74653	87256	129224	72442
Nuclear	0	0	1800	9221	9221
Hydro	20613	23582	28600	36330	15717
Renewables	1901	8227	25024	57606	55705
MED-11	**118798**	**156048**	**200389**	**311919**	**193120**

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

Figure 33. MEDPRO Reference Scenario: Installed capacity of renewable energy in 2009 compared with projections for 2030 (excluding hydro)



Source: Own elaborations for the MEDPRO Energy Reference Scenario.

2.3 National programmes for renewable energy in MED-11 countries

2.3.1 Algeria

The solar potential in the country is very high; the average energy received per year over the surface of the country is 170,000 TWh.[22] The Sahara region is especially rich in this respect. With its ideal location, Algeria has the largest solar potential in the world. The average annual duration of sunshine on Algerian territory exceeds 2,000 hours, to reach 3,500 hours of sunshine in the Sahara desert, which represents 86% of the Algerian territory.

The wind potential varies according to the geographical situation, so in the north of the country, the wind potential is characterised by an average speed of moderate winds (1-4 m/s). This potential energy is ideal for pumping water particularly on the highlands. In the south, the average wind speed exceeds 4 m/s, notably in the southwest, where average wind speeds exceed 6 m/s in the region of Adrar.

There is substantial geothermal potential in Algeria. More than 200 hot springs were surveyed in the north of the country. About one-third (33%) of them have temperatures above 45°C. Further south there is a vast geothermal reservoir extending over several thousand km^2. This reservoir is commonly called the 'Albian table' and has an average temperature of 57°C. The total potential of the geothermal resource in terms of electricity generation is estimated at 700 MW.

There are many dams on the rivers of Algeria, but they are mainly used for irrigation and drinking water and produce little power. The share of hydraulic capacity in power production is 5% (installed capacity of 286 MW).

The biomass potential is relatively limited. In broad terms Algeria is divided into two parts. The wooded areas cover about 250 million hectares or a little more than 10% of the total area of the country. The Saharan areas cover almost 90% of the territory. In the north of Algeria, forests cover 1.8 million hectares and scrub around 1.9 million hectares. The total theoretical biomass potential is estimated at 37 million toe, of which about 10% may be recoverable. Some 5 million tons of urban and agricultural waste are produced each year. The theoretical energy potential is about 1.33 Mtoe/year.

Recognising the increasing interest in renewable energies and their issues, Algeria integrated their development into the national energy policy, by the adoption of a legal framework favourable to the development of these energies, the realisation of infrastructure in this domain and the planning of important projects. An important programme was conducted on behalf of the steppe zone of the highlands, in which more than 3,000 homes were electrified with solar and benefited from irrigation equipment by solar and wind. In addition, as part of the national rural electrification, 18 villages of the far south have also been electrified with solar. In terms of renewable electricity, the cumulated production in the period 2011–30 is expected to be more than 400 TWh (60 TWh of which in 2030). The objective of penetration in the national electric balance is estimated at 40% in 2030. This objective could possibly be revised upwards depending on the cost, the progress in the manufacturing of equipment, budgetary constraints and technological progress. According to the MEDPRO Reference Scenario, by 2030 about 2,000 MW will be produced from wind, 2,800 MW from solar PV and 7,200 MW from solar thermal in the country (Table 41).

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[22] All the information in this subsection is derived from PWMSP Project Consortium, *Benchmarking of existing practice against EU norm, Country Report: Algeria,* 2011(a) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/Algeria.pdf) and Ministry of Energy and Mines (Algeria) and Sonelgaz, *Renewable Energy and Energy Efficiency Program*, Algiers, March 2011.

Table 41. MEDPRO Energy Reference Scenario for renewable energy – Algeria

ALGERIA - REFERENCE SCENARIO	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**2**	**43**	**71**	**113**	**7,7%**	**6,2%**	**4,7%**
Hydro	0	0,3	0,3	0,3	1,1%	1,9%	-0,7%
Renewables	**0**	0,01	**12**	**30**		93,9%	47,9%
Wind	*0*		*1*	*4*			
Solar PV	*0*	*0,01*	*3*	*7*		69,4%	37,9%
Solar Thermal	*0*		*8*	*19*			
Installed Capacity - MW	**0**	**11352**	**19082**	**30975**		**7,7%**	**4,9%**
Hydro		228	394	418		4,1%	2,9%
Renewables	**0**	28	**4821**	**12002**		96,9%	33,5%
Wind		*0,08*	*520*	*2 000*			62,2%
Solar PV		*3*	*1 100*	*2 800*		72,1%	38,9%
Solar Thermal		*25*	*3200*	*7200*			31,0%

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

2.3.2 Egypt

Hydropower in Egypt has been the dominant renewable energy resource, but its current potential is fully utilised. As a result of the continued growth of the energy supply, its stable absolute size is dwindling as a share of Egypt's total energy supply. Hydropower has hit a natural constraint, which cannot be addressed through policy interventions or further investments. Egypt is competitive in other renewable energy resources because of its natural endowments, infrastructure, human resources and proximity to potential export markets. For example, Egypt is the best positioned in the Mediterranean basin to exploit solar resources (DLR, 2005). Exploitation of these resources, however, falls behind the full potential and performance of other countries.

Egypt enjoys excellent wind energy potential. There are ambitious plans for the expansion of wind energy, and the costs are attractive compared with solar energy. Since 2001, a series of large-scale wind farms has been established with a capacity of 550 MW in cooperation with Germany (KfW), Denmark (DANIDA), Spain and Japan (JICA). Energy subsidies are prohibiting the normal development of the industry, which should be expanding its supply, maximising efficiency, improving quality and investing in appropriate R&D. Despite this, plans are proceeding for tenders that will expand wind energy generation in Egypt. Moreover, there are market rumours than CSP might follow suit. Additionally, the Unified Electricity Law, currently in draft form, is establishing a framework that will be more conducive to the expansion of renewable resources.

According to the report by the project "Paving the Way for the Mediterranean Solar Plan" published in 2011, it is officially confirmed that

> Egypt's power sector is estimated to have a peak demand of around 40,000 MW in year 2020 and 60,000 MW in year 2030. The corresponding installed capacity, according to the Ministry of Energy and Electricity (MoEE)/EEHC expansion plan will be 46,000 and 70,000 MW, respectively. The current capacity expansion needs are in the range of 1,000–1,200 MW annually. It is becoming more difficult for the government/MoEE to secure funds for these projects. Most of the government generation projects so far have secured funds through soft loans, which might not be the case in the future. The Strategy of Egypt sets out objectives and targets and defines the combinations of policy instruments that are expected to achieve the targets. The Supreme Council of Energy in February 2008 approved a plan to satisfy 20% of the generated electricity from renewable energy by 2020, including a 12% contribution from wind energy. This figure translates into about 7,200 MW of grid-connected wind farms and an 8%

contribution from other sources, mainly hydro and solar energy. The new electricity law 'under ratification' has adopted three mechanisms for power generation from renewable sources (grid-connected wind farms). These mechanisms are plants built by NAREA (2,200 MW), plants built through competitive bidding (2,500 MW) and plants built through the feed-in tariff (2,500 MW).[23]

Table 42. MEDPRO Energy Reference Scenario for renewable energy – Egypt

EGYPT - REFERENCE SCENARI	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**8**	**131**	**208**	**286**	**7,4%**	**4,7%**	**3,8%**
Hydro	5	15	18	18	2,8%	1,6%	1,1%
Renewables	**0**	1	**7**	**23**		20,7%	16,4%
Wind	*0*	*0,93*	*6*	*21*		19,8%	16,1%
Solar PV	*0*	*0,03*	*0,1*	*0,2*		8,7%	7,7%
Solar Thermal	*0*		*0,4*	*1,5*			
Installed Capacity - MW	**0**	**23812**	**45470**	**66684**		**6,6%**	**5,0%**
Hydro		2842	3071	3071		0,7%	0,4%
Renewables	**0**	441	**2376**	**8022**		20,2%	14,8%
Wind		*425*	*2100*	*7200*		19,2%	14,4%
Solar PV		*16*	*25*	*80*		8,7%	8,0%
Solar Thermal			*214*	*650*			

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

2.3.3 Libya

Libya is a traditional oil-exporting country with 6 million inhabitants distributed over an area of 1,750,000 km^2. In spite of a large national electric grid (high voltage, medium voltage and low voltage network), there are many villages and remote areas located far away from these networks. Economically these areas cannot be connected to the grid, owing to its small population and the small amount of energy required. In the past, these facts dictated the use of diesel generators as a power supply. The use of diesel generators involves continuous maintenance and a continuous supply of fuel. For these reasons, renewable energy could be a solution to the problems.

Libya has significant wind and solar energy potential. According to Chouireb (2011), in 2004 measurements of the wind speed statistics were conducted and showed that there is high potential for wind energy in Libya. The average wind speed at a 40 m height was between 6-7.5 m/s. The region around the city of Misurata would have the highest realisable energy output. Before the war, Libya's goal was to install up to 10 MW of wind turbines. The region with the highest amount of solar radiation is located in the south of Libya. The accessible radiation depends not only on global radiation, but also cloud coverage and exposure are very important.

A study for the Center of Global Development has proposed building CSP plants in the northwest area between Ghadamis and Al Quaryah Asharqiyah. Before the war, 1.3 MW of PV capacity had been installed in Libya, and especially decentralised electricity generation in rural areas had been encouraged. Photovoltaics are also used in agriculture to supply water pumps with electricity instead of using diesel. The plan was to install an overall PV capacity of 10 MW by 2011. The Renewable Energy Authority of Libya (REAOL) was founded to promote the development of renewable energy in

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[23] See PWMSP Project Consortium, *Benchmarking of existing practice against EU norms, Country Report: Egypt,* 2011(a) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/Egypt.pdf).

Libya. REAOL has set a target to cover 10% of Libya's energy supply from renewable energy resources by the year of 2020 and 30% by 2030. To meet these objectives, REAOL has developed a roadmap for the expansion of renewable-energy production capacity. REAOL handed the roadmap over to the Ministry of Electricity and Energy. The ministry, which was disbanded in 2008, approved the roadmap.

Libya has a good wind regime (around 7 m/s) especially in the north. The daily average of solar radiation on a horizontal plane is 7.1 kWh/m^2/day in the coastal region and 8.1 kWh/m^2/day in the southern region, with average sun duration of more than 3,500 hours per year. CSP and PV are therefore promising in the future. It shows also that the total installed capacity of these three technologies can reach about 10 GW with about 35 TWh electricity generation in the year 2050 (El Sayed Shaaban, 2011). REAOL has targeted a 6% renewable energy share of installed power generation capacity by 2015, and a 10% renewable energy share by 2020. Wind farm projects within the mid-term (2015) plan concern 750 MW wind, 100 MW CSP and 50 MW PV and 140 MW of solar water heating. According to the plan, Libya intended to install 1,500 MW of wind, 800 MW of CSP, 150 MW of PV and 300 MW of solar water heating by 2020. The MEDPRO Energy Reference Scenario assumes a somewhat slower penetration of renewables in Libya, reaching the originally planned 2020 levels around 2028 and 2030 (Table 43).

Table 43. MEDPRO Energy Reference Scenario for renewable energy – Libya

LIBYA - REFERENCE SCENARIO	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**0**	**31**	**45**	**56**	**11,4%**	**5,3%**	**3,0%**
Hydro	0		0	0			
Renewables	**0**	0	**2**	**6**		28%	20%
Wind	*0*	*0,1*	*1,7*	*4,0*		28%	19%
Solar PV	*0*	*0,02*	*0,1*	*0,4*		15%	15%
Solar Thermal	*0*		*0,2*	*2,0*			
Installed Capacity - MW	**0**	**6274**	**9730**	**14550**		**3,8%**	**4,1%**
Hydro			0	0			
Renewables	**0**	1	**900**	**2950**		79%	44%
Wind		*0,2*	*750*	*1750*		110%	54%
Solar PV		*1,3*	*50*	*200*		40%	27%
Solar Thermal			*100*	*1000*			

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

2.3.4 Morocco

Morocco enjoys important national resources in the form of wind, hydro and solar that are as yet scarcely exploited. Wind is especially attractive in the medium term. Morocco has an excellent wind potential mainly in the north and south. Essaouira, Tangier and Tetouan have an annual average of between 9.5 and 11 m/s at 40 meters, while Tarfaya, Taza and Dakhla have an annual average of between 7.5 m/s and 9.5 m/s at 40 meters.

The government estimates that the potential for development in the medium term is 7,300 MW. Of this resource, it is calculated that wind energy can be developed the most quickly and cheaply. According to the Centre de développement des énergies renouvelables (CDER) the results of a study conducted with GIZ show the wind potential is 5,290 TWh/year (2,645 GW) and the technical potential is 3,264 TWh/year (1,632 GW).[24]

According to the report published by the project "Paving the Way for the Mediterranean Solar Plan", the development of these resources would contribute to the realisation of the national objectives of security of supply and the reduction of GHG emissions.[25] This potential is clearly recognised in the comprehensive strategy for the energy sector that was published in March 2008 and which contains quite specific targets for renewable energy. It is intended that renewable energy will account for 8% of primary energy supply by 2012 and 18% of the supply of electricity. An indicative list of priority renewable energy projects has been established, including 1,000 MW of generating capacity from wind. The plants will be mainly IPPs. The PNAP also includes measures aimed at rehabilitating the assets of the public utility ONE and optimising production for the hydro plant.

In November 2009 the government announced a most ambitious programme for renewable energy, known as the Integrated Solar Energy Generation Project. Under this plan, the part of installed capacity of renewable energy in the power system will represent 42% of total installed capacity by 2020. The essence of the project is a proposal to generate electricity from installations working on the basis of CSP. The aim of the CSP component is an installed capacity of CSP of 2,000 MW by 2019 on five sites covering 10,000 hectares. The investment will be comprised of 3 x 500 MW plants and single plants of 100 MW and 400 MW. The 400 MW plants are located; the capacity created would be equal to 38% of the current total installed capacity in Morocco. The generation from these plants would be 4,500 GWh per year, corresponding to 18% of the current annual generation. The cost, as estimated in the solar plan, would be 70 billion Moroccan dirhams ($9 billion). The schedule is demanding; the first plant is to be commissioned in 2015 and the final component by the end of 2019. It is envisaged that the programme would save approximately 1 million toe per year, with a value at present prices of about $500 million dollars and would save about 3.7 billion tonnes of CO_2 emissions each year. A dedicated agency was created in 2009 for the implementation of this plan, known as Moroccan Agency for Solar Energy (MASEN). The tasks of the agency are to manage the overall project, including design, choice of operators and implementation, and to coordinate and supervise all the other activities related to this programme. The first request for proposals was issued in 2010. At the time of writing five proposals received were being evaluated. Finance for the venture is expected from the Moroccan state, the Hassan II Fund for Economic & Social Development, energy investment companies and the Office National de l'Electricité (PWMSP, 2011a).

Ouarzazate's 500 MW solar project is the first concrete step of the Moroccan Solar Plan. The construction of the first phase of the project (160 MW), awarded on 24 September 2012 by MASEN to a Saudi Arabian consortium (ACWA International Power, with Spanish companies Aries and TEK), will start soon in the fourth quarter of 2012, and the overall project should be completed by 2015.

There is also progress at the regional level. GIZ is supporting a project to create master plans for renewable energy in three regions of the country. In Morocco there is no legal obligation to achieve a predefined target; apart from the 2,000 MW solar initiative and the 2,000 MW wind energy programme, there are no other targets. It is important to mention that the former initiatives are clearly defined and the task to implement the different projects related to the two programmes is clearly attributed to MASEN, ONE and SIE. Achieving the 2,000 MW solar and wind initiatives is the responsibility of the designated agencies to implement the programme and the deployment schedule is their responsibility.

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[24] See PWMSP Project Consortium, *Benchmarking of existing practice against EU norms, Country Report: Morocco*, 2011(a) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/Morocco.pdf).

[25] Ibid.

Table 44. MEDPRO Energy Reference Scenario for renewable energy – Morocco

MOROCCO - REFERENCE SCENARIO	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**2**	**21**	**46**	**76**	**5,9%**	**7,8%**	**6,4%**
Hydro	1	3,0	2	3	1,8%	4,6%	0,6%
Renewables	**0**	0,4	**5**	**10**		29,2%	16,7%
Wind	*0*	*0,39*	*3*	*5*		23,6%	13,2%
Solar PV	*0*	*0,001*	*0,1*	*0,3*			30,4%
Solar Thermal	*0*		*2*	*5*			
Installed Capacity - MW	**0**	**6370**	**11326**	**16726**		**7,3%**	**4,7%**
Hydro		1748	2369	2700		2,9%	2,1%
Renewables	**0**	286	**2060**	**4260**		30,1%	13,7%
Wind		*255*	*1100*	*2100*		22,9%	10,6%
Solar PV		*6*	*50*	*146*			16,4%
Solar Thermal		*25*	*900*	*2000*			23,2%

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

2.3.5 OSE countries

2.3.5.1 Israel

The Government of Israel supports the development of power projects fuelled by the sun's clean, abundant and renewable energy, and undoubtedly has taken substantial steps towards advancing the use of renewable energy:

i) setting a guiding target for producing electricity from renewable sources at a level of 10% of the county's energy requirements by 2020. (Once achieved, it would be equivalent to approximately 2,250 MW RE capacity, including 140 MW of biomass, 1,060 MW of wind and 1,050 MW of PV installations);

ii) acting towards construction of renewable energy-based power stations, especially in the Negev and Arava areas, at a scope of no less than 250 MW every year from 2010 until 2020; and

iii) determining an interim target of 5% for generating electricity from renewable energy during 2014.

The Planning Authority will cooperate with the Electricity Authority, the Ministry of National Infrastructure, the Ministry of Environmental Protection, the Israeli Land Authority and the Ministry of Defence to identify land lots suitable for the construction of power plants based on renewable energies. The National Council will approve a national outline plan, which will mark sites suitable for the construction of at least 500 MW within a year and a half from the government's decision. The national council will act to approve the national outline plan subject to amendments and recommendations by the team of NOP 10 editors, within four months of it being submitted to them. The Public Utilities Authority will examine tariffs and criteria for applying the government's policy of encouraging construction of electricity production plants from renewable energies at a total volume of 500 MW for the first phase. After realisation of 350 MW, the tariffs will be re-examined.[26]

2.3.5.2 Gaza/West Bank

The Palestinian Energy and Environment Research Centre (PEC), established in 1993, conducts research on increasing the efficiency of energy usage and developing renewable energy in Gaza/West

[26] PWMSP Project Consortium, *Benchmarking of existing practice against EU norms, Country Report: Israel*, 2011(a) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/Israel.pdf).

Bank. According to the general-directorate of the centre, the use of solar energy for water heating is already common in the area and the latest survey on household energy by the Palestinian Central Bureau of Statistics indicates that over 60% of households use solar water heaters.[27] In addition to solar technology there are many substantial forms of renewable energy in use in Gaza/West Bank. Only biomass, as a use of agricultural waste for heating and cooking, is common in rural areas.

2.3.5.3 Jordan

According to the National Energy Research Centre (NERC), Jordan has huge potential for renewable energy utilisation. Among existing renewable energy plants are a 1 MW biogas plant that utilises methane from organic waste decomposition for electricity production and two wind farms with a total capacity of around 1.5 MW at Hofa and Al-Ibrahmiyah in the north of the country. In 2006, both wind farms generated a total of 3 GWh of electricity. Solar energy is mainly used for water heating. There are around 25 Jordanian manufacturers of solar water heating systems. The total area of installed systems in the country in 2006 is estimated at 661,500 m^2, generating about 485 GWh per year. The current penetration rate in households is estimated at 14%. Until 2015, the dissemination of solar water heaters shall be increased by installing an area of 50,000 m^2 of solar panels annually. The government has set ambitious targets to increase the contribution of renewable energy sources to the national energy supply. The share of renewable energy in the total energy mix shall reach 7% by 2015 and 10% by 2020, including 600 MW of wind energy projects and 300-600 MW of thermal solar projects. The implementation of the renewable energy targets as well as the elaboration of policy strategies is under the auspices of the Renewable Energy and Energy Efficiency Department within the Jordanian Ministry of Energy and Mineral Resources (MEMR) in collaboration with the Ministry of Planning and International Cooperation.[28] The latter is responsible for the acquisition of international funding for energy projects and the development of international projects. The NERC was formed in 1998 to support and conduct research, development and training activities in the fields of renewable energy and energy efficiency. To meet the targets of the energy strategy, in early 2008, the MEMR submitted a draft law for the promotion of renewable energy. It has not yet been adopted. The law includes a priority list for the usage of land with high potential for renewable development, substantial tax exemptions for renewable energy facilities (e.g. from income tax or customs duties) and provisions for establishing the Jordan Renewable Energy and Energy Efficiency Fund.

2.3.5.4 Lebanon

The energy sector in Lebanon has been facing a serious problem with a generation capacity that cannot meet the ever-growing energy demand. This has led to an increasing gap between generation and demand that has left the country struggling with frequent power shortages. Back in 2005, a new milestone was put in place, aiming at the reduction in the demand for energy and in the development of the renewable energy sector, thus creating a more sustainable and environmentally friendly energy sector. It is within this framework that the Lebanese Center for Energy Conservation (LCEC) started its activities under the direct supervision of the Ministry of Energy and Water and the United Nations Development Programme (UNDP). In 2011, and after five years of continual efforts in the energy efficiency and renewable energy sectors, Lebanon issued the first National Energy Efficiency Action Plan (NEEAP) 2011–15. Setting the objectives for the five years to come, the NEEAP includes 14 national initiatives in the different fields of energy efficiency and renewable energy. The NEEAP has set a national objective of 12% of renewable energy by 2020. In fact, the NEEAP includes clear objectives at the level of energy efficient lighting in the residential sector (the national landmark project of 3 million compact fluorescent lamps) as well as the public sector. It also includes a

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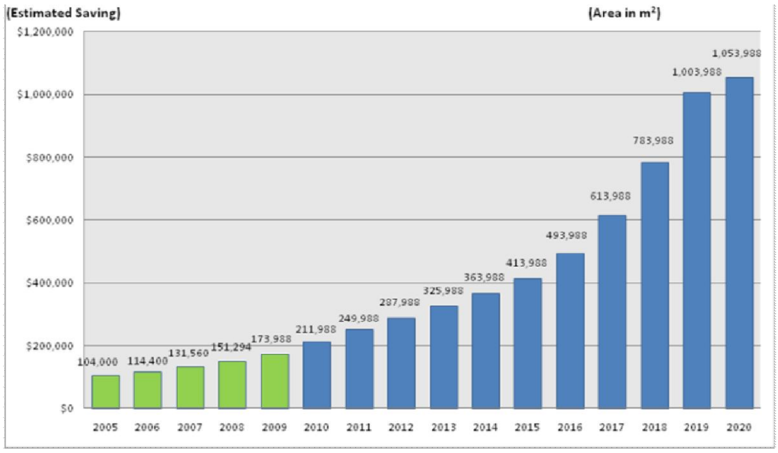
[27] PWMSP Project Consortium, *Benchmarking of existing practice against EU norms, Country Report: Palestine*, 2011(a) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/Palestine.pdf).

[28] PWMSP Project Consortium, *Benchmarking of existing practice against EU norms, Country Report: Jordan*, 2011(a) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/Jordan.pdf).

dedicated initiative aiming at the installation of 190,000 m^2 of new installed collector area over the period 2009–14 (Figure 34). This initiative coincides with the efforts of the UNDP, which launched a national initiative to push for the development of the market for solar water heaters in Lebanon.

Figure 34. Estimated current and future solar installations (2005–20)



Source: "Country under focus: Lebanon", *Newsletter*, No. 6, March 2011 (see RCREEE, 2010-12) (www.rcreee.org/Newsletter/RCREEE_Newsletter_Issue6.pdf).

At the level of renewable energy, the national wind atlas of Lebanon was officially launched in January 2011, showing potential of nearly 1,500 MW for wind power. Wind energy and other types of renewable energy applications are considered major milestones of the national NEEAP.

2.3.5.5 Syria

Hydropower is the only significant renewable energy contribution to Syria's energy supply at present, providing between 2,000 GWh and 4,000 GWh per year, depending on precipitation levels. Two main hydropower plants are installed in Syria: the Al-Thawra Dam (880 MW) and the newly commissioned Teshreen Dam (630 MW). Both are located on the Euphrates, and together provide around 90% of the hydroelectric supply (Table 45).

Table 45. Operating hydropower plants in Syria

Basin / River	Name / Location	Installed Capacity (MW)	Typical Output (GWh/year)
Euphrates	Al-Thawra	880	2,000
	Al-Baath	75	300
	Teshreen	630	1,300
Barada	Wadi-Barada	8	24
Orontes	Al Rastan	8	12
	Shaizer	7	4
Afrin	17th of April	10	40
Al-Khabour	Hassakeh-West	1.2	3.3
Total		**1,619.2**	**3,683.3**

Sources: Al-Alao (1998) as also cited in Aljawabra (2011).

Syria is also endowed with considerable potential for solar energy, which is available in a largely uniform manner across the geographical spread of the country. The average global, horizontal solar radiant flux in Syria is approximately 5 kWh/m^2/day or 1.8 MWh/m^2/year. The average daily radiant flux varies from 4.4 kWh/m^2/day in the mountainous areas in the west to 5.2 kWh/m^2/day in the desert regions. The annual sunshine hours also vary between 2,820 to 3,270 hours/year, according to the mean, annual daily radiation on the horizontal surface (Wh/m^2) at 18 meteorological stations in Syria.

There are several small solar PV systems in Syria on and off grid, with estimated total capacity of 1 MWp; these systems are mainly used for water pumping and lighting (off grid) and some systems are connected to the grid. There is also a factory for PV panel production with production capacity of 15.9 MW/year. The production started in October 2010. The Ministry of Electricity/PEEGT will use the total production of that factory to install small and medium PV grid-connected plants all over the country. NERC has signed a contract with the German company Sunset for the installation of a 1 MWp PV grid-connected plant. This plant consists of five systems, with each system being 200 kWp. There were plans to implement the project last year but it has been postponed with the present situation in Syria. There is no CSP system in Syria to date.[29]

Syria is divided into four main regions depending on the wind speed. The first region (the south and middle of Syria) enjoys wind speeds in access of 11.5 m/s and the other regions have wind speeds in the range of 3.5-10 m/s. To date, there is one small wind turbine in the country, which has had a nominal capacity of 150 kW grid-connected since 1994. NERC has been waiting since April 2011 to sign a contract with Gamesa for the installation of a 50 MW wind park at the northern border of Qatineh Lake in central Syria. This project was awarded to Gamesa in December 2010 with a contract value of €60 million. There are also negotiations between Vestas and the Ministry of Electricity/PEEGT and NERC to sign a contract for the installation of a 90 MW wind park at the border of Qatineh Lake (Table 46).

Table 46. Generation expansion plans until 2020

Name of Plant Site	Type of Plant	Installed Capacity(MW)	Year of Initial Operation	Number of Unit	Location of Plant
TISHREN-steam	Thermal	400	2011	2	SAOUTH
NASREAH-NEW|-CC	combined cycle	450	2012	3	SAOUTH
DIR-ALI-2	combined cycle	750	2012	3	SAOUTH
JANDER-NEW -CC	combined cycle	450	2012	3	Central
Qatineh1	Renewable-WIND Park	50	2013	25	Central
Qatineh2	Renewable-WIND Park	90	2013	30	Central
DER-ALZOUR(TAEYEM)	combined cycle	750	2013	3	EAST
DIZEL-ALEPO IND.	Thermal	200	2014	-	NORTH
DIZEL-NASREAH	Thermal	200	2014	-	SAOUTH
Gabageb	Renewable-WIND Park	50	2014	-	SAOUTH
ADRA IND.3	combined cycle	450	2015	3	SAOUTH
RASEM-ALHMAM	Thermal	1000	2015-2016	4	NORTH
ALHIJANA-Sukhneh	Renewable-WIND Parks	200	2016	-	SAOUTH and Central
SWEDEAH -CC	combined cycle	450	2016	3	EAST
ABO-SHAMAT(GAS)	Thermal	300	2017	2	SAOUTH
NORTH-ALEPPO	COOL	900	2017-2018	4	NORTH
TREFAWY-	Renewable-WIND Park	100	2018	-	NORTH
TREFAWY-CC	combined cycle	450	2018	3	NORTH
LATAKIA-CC	combined cycle	750	2019	3	WEST
HALBIA-ZALBIA	Pump Storage HYDRO PP	1000	2020	10	EAST
Several small solar Plants	Photo-Voltaic	100	2011-2020	-	-

Source: PWMSP Project Consortium, *Benchmarking of existing practice against EU norms, Country Report: Syria* (2011a) (www.pavingtheway-msp.eu/fileadmin/paving-the-way/Syria.pdf).

[29] PWMSP Project Consortium, *Benchmarking of existing practice against EU norms, Country Report: Syria*, 2011(a) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/Syria.pdf).

2.3.6 Tunisia

Tunisia produces about 66 MW from hydropower and 55 MW from wind turbines. Wind power is considered the most promising renewable pathway. Before the events relating to the Arab Spring unfolded, the government's plan was to ramp up wind power capacity to 240 MW by 2012. A 120 MW wind farm is under construction in Bizerte in north Tunisia. With regard to solar energy, the Tunisian government puts a strong focus on solar water heaters. PV modules have been installed in 12,500 households and 200 schools in rural areas. Furthermore, PV pumping applications are relatively developed in Tunisia, with a total existing capacity of 255 MW.

In recent years STEG has carried out the tenders for the construction of the combined cycle single shaft-type plant in Sousse (with a total capacity of between 380 MW and 450 MW) as well as a study of the technical feasibility of a solar thermal power plant. The terms of reference of the study include the construction of a solar thermal power plant of 25 MW and the opportunity to study the building of a 10 MW PV power plant.

The XIIth Plan[30] for the period 2012–2016 developed before the Arab Spring events provides for commissioning in 2013 of a combined cycle 400 MW-level plant in Sousse, in 2014 of a combined cycle plant of 400 MW in the north with 400 MW optional (depending on the progress of major planning projects) and in 2016 the central project of 1,200 MW ELMED, including 400 MW for the Tunisian market.

To further expand national renewable energy production, the Tunisian government adopted in September 2009 a policy entitled "Plan Solaire Tunisien".[31] The plan aims at reducing energy use by 22% by 2016 through an expansion of renewable energy production. The solar plan encompasses a total of 40 technology projects. The project portfolio is not limited to solar energy but also includes wind energy projects and energy efficiency initiatives. In the field of solar energy, projects for solar thermal applications as well as decentralised and centralised power generation are being pursued. The Tunisian Solar Plan would prevent the issuance of 1.3 million tonnes of CO_2 per year, and also save 100 Mtoe by 2030. The project requires expensive facilities and significant investments in the long term (the estimated cost is $2 billion). The Tunisian Solar Plan would fit into two wider regional programmes: the Mediterranean Solar Plan and DESERTEC. The plan includes more than 40 renewable energy projects (to be developed between 2010 and 2016), notably the construction of a 50 MW CSP plant integrated with a combined cycle gas-turbine power plant of 150 MW, and two PV power plants of 10 MW.

The Tunisian Solar Plan will not exclusively cover solar energy, but also such complementary areas as wind energy, energy efficiency, electrical interconnection with Italy and the manufacture of PV panels. Private firms and public companies, also supported by international funds, would mostly conduct the project. The main component of the Tunisian Solar Plan is to build a solar power plant with a capacity of 1.2 GW and an installed capacity of 1 GW. The plant would export two-thirds of its production to Italy. In this regard, Tunisia has confirmed its involvement in DESERTEC and aims at becoming an international platform for the production and export of solar power.

The Tunisian Solar Plan will create new job opportunities, thereby reducing unemployment in the country (the unemployment rate in Tunisia was around 14% in 2009). Projects for centralised power generation add up to a capacity of approximately 100 MW for CSP plants and 20 MW for PV operations. Furthermore, the government aims at establishing manufacturing capacities for PV modules with a total capacity of 14 MW per year. The capacities of all planned wind power projects cumulate to 280 MW. Mitsui Engineering is seeking to build a tower-type CSP plant with a capacity of 5 MW in El Borma in southern Tunisia after conducting a feasibility study next year under a joint

[30] AfDB, *Tunisie - Document de stratégie pays intérimaire 2012-2013*, AfDB, Tunis-Belvedère, 2012.

[31] See the website article by the Tunisian National Agency for Energy Conservation (ANME), "Le plan solaire tunisien (PST)", at http://www.anme.nat.tn/index.php?id=101.

project of the Japanese and Tunisian governments. The El Borma plant will be combined with a 39 MW gas turbine combined cycle. In addition, the Tunisian government is also working on solar water heating, and is showing great success especially after implementing the PROSOL Tunisia programme.

Table 47. MEDPRO Energy Reference Scenario for renewable energy – Tunisia

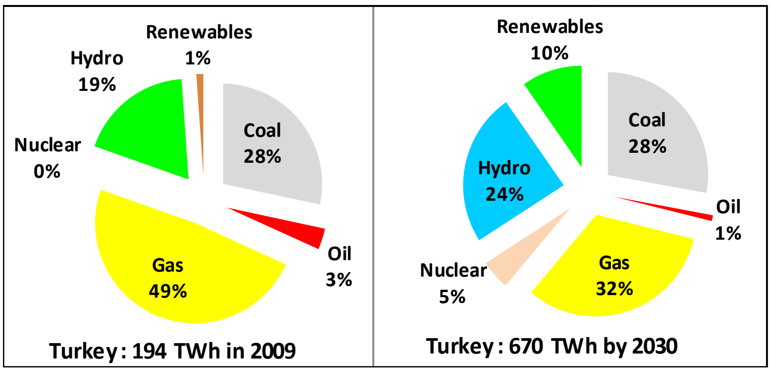
TUNISIA - REFERENCE SCENARIO	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**1**	**15**	**29**	**45**	**7,6%**	**6,6%**	**5,4%**
Hydro	0	0	0,06	0,06	1,2%	2,5%	-1,0%
Renewables	**0**	0	**2,3**	**6,8**		39%	22%
Wind	*0*	*0,10*	*1,5*	*3,9*		33%	19%
Solar PV	*0*	*0,01*	*0,1*	*0,6*		28%	23%
Solar Thermal	*0*		*0,6*	*2,0*			
Installed Capacity - MW	**0**	**3484**	**6292**	**10017**		**6,0%**	**5,2%**
Hydro		66	66	66		0,0%	0,0%
Renewables	**0**	59	**836**	**2504**		34%	20%
Wind		*55*	*505*	*1350*		29%	16%
Solar PV		*4*	*50*	*250*		27%	22%
Solar Thermal			*253*	*850*			

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

2.3.7 Turkey

Turkey is heavily dependent on imported oil and gas, but it implemented over the last decades an impressive hydroelectric power plant park. For the moment, especially concerning wind power, Turkey does not exploit its huge potential of renewable energy. The technical potential in Turkey in terms of wind power is about 83,000 MW. In spite of this potential, Turkey's wind energy installed capacity was about 364 MW and 808 MW in 2009. The present share of renewable sources for electricity generation in Turkey is 20% (1% excluding hydro). If the governmental plans are implemented as announced, it is expected that by 2030 the renewable share will rise to 34% (10% excluding hydro)[32] (Figure 35).

Figure 35. Renewables in Turkey (2009–30)

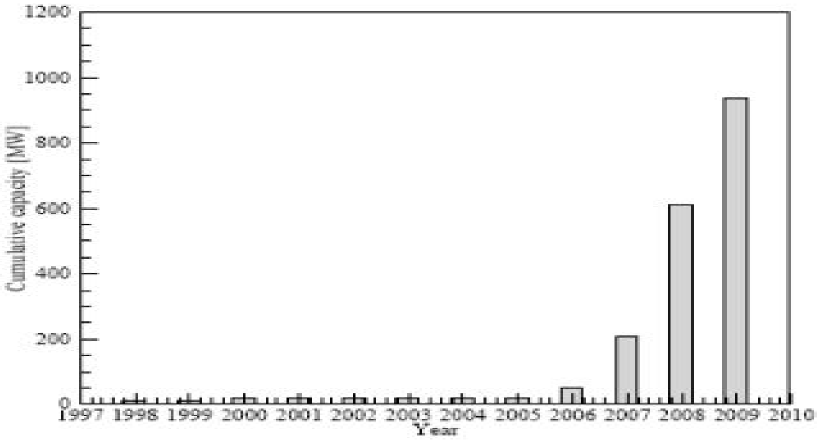


Source: Own elaborations for the MEDPRO Energy Reference Scenario.

[32] See M. Gökçek, "Developing Wind Energy in Turkey", in A. Ng (ed.), *Paths to Sustainable Energy*, InTech Europe, Rijeka, Croatia, 2010.

The installed wind power capacity for power production reached 808 MW at the end of 2009 (as shown in the Figure 36 below) and 1,030 MW at the end of 2010. It is expected that total wind energy installed capacity will have reached 1,523 MW by the end of 2011.

Figure 36. Installed wind power capacity for power production in Turkey



Source: Gökçek (2010).

Turkey's wind energy potential, estimated at about 83,000 MW, is concentrated in the north of the country and in locations along the Aegean Sea and Marmara Sea coast.

Table 48. MEDPRO Energy Reference Scenario for renewable energy – Turkey

TURKEY - REFERENCE SCENARIO	Electricity Generation				Average Annual Growth		
	1970	2009	2020	2030	1970-2009	2009-2020	2009-2030
Electricity Output - TWh	**8**	**194**	**383**	**671**	**8,4%**	**6,5%**	**6,1%**
Hydro	3	36	89	164	6,5%	8,6%	7,5%
Renewables	**0**	2,2	**33**	**65**		41%	18%
Geothermal	*0*	*0,5*	*3*	*4*		29%	10%
Biomass	*0*	*0,1*	*0,30*	*0,34*		23%	10%
Biogas	*0*	*0,2*	*0,21*	*0,30*		14%	2,4%
des Industrial Waste and non-renew waste)	*0*	*0*	*0,2*	*0,3*		3,1%	
Wind	*0*	*1,5*	*29*	*59*		49%	19%
Solar PV	*0*		*0,1*	*0,6*			
Solar Thermal	*0*		*0,2*	*0,7*			
Installed Capacity - MW		**43348**	**65990**	**113320**		**4,3%**	**4,7%**
Hydro		14553	19969	27000		3,8%	3,0%
Renewables		**1017**	**10823**	**21396**		39%	16%
Geothermal		*80*	*500*	*600*		29%	10%
Biomass		*69*	*75*	*85*		0,4%	1,0%
Biogas		*33*	*38*	*50*		8,2%	2,0%
des Industrial Waste and non-renew waste)		*27*	*30*	*40*		4,2%	1,9%
Wind		*808*	*10000*	*20000*		47%	17%
Solar PV		*0*	*80*	*321*			
Solar Thermal		*0*	*100*	*300*			

Source: Own elaborations for the MEDPRO Energy Reference Scenario.

2.4 Stakeholders dealing with renewable energy

Renewable energy policies in the region are typically led by the ministry responsible for the energy sector. In some countries, this activity is complemented by the energy regulatory authorities (Algeria, Egypt, Gaza/West Bank, Israel and Jordan) as well as the agencies responsible for the promotion of renewable energies (all countries apart from Israel and Lebanon) (Table 49).

Table 49. Main stakeholders involved in renewable energy, by country

Country	Ministry	Renewable energy agency	National electricity operator	Energy regulatory authority
Algeria	MEM	NEAL	SONELGAZ	CREG
Egypt	MEE	NREA	EEHC	ERA
Gaza/West Bank	MENR	PEA	GEDCo	PENRA
Israel	MNI	No	IEC	PUA
Jordan	MEMR	NERC	NEPCO	ERC
Lebanon	MEW	No	EDL	LCEC
Morocco	MEMEE	ADEREE MASEN	ONE	No
Syria	MoE	NERC	PEEGT, PEED	No
Tunisia	MIT	ANME -STEG EN	STEG	No

Source: Observatoire Méditerraéen de l'Energie.

The role of renewable energy agencies is to implement the policy of the government on the ground. To be effective, this function cannot be properly conducted either by those responsible for the design of renewable energy policies (ministries) or by those in charge of the distribution of electricity services (utilities). The former are typically characterised by lengthy and heavy procedures, which prevent a smooth and flexible implementation of renewable energy policies. The latter may face a conflict of interest as they are more concerned with the reduction of costs and the generation of profits than with the promotion of public goods. For all these reasons, dedicated renewable energy agencies that are separated from both policy formulation authorities and service providers are the best guarantees for the implementation of renewable energy policies.

The role of an energy regulatory authority is to prevent political discretion in the implementation of energy policies, especially in the case of private sector provision. Regulatory agencies are legally independent from the line ministry and they behave as impartial decision-makers responsible for the enforcement of contracts and the quality of service standards.

2.5 Overview of the institutional and regulatory frameworks

During the last two decades, MED-11 countries have developed different institutional schemes for the promotion of renewable energies. Approaches differ from country to country but the majority of them have moved towards more ambitious objectives in terms of RE development. Public initiatives, such as the Mediterranean Solar Plan (MSP), and private programmes like DESERTEC or Medgrid have contributed to this trend.

Almost all the countries have passed legislation regulating the RE sector or are in the process of approval (Table 50). Nevertheless, incentive measures for the development of RE are rather limited. Only a few of these regulations foresee the support of RE development by feed-in tariffs; more often only simplified authorisation procedures or tax exemptions are in place. Third-party access is only allowed in Algeria, Israel, Morocco and Tunisia (in Tunisia, only for auto-producers).

Table 50. Legislative framework, by country

Countries	RE legislation	Feed-in tariffs	Other supporting mechanisms	Third Party Access	IPP
Algeria	Yes	Yes	No	Yes	Yes
Egypt	Under Development[20]	No	Yes	No	Yes
Gaza/West Bank	No	No	No	No	Yes
Israel	No	Yes	Yes	Yes	Yes
Jordan	Yes	No	Yes	No	Yes
Lebanon	No	No	No	No	No
Morocco	Yes	No	Yes	Yes	Yes
Syria	Under Development[21]	No	No	No	No
Tunisia	Yes	No	Yes	Yes (self producers)	Yes

Source: Observatoire Méditerraéen de l'Energie.

3. Electrical interconnections

3.1 Outlook of the electric interconnections

The international interconnections allow cross-border energy exchange between the market players in neighbouring countries. They also guarantee the secure operation of the power system, allowing generation reserves to be pooled in order to deal with unexpected outages affecting generation or transmission facilities, or sudden fluctuations in electricity demand. Over the past few years, MED-11 countries have pledged to connect their grids. Several interconnections are already in operation: five connections between Algeria and Tunisia, and three connections between Algeria and Morocco. Other interconnections have recently been commissioned, among which are those connecting Spain to Morocco, Algeria to Morocco, Libya to Egypt, Egypt to Jordan, Syria to Jordan and Lebanon, Tunisia to Libya, and Syria to Turkey (e.g. Figure 37).[33]

The MED-11 area, however, is currently divided into two not-as-yet interconnected blocs: the western bloc (from Tunisia to Morocco) and the eastern bloc (from Libya to Syria). This situation is set to change in view of the many interconnection projects in progress, initially connecting the blocs to one another, and then connecting them directly, via underwater cables, to Europe.

Since the commissioning of the Spain–Morocco connection in 1997 (doubled up in July 2006), the two Mediterranean shores have been connected. The interconnection between the two shores will be further reinforced by the future tripling of the Spain–Morocco line and the underwater cable projects connecting Algeria to Spain and Italy, Tunisia to Italy, Libya to Italy, and Montenegro to Italy.

Most of the MED-11 countries are connected to a regional electricity network. There are two electricity networks, one in the Maghreb region (Morocco–Algeria–Tunisia) and the other in the Mashreq region (Libya, Egypt, Jordan, Syria, Lebanon and Gaza/West Bank). The electricity network is part of the Arab power system, which was started in 1988 by a five-country agreement among Jordan, Syria, Egypt, Turkey and Iraq. The first step in these efforts was to reach a common regional standard that would allow member countries to connect to the network. Based on this commitment, each country undertook an upgrade of its electricity system.

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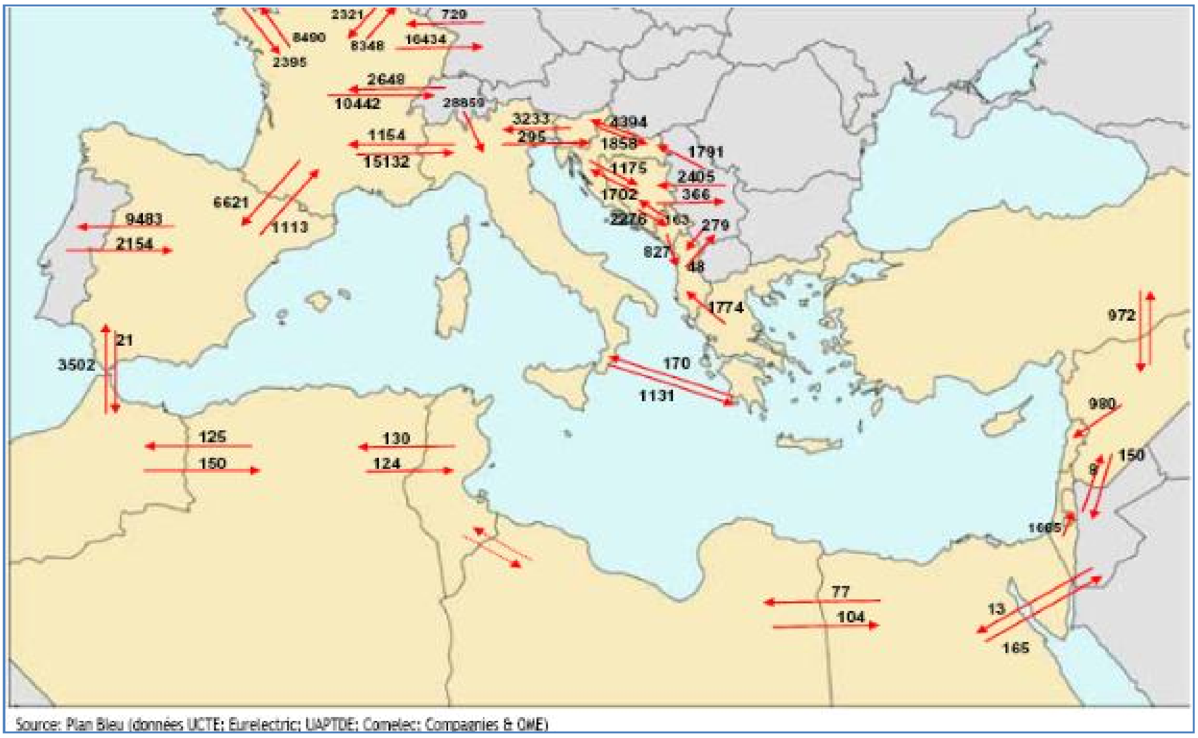
[33] This section in mainly based on information provided in the four volumes of the *MedRing Update Study* (MED-EMIP, 2010).

After the completion of those efforts, the project was extended to Lebanon, Libya and Gaza/West Bank (the latter was officially included in 2008). There are currently 400 kV connections between Spain, Morocco, Algeria and Tunisia and around 400-500 kV interconnections between the national power systems of Egypt, Iraq, Jordan, Lebanon, Syria, Libya, Turkey and Iran.

Although MED-11 countries seem to be well interconnected, the regional exchange of power has been lower than the available interconnection capacity. Despite the existing infrastructure, intra-Maghreb electricity trade is very feeble, especially when the needs, availability of resources and the geographical proximity are considered (Table 51). Net exchanges among Mediterranean countries amounted to 73 TWh in 2007. Only a tenth of the total intra-Mediterranean exchanges, that is around 7.5 TWh in 2007 and 10.7 TWh in 2008, involve trade among the MED-11, including exchanges with Europe (Morocco–Spain). These small quantities are due to the limited capacity of the existing electrical interconnections. The largest portion is exchanged between Morocco, Spain, Libya, Egypt, Jordan, Syria, Lebanon, Algeria and Tunisia. Even though Libya and Tunisia have been linked since 2003, they have not started trading electricity yet.

Figure 37. Interconnections in the Mediterranean region



Source: Plan Bleu as cited in El Andaloussi (2010).

Table 51. Total electricity trade in 2008 (GWh)

	Imports	Exports	Total
Eastern Med	4949	908	5857
Southern Med	4158	733	4891
Total MED-11	9107	1641	10748

Source: El Andaloussi (2010).

The only significant amount of exchanged electricity is between Morocco and Spain (3.5 TWh as of 2007 and 4.2 TWh in 2008). A new 400 kV line linking Algeria to Morocco is expected to facilitate the purchase of Algerian electricity by Spain. At present, there is an average of 500 GWh in annual power trading among Algeria, Morocco and Tunisia.

The region also faces a lack of synchronisation among the interconnected systems. The electricity networks of Morocco, Algeria and Tunisia are synchronised with continental Europe's UCTE network. Nonetheless, neither the Libyan nor the Egyptian network are synchronised with their neighbours or continental Europe. Israel constitutes a synchronous bloc and is not connected to its neighbours, except Gaza/West Bank.

Interconnections are mainly exploited for mutual aid with remuneration in kind, but new agreements for energy exchanges are emerging. As an example in particular, commercial agreements are in place between Egypt and Jordan, and (since 2007) Egypt has been exporting power to Syria.

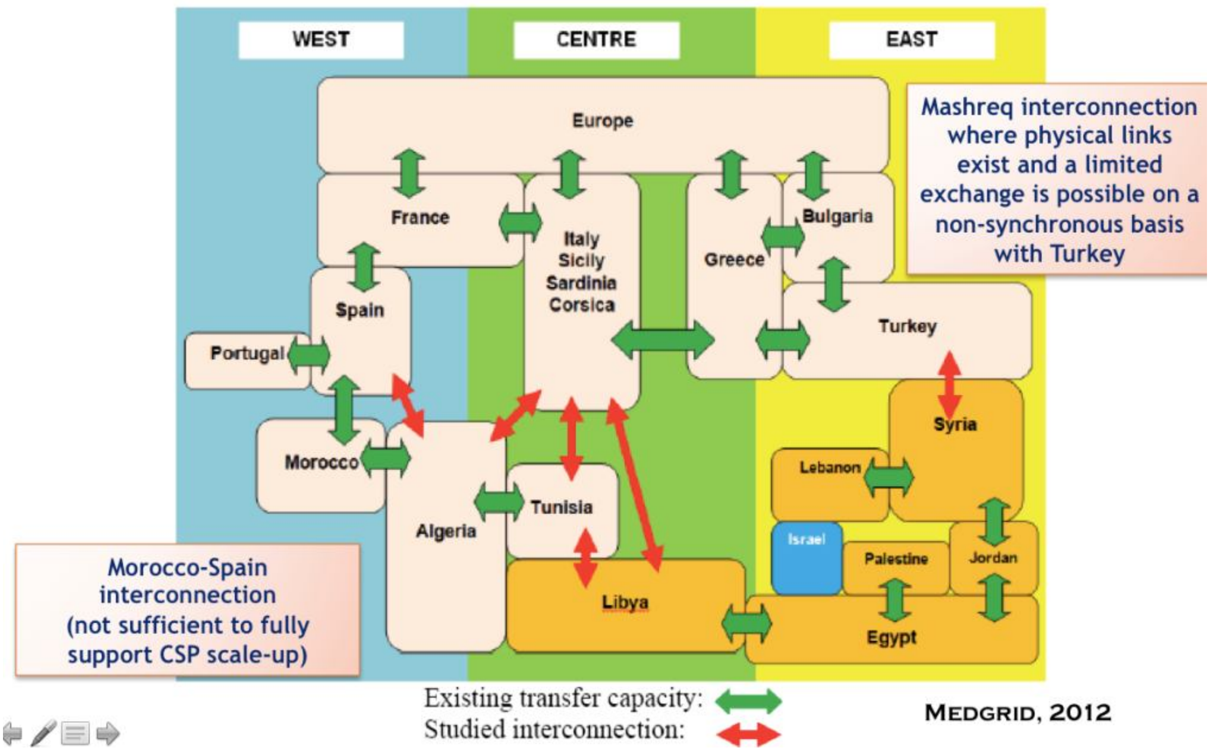
In 2008, eastern countries exported 908 GWh and imported 4,949 GWh of electricity. The southern countries exported a total of 733 GWh in electricity and imported 4,891 GWh. The total electricity exchanges reached 10,748 GWh in 2008.

3.2 Description of the existing electrical interconnections in the MED-11 countries

Syria–Turkey

Syria has interconnections at the 400 kV level with Turkey, Jordan and Lebanon and is a part of the regional grid, which also includes Egypt and Libya (see Figure 38). Interconnections at the 400 kV level with Iraq is under construction.

Figure 38. Current status of existing interconnections



Source: Medgrid (2012) (presentation at the EuroMed Energy Forum, Brussels, 20 June 2012).

At present, the two countries, Syria and Turkey, are connected through a 124 km-long 400 kV single circuit line, commissioned in 2007 (Birecik–Aleppo). The line is at present in operation for local power exchanges from Turkey to Syria in 'islanded' mode, i.e. the two grids are not synchronised. Turkey supplied the Syrian border region with 132 GWh in 2006, 962 GWh in 2007 and 97 GWh in 2008.

Recall that the energy exchanges from Turkey to Syria happen in 'islanded' operation mode, i.e. without the full synchronisation of the two power systems, but with local power generation in Turkey connected in antennas to the commissioned 400 kV line from Birecik to Aleppo. The sharp decrease of energy imported from Turkey by Syria in 2008 was due to the expiration of the energy purchase contract with Turkey at the end of 2007. Negotiations are ongoing to agree on a new energy purchase contract.

Syria–Lebanon

Currently, the two countries are linked through two AC lines from Tartous (Syria) to Deir Nebouh (Lebanon). The older line, commissioned in 1972, operates at 66 kV and the second line operates at 230 kV. These lines are used to supply electricity to Lebanon only in 'islanded' operation. The rest of the Lebanese system is still separated from the other Mashreq countries.

A new 400 kV AC single circuit OHL, 44 km in length, from Damascus (Syria) to Kesara (Lebanon) will be operative in April 2010. The Syrian part and the 400 kV Kesara substations (S/S) (Lebanon) have been completed. The connection from the final tower on the Syrian side to the final tower on the Lebanese side is still to be completed. The line is composed of one circuit on the Syrian side and two circuits on the Lebanese side. This implies that one circuit in Lebanon is not operated and the line could be expanded once the Syrian side is upgraded to two circuits.

Once the new 400 kV line is completed, the whole power system of Lebanon will be synchronised with the other Mashreq countries. Yet, the existing 66 kV and 230 kV lines will continue to be operated to feed loads in Lebanon in 'islanded' mode, since their parallel operation with the 400 kV would cause unacceptable overloading owing to their much smaller rating. This means that a 'functional' line is connected in island and cannot be considered a proper country connection in operation. This is the case of the connection between Lebanon and Syria. All exchanges are based on the 66 kV and 230 kV lines (the 400 kV was put in operation in 2010). Syria supplied Lebanon for 182 GWh in 2006, 234 GWh in 2007 and 144 GWh in 2008.

Jordan–Syria

At present, the two countries are interconnected by a 400 kV AC single circuit OHL 217 km in length. It connects Amman north (Jordan) to Der Ali (Syria) and has been in operation since January 2001. Commercial agreements are in place between Egypt and Jordan for energy imported from Egypt. For the year 2008, electricity exchanges reached 258 GWh, in which Jordan exported 245 GWh to Syria and Syria exported 13 GWh to Jordan.

Jordan–Palestinian Territories (West Bank)

The interconnection between the Palestinian Territories and Jordan consists of a 30 km-long, 132 kV double circuit OHL between Suweimeh S/S (Jordan) and Jericho (Palestinian Territories). This link was energised and put into operation on 25 February 2008 with a load of 10-15 MW. The line currently operates at 33 kV to supply the Jericho District (isolated region) and has a capacity of 20 MW. Jordan supplied the West Bank for 112 GWh in 2006, 141 GWh in 2007 and 158 GWh in 2008.

Egypt–Gaza

Egypt is interconnected with the Gaza Strip through a 22 kV line, which has been supplying power to the southern part of the Gaza Strip since 2006. The capacity of the line is 17 MW. Egypt supplied Gaza with 29 GWh in 2006, 123 GWh in 2007 and 134 GWh in 2008.

Egypt–Jordan

In operation since October 1998, this interconnection consists of a 400 kV AC, single circuit, submarine cable (13 km) across the Red Sea between Taba (Egypt) and Aqaba (Jordan). The transformers are installed in Taba to change the voltage level from 400 kV to 500 kV; 500 kV is the standard EHV level in the Egyptian backbone transmission system. Commercial agreements are in place between Egypt and Jordan for energy imported from Egypt. For the year 2008, electricity exchanges reached 543 GWh, in which Egypt exported 534 GWh to Jordan and Jordan exported 9 GWh to Egypt.

Egypt–Syria (through Jordan)

New agreements for energy exchanges are emerging. In particular, commercial agreements are in place between Egypt and Jordan for energy imported from Egypt, and more recently (since 2007), Egypt has started exporting power to Syria (200–270 GWh/year). The agreement for power exports from Egypt to Syria implies transit across Jordan. Hence, a scheme for the remuneration of the Jordanian transmission system operator (NEPCO) had to be put in place. Exchanges in 2004 entailed exports of 116 GWh from Egypt to Syria via Jordan. For the year 2008, electricity exchanges reached 266 GWh, in which Egypt exported 206 GWh to Syria and Syria exported 6 GWh to Egypt, based on actual bills between the countries.

Libya–Egypt

This interconnection is composed of a 220 kV double circuit OHL. It is 163 km long and links Tobruk S/S (Libya) with Saloum S/S (Egypt). The line was commissioned in May 1998. The interconnection will be reinforced by a new EHV line at 500 kV (on the Egyptian side), connecting Marsa–Matrouh to Tobrouk. Transformation to 400 kV takes place in the Tobrouk S/S. The profitability of this new line has been investigated in the MEDRING and the ELTAM studies. Its commissioning was envisaged for the year 2015. Exchanges are due to both mutual and commercial transactions. For the year 2008, different values were provided by Egypt and Libya: 69 GWh and 117 GWh by Libya, and 74 GWh and 124 GWh by Egypt (see also Box 1).

Tunisia–Libya

Two OHLs interconnect the two countries. A double circuit 225 kV line (380 km in length) exists between Mednine S/S (Tunisia) and Abou Kammash S/S (Libya). A single 225 kV circuit connects Tataouine (Tunisia) to El Rowis (Libya). The construction of the lines was completed in 2003, but they are still not in operation. In 2005, a failed synchronisation attempt was made between Libya and Tunisia. In fact, a first attempt at synchronisation between Tunisia and Libya was tried on 21 November 2005. This trial, which would have synchronised the European Network of Transmission System Operators for Electricity/Synchronous Continental Region (ENTSO-E/SCR) with Libya and all of the Mashreq countries up to Syria, experienced an emergency interruption triggered by a defence plan in the Maghreb grid. *Ex-post* analyses revealed some deficiencies, such as an insufficient capacity of transmission lines at cross-border cut-sets, and faulty performance in the MED-11. The total thermal capacity is 500 MW, with commercial capacity of 200-180 MW.

Algeria–Tunisia

At present, the two countries are interconnected through four lines: Tajerouine–El Aouinet, operating at 90 kV, commissioned in 1952; Fernana–El Kala, operating at 90 kV, commissioned in 1955; Tajerouine–El Aouinet operating at 225 kV, commissioned in 1980; and Metlaoui–Djebel Onk operating at 150 kV, commissioned in 1984.

A fifth 400 kV line (Jendouba–El Hadjar), completed at the end of 2005, will be fully operative by 2012 after having finished the construction of the 400 kV S/S. With the line operated at 400 kV, the commercial transfer capacity is expected to reach 300 MW. For the year 2008, electricity exchanges reached 281 GWh, in which Algeria exported 137 GWh to Tunisia and Tunisia exported 144 GWh to Algeria.

Box 1. International electrical interconnections

International Electrical Interconnection

The Egyptian power sector since more than twenty five years was keen to improve its performanc through diversification of electrical energy resources and adopting new policies for energy trade at regional and international levels .This could be achieved through several axes of electrical interconnection with Arab, African and European countries as follows:.

1. The Axis of Integrated Arab Electrical Interconnection

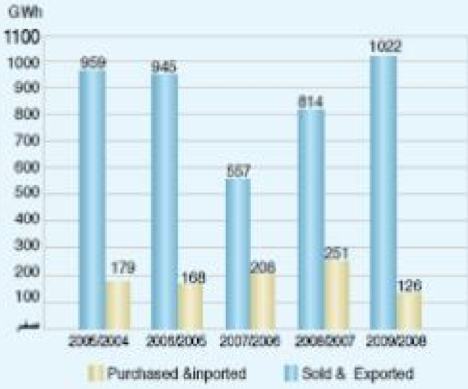
- The following interconnections are in operation:

Electrical Interconnection Egypt-Libya	5/1998
Electrical Interconnection Egypt-Jordan	10/1998
Electrical Interconnection Syria-Jordan	3/2000
Electrical Interconnection Syria-Lebanon	4/2009

This has lead to the interconnection between the transmission systems of, Syria, Jordan, Egypt and Libya.

Description	Libya	Jordan	Syria	Lebanon
Interconnection voltage K.V	220	400	400	400
Solod &Exported Energy (GWh)	70	638	186	128
Purchased & Imported Energy(GWh)	111	13	2	-

•includes in- kind exchange



- In the framework for completing the interconnection system between the eight Arab Mashrequ Countries (Egypt, Jordan Syria, Lebanon, Libya, Iraq, Turkey, and Palestine) ,the 400 KV interconnection between Syria and Lebanon was commissioned in April,2009 and an agreement that Egypt exports 450 MW of power to Jordan ,Syria and Lebanon, divided equally between them, was reached . Also an exchange of power agreement was signed between Egypt and Lebanon in February 2009.

- As for the interconnection between Mashrequ and Arab Maghreb countries(Libya ,Tunisia, Algeria and Morocco), bending on the success of the second commissioning tests for the interconnection line Libya -Tunisia which is planned by the end of this year, the interconnection between Arab Mashrequ and Arab Maghreb countries will be achieved.

- In the framework of achieving the Integrated Arab Electrical Interconnection, the techno-economic feasibility study for the interconnection between the Kingdom Of Saudi Arabia and Egypt has been completed. The study concluded the feasibility of exchange of power up to 3000 MW between the two countries. The implementation of this project will lead to an integrated interconnection between Maghreb Arab Countries, Mashrequ Arab Countries and the Countries of Gulf Cooperation Council; this represents 98% of total generation capacities of the Arab Countries.

2. The Axis of African Electrical Interconnection:

- Since the beginning of the nineties, Egypt in cooperation with the African Development Bank studied the possibilities of electrical energy trade between African countries and Europe and a techno-economic feasibility study for the interconnection between Aswan in Egypt and Inga Dam in Democratic Republic of Congo (DRC) passing through Central Africa and Sudan to transmit 40 GW of hydro power generated from Inga to North Africa and Europe was conducted.
- Egypt-represented by MOEE- participating in the Nile basin initiative and techno-economic feasibility study for electrical energy trade between the Eastern Nile Basin Initiative (Egypt, Ethiopia, and Sudan) completed in December 2008. The study concluded the feasibility of exporting 3200 MW from Ethiopia to Sudan (1200MW) and to Egypt (2000MW).
- Moreover, Egypt is a member of the East Africa Energy Forum comprising nine countries (Egypt, Ethiopia, Sudan, Kenya, Rwanda, Burundi, Tanzania, Uganda, Democratic republic of Congo) in addition to its effective participation in the committees and meetings of the African Union for Production and Distribution of Electrical Energy(UPDEA) comprising more than fifty African countries.

3. The Axis of Electrical Interconnection with Europe:

Through Egypt`s participation in the Observatoire Mediterranean de l'Energie (OME) and the Study Committee for the electrical interconnection of the Southern and Eastern Mediterranean Countries, discussions are on the way to study the interconnection between Egypt and Greece.

The study aims at achieving the interconnection with the European network and exporting renewable energy (Solar and Wind) from Egypt to Europe.

Accordingly, Egypt will become the focal and central point for electrical energy trade between Countries of Gulf Cooperation Council, Arab Mashrequ, Arab Maghreb, Nile Basin countries and Europe.

Future Vision for Regional Electrical Interconnection

Study for upgrading the interconnection with Arab Maghreb Countries through Libya to 500/400 kV has been finalized in April, 2004.

The study final report was presented to the concerned countries (ELTAM) , and it was agreed to implement the recommended projects for repowering the national networks (500/400KV) of Egypt and Arab Maghreb Countries according to the following time schedule.

1. Libya will finalize the construction of the 400KV lines before year 2010.
2. Egypt will finalize the construction of the 500KV Sidi Krir / El Saloom line and El Saloom 500 KV substation by year 2012.

Source: EEHC (2010).

Morocco–Algeria

Until 2008, the two countries were just interconnected by two single circuit 220 kV lines (Oujda–Hazaouet and Oujda–Tlemcen), commissioned in 1992 and 1998 Each has a thermal capacity of 250 kVA). The commercial capacity is approximately 240 MW. A new double circuit 400 kV line has allowed the total interconnection capacity between the two countries (four circuits) to reach the order of 400 MW, which will rise to 800 MW. No further reinforcements are foreseen by 2020. The second circuit shall be in operation in February 2010 the latest. The thermal capacity of each circuit is 1,200 MVA. For the year 2008, electricity exchanges reached 318 GWh, in which Algeria exported 184 GWh to Morocco and Morocco exported 134 GWh to Algeria.

Morocco–Spain

For the year 2008, electricity exchanges reached 4,243 MW, in which Spain exported 4,227 GWh to Morocco and Morocco exported 15 GWh to Spain. In 2011, Spain exported to Morocco about 4,400 GWh.

New interconnection projects in the MED-11 countries

A short description of the new interconnection projects is subsequently given. Most of these projects are still under discussion (see also Tables 52-53 and Figures 39-40).

Jordan–Syria

A doubling of the existing 400 kV interconnection between the grids in Syria and Jordan (from 350 to 700 MW in commercial capacity) is envisaged for the future.

Syria–Iraq

This interconnection consists of a 400 kV AC single circuit OHL with a length of 165 km. It runs from Tayem S/S (Syria) to Qa'im S/S (Iraq). The 400 kV S/S on the Syrian side has been completed.

Jordan–Palestinian Territories

A new 400 kV line between the two countries is envisaged in order to supply power to the West Bank. The line will connect the new S/S in West Amman to a new S/S in East Jerusalem. The West Amman S/S will be connected to the 400 kV transmission backbone of Jordan through two lines towards Samra and Qatraneh S/S. According to the information received from the Palestinian Energy Authority, the schedule for the lines' commissioning is at the beginning of 2013, as recently agreed between Jordan and the Palestinian National Authority.

Egypt–Jordan

The existing 400 kV submarine interconnection between Egypt and Jordan is expected to be reinforced in order to double the interconnection capacity up to 1,100 MW.

Egypt–Palestinian Territories

The Gaza Strip is planned to be fully connected to the Egyptian network. The Islamic Development Fund will finance the project. The line from El-Areesh (Egypt) will provide 150 MW to Gaza. Once decided, the project is expected to be completed in 12-18 months.

Egypt–Libya–Tunisia–Algeria–Morocco

A plan exists concerning the creation of a 400/500 kV transmission backbone from Egypt to Morocco.

Libya–Italy

A feasibility study for a 1,000 MW, 500 kV DC submarine cable, 520 km in length, was completed in February 2008.

Algeria–Spain

A feasibility study for an HVDC connection from Algeria to Spain by means of a 240 km submarine cable with a capacity of 2,000 MW was completed in 2003. It will link Terga (Algeria) to the Littoral de Almeria (Spain). The project has been under negotiation for possible implementation, but no firm decisions have been taken so far.

Algeria–Italy

A feasibility study was completed in June 2004, with two solutions for a 500–1,000 MW, 400–500 kV DC interconnection being analysed:

- a 'direct' line between El Hadjar (Algeria) and Latina (Italy) with a capacity of 1,000 MW; and
- an 'optimised' line between El Hadjar (Algeria) and south Sardinia (Italy) with two 500 MW lines.

No firm decisions have been taken so far for the implementation of the project.

Tunisia–Italy

A feasibility study was carried out in 2004–05 for an interconnection of the electricity grids of Tunisia and Italy through a 400 kV HVDC link. The transfer capacity was determined to be approximately 400 MW in a first stage (monopolar scheme). After the reinforcement of the 400 kV AC grid in Sicily, a second pole is to be installed, to help attain a target capacity of the interconnector of 1,000 MW. The length of the interconnection will be slightly less than 200 km. The link is expected to be in operation by 2015 depending on progress on the construction of new generation in Tunisia.

Table 52. Existing electrical interconnections in southern Mediterranean countries

Country	From substation	To country	To substation	Type AC/DC	Voltage [kV]	Thermal limit (A) winter	Year of operation
Algeria	Ghazaouet	Morocco	Oujda	AC	225	640	1988
Algeria	Tlemcen	Morocco	Oujda	AC	225	640	1988
Algeria	Hassi Ameur	Morocco	Bourdim	AC	220 (400)	1720x2	2006 (2010)
Algeria	Djebel Onk	Tunisia	Metlaoui	AC	150	510	1984
Algeria	El Aouinet	Tunisia	Tajerouine	AC	225	640	1984
Algeria	El Aouinet	Tunisia	Tajerouine	AC	90	380	1952
Algeria	El Kala	Tunisia	Fernana	AC	90	510	1956
Algeria	El Hadjar	Tunisia	Jendouba	AC	220 (400)	1720	2005 (2010)
Morocco	Oujda	Algeria	Ghazaouet	AC	225	640	1988
Morocco	Oujda	Algeria	Tlemcen	AC	225	640	1988
Morocco	Bourdim	Algeria	Hassi Ameur	AC	220 (400)	1720 x 2	2006 (2010)
Morocco	Mellousa	Spain	Tarifa	AC	400	730 MW	1996
Morocco	Mellousa / 2	Spain	Tarifa / 2	AC	400	960	2006
Tunisia	Fernana	Algeria	El Kala	AC	90	510	1956
Tunisia	Metlaoui	Algeria	Djebel Onk	AC	150	510	1984
Tunisia	Tajerouine	Algeria	El Aouinet	AC	225	640	1984
Tunisia	Tajerouine	Algeria	El Aouinet	AC	90	380	1952
Tunisia	Jendouba	Algeria	El Hadjar	AC	220 (400)	1720	2005 (2010)
Tunisia	Medenine	Libya	Abukamash	AC	220	2 x 620	2003
Tunisia	Tataouine	Libya	Rowis	AC	220	620	2003
Libya	Tobruk	Egypt	Saloum	AC	220	2 x 630	1998
Libya	Abukamash	Tunisia	Medenine	AC	220	2 x 620	2003
Libya	Rowis	Tunisia	Tataouine	AC	630	620	2003
Egypt	Taba	Jordan	Aqaba	AC	400	1270	1997
Egypt	Saloum	Libya	Tobruk	AC	220	2 x 630	1998
Egypt	Rafah	Palestin.	Rafah	AC	22	17 MW	--

Source: *MEDRING Update Study* (MED-EMIP, 2010).

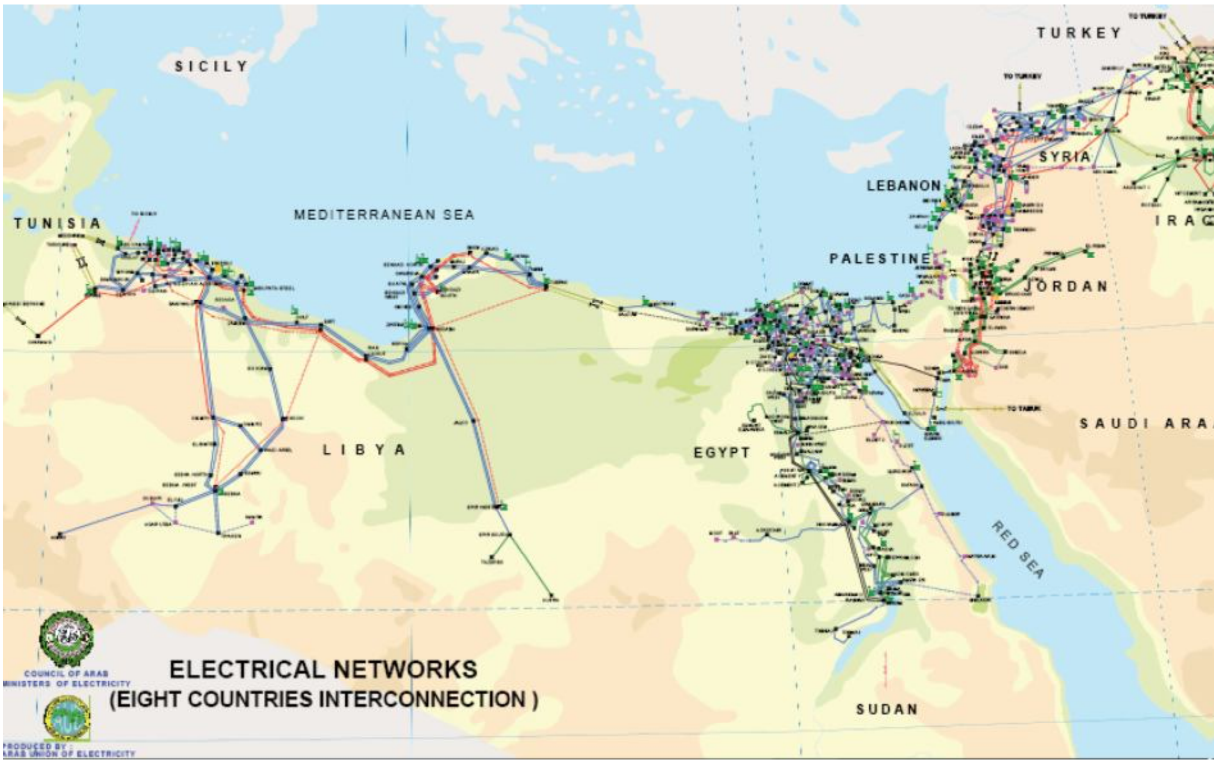
Table 53. Existing electrical interconnections in eastern Mediterranean countries

Country	From substation	to country	To substation	Type AC/DC	Voltage [kV]	Thermal limit (A) winter	Year of operation
Jordan	Aqaba	Egypt	Taba	AC	400	1270	1997
Jordan	Suweimeh	Palest.	Jericho	AC	33 (132)	20 MW	2008
Jordan	Irbed	Syria	Cheikmiskin	AC	230	770	1980
Jordan	Amman North	Syria	Der Ali	AC	400	1450	2001
Palestinian Territories	Jericho	Jordan	Suweimeh	AC	33 (132)	20 MW	2008
Palestinian Territories	Rafah	Egypt	Rafah	AC	22	17 MW	--
Lebanon	Anjar	Syria	Dimas	AC	2 x 66	960 (**)	1972
Lebanon	Deir Nebouh	Syria	Tartus	AC	230	770	1977
Lebanon	Kesara	Syria	Dimas	AC	400 (*)	1660	2009
Syria	Cheikmiskin	Jordan	Irbed	AC	230	770	1980
Syria	Der Ali	Jordan	Amman North	AC	400	1450	2001
Syria	Tartus	Lebanon	Deir Nebouh	AC	230	770	1977
Syria	Dimas	Lebanon	Anjar	AC	2 x 66	960 (**)	1972
Syria	Dimas	Lebanon	Kesara	AC	400 *	1660	2009
Syria	Aleppo	Turkey	Birecik	AC	400	1440	2007

** Double circuit on the Lebanese side; single circuit on the Syrian side.*
*** Thermal capacity of 110 MVA, but the line is operated with an exchange limit of 50 MW.*

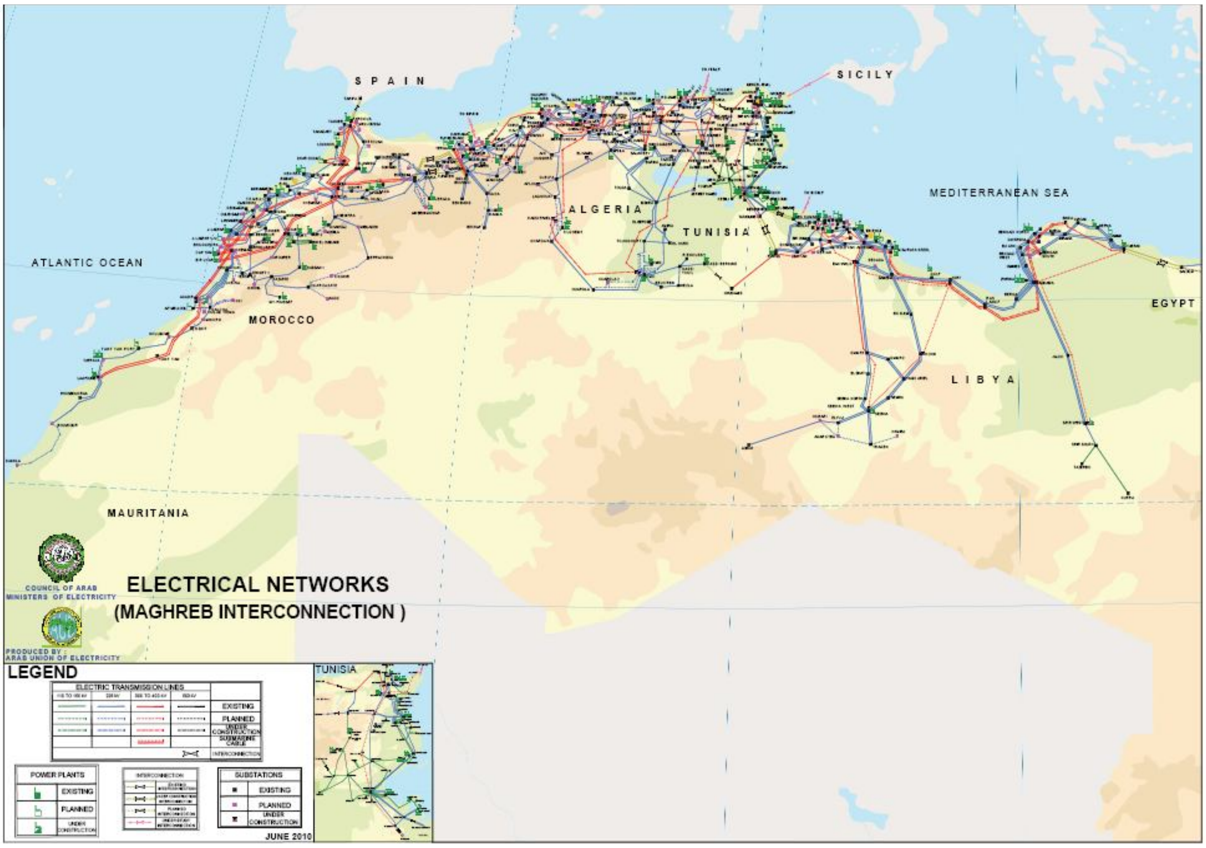
Source: *MEDRING Update Study* (MED-EMIP, 2010).

Figure 39. Electrical networks (interconnections among eight countries)



Source: AUE (2010).

Figure 40. Electrical networks (Maghreb interconnections)

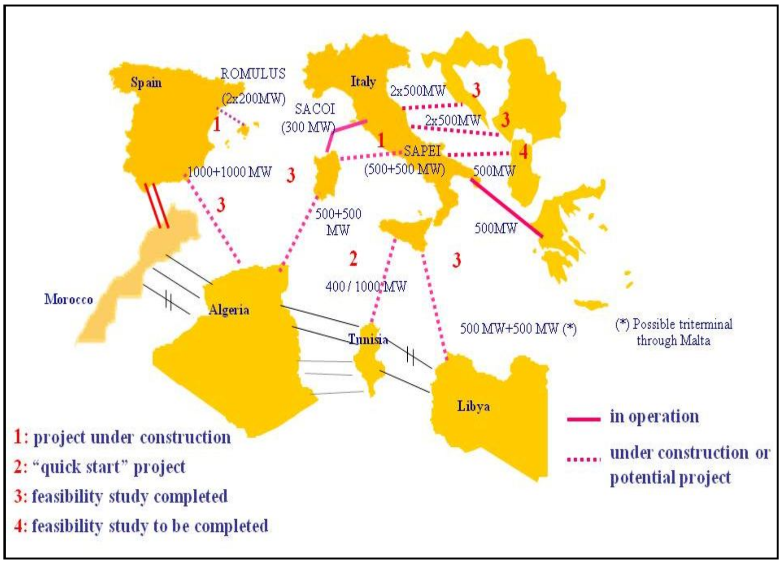


Source: AUE (2010).

3.3 South–north interconnections

Currently, there are HVDC south–north interconnection projects for the following links: Tunisia–Sicily, Algeria–Sardinia, Algeria–Spain and Libya–Sicily (Figure 41).

Figure 41. HVDC interconnection projects



Source: Bruno Cova at CESI RICERCA, Milan.

The only link progressing towards its realisation is the one between Tunisia and Italy. This interconnector will be developed in two stages (400–500 MW in the first stage and an additional 500 MW in the second stage). For the second stage to become operational, the reinforcement of the Sicilian grid is required. The final configuration will be a bipole at ±400 kV DC. The submarine length of the cable is 195 km and the terrestrial length is 30 km. The maximum sea depth is 600 m. The realisation of the project is linked to the construction of a new power plant in Tunisia (coal or gas fired with a capacity of 1,200 MW). In February 2012, the tender for the new power plant was launched. The Tunisian–Italian joint venture (ELMED) was set up in April 2009 and will manage the process of tendering and contract awarding for the construction of the new power plant. The interconnector will be operated in the form of a 'merchant' interconnection with 80% of capacity exempted from third-party access and reserved for the investor in the new power plant. This value is compliant with the Italian Ministerial Decree on Merchant Lines issued in October 2005. Access to the remaining capacity is open. This capacity may eventually be used for trading 'green energy' between the Maghreb and Italy on the basis of Art. 9 of Directive 2009/28/EC on the promotion of the use of energy from renewable sources. The interconnector is expected to enter into operation in 2016. As for the other south–north interconnectors, only feasibility studies have been carried out addressing technical issues, the economic profitability and the environmental constraints. Note that according to the feasibility studies performed, the main rationale for these interconnectors lies in the trading of energy towards Europe. The energy is projected to be produced by gas fired combined cycle units to be installed in North Africa. Hence, the economic profitability is related to the arbitrage between exporting gas and selling electricity on the Italian and/or Spanish markets. The feasibility studies did not consider the possibility of building RE power plants in the Maghreb and selling the generated energy to Europe.

4. EU–Med cooperation for electricity interconnections and renewable energy development

4.1 MEDRING study: Electrical interconnections in the Mediterranean

MEDRING was the most comprehensive study conducted on electric interconnections in the Mediterranean between 2001 and 2003. Under the 'Systmed Experts group', it was supervised by CESI (Italy) in partnership with EDF, REE, DESMIE, Sonelgaz, STEG, EEHC, NEPCO, PEEGT, TEIAS, ONE and GECOL. The MEDRING study sought to i) identify the economic advantages of the electric loop, ii) highlight the operational difficulties and the constraints, and iii) recommend solutions to overcome them.

The study was co-financed by the European Commission in the framework of the MEDA programme and led by a consortium of partners from northern Mediterranean countries and the MED-11. The study, submitted in 2003, concluded with a very positive assessment of the economic benefits and the technical viability of the Mediterranean energy ring, provided that some technical solutions were adopted to overcome operational difficulties.

The Second Strategic Energy Review of the European Commission communicated on 13 November 2008 noted that the ring needs to be completed,[34] linking Europe with the MED-11 through electricity and gas interconnections.

[34] European Commission, Communication on the second strategic energy review an EU energy security and solidarity action plan, COM(2008) 781 final, Brussels, 13 November 2008.

The overall objective of the "MEDRING Update Study – Electricity Sector" project was to source, update and analyse relevant as well as authentic performance data of the electricity sector of 22 countries and territories forming the Mediterranean ring in support of a 2010 European Commission Communication concerning improved integration of the electricity market. It took into account recent developments with respect to diversification of the primary energy mix for electricity generation and the newest European Commission directives enabling the export of electricity from renewable energy resources by non-EU members of the Union for the Mediterranean to the EU-27.

The MEDRING update study provided short-term recommendations that are quantifiable, measurable and most likely achievable within a period of five years, as well as laying the foundation for larger investments to achieve a common and jointly supported objective.

4.2 Mediterranean Solar Plan

The Mediterranean Solar Plan is an opportunity for political and technical cooperation for a sustainable energy system in the Mediterranean. The objective of the MSP is to provide 20,000 MW of installed capacity from renewable sources (mainly solar and wind) by 2020 and to develop electricity networks and interconnections between north and south and south–south.[35] Energy efficiency and technology transfer are also included as accompanying measures.

Solar and wind power will allow countries in the south and east of the Mediterranean to reduce their energy dependence and their energy bills. There are three major flagship projects for the Mediterranean region: the MSP, DESERTEC and Medgrid (ex-Transgreen).

A limited number of projects were chosen. In the field of energy, the heads of state and government opted for the MSP. They also requested the establishment of a Mediterranean water strategy that contains a large energy dimension. In the coming years, 20% of the increased demand for electricity will come from the water sector. The MSP is a major project and key priority of the Union for the Mediterranean (UfM), which was endorsed by the Paris summit in July 2008 and at the UfM foreign affairs ministerial meeting in Marseilles in November 2008. One of the points raised at the summit was that Europe had built around the coal and steel, and now both shores of the Mediterranean had to do so around water and sun.

Energy is at the heart of major political issues: security of supply, economic competitiveness and environmental performance. It is also an area especially associated with questions of distributive justice about annuities and distribution. The Mediterranean region is characterised by two major and obvious inequalities: inequality between the northern countries, richer and more energy consuming than those in the south; and inequality in the energy resource endowments that are highly concentrated in three countries, Algeria, Libya and Egypt (6% of world reserves of natural gas and 6% of oil reserves).[36] Trade in oil and gas is particularly important and mutually reinforcing. In addition, the strengthening of electricity connections north–south and east–west has many beneficial effects in the region. Moreover, the Mediterranean is also endowed with exceptional resources in renewable energy, particularly solar and wind in the south and east.

Faced with this potential, access to energy, energy security and environmental constraints are major challenges for the economic and social development in the Mediterranean, while environmental degradation must be curbed locally and globally.

These challenges can be tackled through the launching of a Euro-Mediterranean cooperation around a sustainable energy system based on accessibility extended to the southern Mediterranean and the energy economy and renewable energy development in the north, south and eastern Mediterranean.

[35] European Commission, *The Mediterranean Solar Plan: Strategy paper*, Brussels, February 2010.

[36] Ibid.

The main goal of the MSP is to satisfy the needs and energy security of countries south and north through the export of electricity. Key issues therefore also include the need to complement and strengthen the network of electrical interconnections in the Mediterranean. The quantitative targets of the plan for 2020 are the installation of 20 GW of new capacity from renewable sources (mainly solar and wind) and the development of electricity networks and interconnections between north and south and south–south. Energy efficiency and technology transfer are currently considered accompanying measures.

Compared with a baseline scenario based on carbon production, the discounted cost of the plan has been estimated at €14–32 billion over the entire lifetime of means of production. Important as they are, these amounts must be relativised at the regional level, particularly because of the strong increase in the consumption of electricity in the southern and eastern Mediterranean: relative to the size of the market, the additional annual cost of electricity generation from renewable sources should be between 0.5 and 1.3% in 2020.[37]

The economic problems of the MSP are therefore twofold: first to improve the profitability of projects by adjusting the purchase price of electricity prices and local prices for export to the north, carbon credits and green certificates in Europe along with local incentives for renewable energy; and second to ensure their financing. Equity (local and international) should be assured if the product is sufficiently profitable and risk-controlled, attracting debt/development finance institutions (the European Investment Bank, Agence Française de Développement and KfW, European Bank for Reconstruction and Development, World Bank and African Development Bank) and commercial banks.

To enable this implementation, it is necessary to overcome the many technical, financial and administrative barriers to the development of large-scale renewable energy and energy efficiency in the region and to establish a clear regulatory framework and a system of shared governance. From the political point of view, the harmonisation of laws and adoption of economic instruments will be crucial to creating a green energy market that is competitive at the regional level.

The MSP was presented in detail in 2008. More than 150 projects (or 'intentions') were presented at the Franco–Egyptian presidency of the Union for the Mediterranean as a summary sheet (non-binding), for a total capacity of about 12 GW shared equitably between solar and wind projects in ten countries, including Jordan, Tunisia, Egypt, Morocco and Turkey. In addition, a score of projects on energy efficiency were proposed in five countries (e.g. Table 54 and Figure 42). An informal group of experts from Germany, Egypt, France, Italy, Morocco and the European Commission (observer) was established and met three times to discuss the operation of the MSP with the aim of putting in place a clear framework of governance, approved by all stakeholders. The next milestone for the plan will be to organise a meeting of energy ministers to launch priority projects.

The priority areas of action of the MSP are as follows:

i) setting up an adequate legal, regulatory, institutional and organisational framework to enable the development and massive deployment of solar energy and other renewable energy technologies;

ii) limiting the growth of energy demand and improving energy efficiency and energy savings;

iii) promoting the development of electricity interconnections to establish a viable grid system for the trade of Euro-Mediterranean green electricity; and

iv) facilitating cooperation on technology aspects.

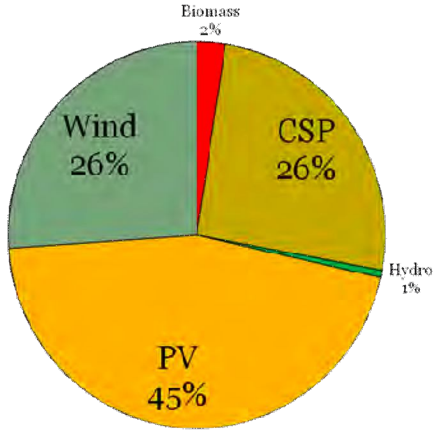
[37] Ibid.

Table 54. MSP – Number of projects by country

Country	Number of projects
Morocco	33
Turkey	29
Tunisia	29
Egypt	20
Jordan	20
Syria	12
Algeria	6
Lebanon	4
Italy	4
Palestine	3
Israel	1

Source: Mediterranean Solar Plan.

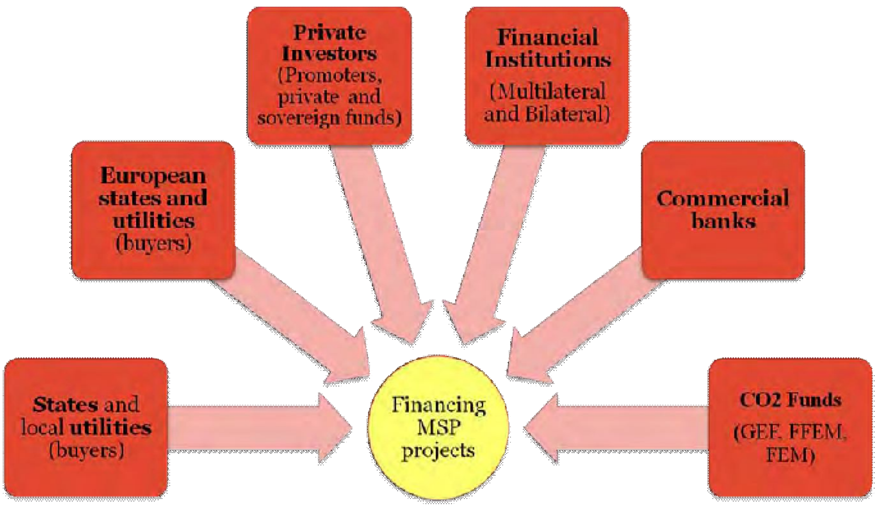
Figure 42. MSP – Projects by energy source



Source: Mediterranean Solar Plan.

The total cost of the Mediterranean Solar Plan is estimated at €45 billion, with up to €39 billion for electricity production and €5 billion for electricity transportation.[38] The financial framework is composed of local contracts (state and local companies as buyers), export contracts (European companies as buyers), equity from investors (banks, private or sovereign funds and energy companies), and debt or risk guarantees (multilateral organisations) related to country risks or special projects (national or European funds) (Figure 43).

Figure 43. MSP – Financing framework



Source: Mediterranean Solar Plan.

4.3 DESERTEC

The DESERTEC concept is designed to bring deserts and existing technology into service to improve global security of energy, water and the climate. The project has been developed by TREC (Trans-Mediterranean Renewable Energy Cooperation), an international network of scientists, politicians and

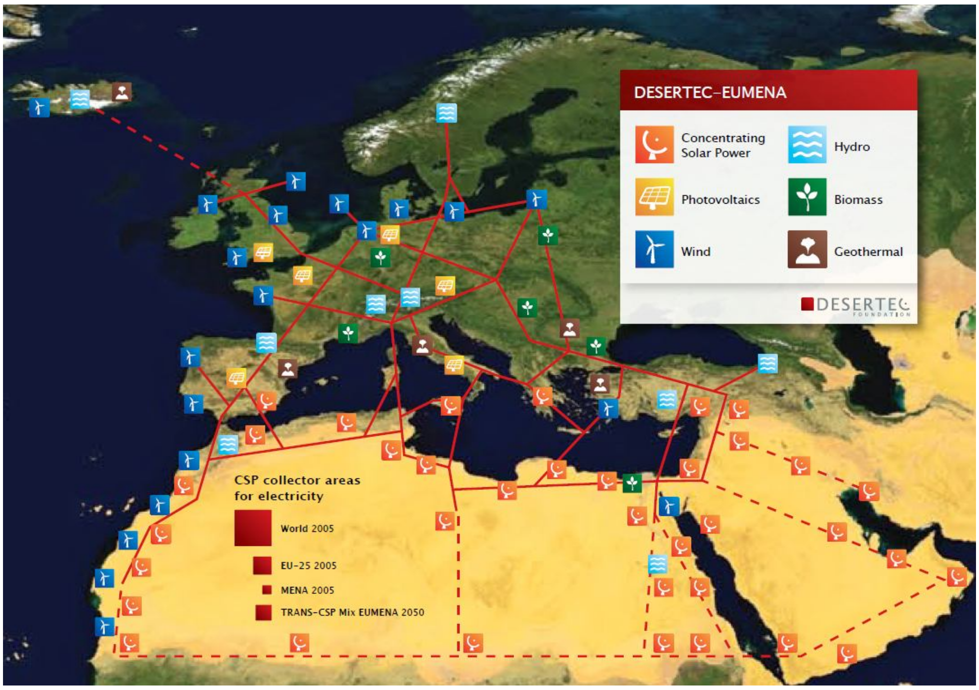
[38] Ibid.

other experts in the development and implementation of renewable energy. Based in Berlin, TREC was founded in 2003 by the Club of Rome, the Hamburg Climate Protection Foundation and the National Energy Research Center of Jordan. The DESERTEC Foundation has been founded in order to strengthen the activities of TREC.

The idea at the basis of DESERTEC (as presented for the first time in 2009 by 12 enterprises and banks) is to launch a cooperative initiative within the EU–Middle East and North Africa (MENA) region, for the production of electricity and desalinated water using concentrating solar thermal power and wind turbines in the MENA deserts (e.g. Figure 44).

These technologies can meet the growing demands for power production and seawater desalination in the MENA region, and produce clean electrical power that can be transmitted via HVDC transmission lines with relatively little transmission loss to Europe (10-15%).

Figure 44. DESERTEC map of EU–MENA



Source: DESERTEC Foundation (www.desertec.org).

TREC was founded with the goal of providing clean, cost-efficient energy for EU–MENA as soon as possible and based on economic cooperation between the countries in the region. TREC sees the power from deserts as a supplement to European sources of renewable energy and as a means of speeding up the process of cutting European emissions of CO_2 and increasing the security of European energy supplies. For people in the MENA region, this would mean plentiful supplies of clean electricity, jobs, earnings, an improved infrastructure, potential for the desalination of seawater and several potential benefits (e.g. for agriculture) from the shade provided by solar collectors.

TREC has been involved in the conduct of three studies that have evaluated the potential of renewable energy in MENA, the expected needs for water and power in EU–MENA between now and 2050 and issues relating to the construction of an electricity transmission grid connecting the EU and MENA (EU–MENA connection). These three studies were commissioned by the German Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU) with the German Aerospace Center (DLR) taking the lead. These 'MED-CSP' and 'TRANS-CSP' studies were conducted between 2004 and 2006. The 'AQUA-CSP' study, covering aspects of solar desalination, was completed towards the end of 2007.

Satellite-based studies by the DLR have shown that, by using less than 0.3% of the entire desert area of the MENA region, enough electricity and desalinated seawater can be produced to meet the growing needs of these countries and of Europe. Power generation from wind energy is particularly attractive in Morocco and in areas around the Red Sea. Solar and wind power can be transmitted throughout the region via HVDC transmission lines, and to Europe with transmission losses of up to 15%. The Union for the Mediterranean, including many countries in MENA, is interested in this kind of cooperation.

Construction of new concentrating solar thermal power plants has already begun in Spain and the US (Andasol 1 & 2, Solar Tres, PS10 and Nevada Solar One). Projects are underway in Algeria, Egypt and Morocco, and further plants are planned in Jordan and Libya. Morocco is implementing a feed-in law to support wind power in particular. In the EU, discussions are in progress concerning the construction of an HVDC supergrid across Europe and plans for offshore wind farms in northern Europe, with an associated HVDC supergrid, are taking shape.

The DESERTEC concept should be finalised by 2012 and investments have been announced reaching €400 billion.

4.4 Medgrid

The objectives of the MSP require a major effort to increase the power interconnection between countries in the south and between them and the north shore. Key issues therefore include the need to complement and strengthen the network of electrical interconnections between countries on both shores of the Mediterranean. According to MEDELEC (an association of electricity industries in the Mediterranean), the maximum transmission capacity that the network could achieve on the basis of existing investment plans would be about 5 GW. In short, these are achievable goals, but very ambitious as the obstacles to be overcome are many.

Based in Paris, Medgrid was created in 2010 by a group of utilities, grid operators and equipment makers, with the target of carrying out a feasibility study of the development of a grid aimed at connecting Europe to North African solar electricity producers (Figure 45).

Figure 45. Medgrid

Source: Medgrid, "La vision" (www.medgrid-psm.com/le-projet/la-vision/).

Medgrid is an industrial initiative formed under the framework of the MSP. Twenty companies have already joined the project: Abengoa, Alstom Grid, Areva, Atos Origin, CDC Infrastructures, EDF, Ineo, Nemo, Nexans, Nur Energie, ONE, Pan Med Trading and Investment, Prysmian, Red Electrica, RTE, Siemens, Soitec Concentrix Solar, Taqa Arabia, Terna and Walid Elias Establishment. The French development agency (AFD) also concluded a strategic and financial partnership with Medgrid.

In the frame of the Euro-Mediterranean Power Grid Project, Medgrid wants to respond to a strong need for underwater direct current interconnections between the two shores of the Mediterranean Sea, allowing the co-development of energy between Europe and the MED-11.

The idea of its stakeholders is that Medgrid can bring two main advantages:

- profitability for the solar plants in the southern and eastern countries, as a part of the electricity produced by solar power plants can be sold to Europe at higher prices for feed-in tariffs; and
- security of supply, with the import and export of electricity to respond to peak demand and intermittent renewable production.

Medgrid has five main commitments:

- design the Mediterranean grid master plan for 2020, leading to concrete investment projects;
- promote a regulatory and institutional framework for the exchanges of green electricity;
- assess the benefits of investment in grid infrastructures;
- develop technical and technological cooperation with southern and eastern countries in the area of power grids; and
- promote advanced HVDC technologies for power transmission.

Medgrid is committed to carrying out its work in conjunction with other projects of the MSP and in harmony with the solar plans of MED-11 countries.

4.5 Med-TSO

Med-TSO, the Association of Mediterranean Transmission System Operators, was launched by the European Commission at a conference on "Multilateral cooperation for the integration of the Mediterranean electricity systems" held on 4 May 2012 in Rome. Med-TSO held its first General Assembly meeting in Tunis on 6-7 September 2012. Noureddine Boutarfa, Président Directeur Général of Sonelgaz and Chairman of Med-TSO, pointed out that the first General Assembly had adopted the organisational rules for Med-TSO.

According to a European Commission Energy Directorate communiqué, Med-TSO aims at the integration of a regional electricity market in the long term, by "coordinating the development plans and the operation of the grids in MED-TSO countries, encouraging the integration of their electricity systems and the implementation of common criteria and harmonised, transparent and non-discriminatory rules of access to and usage of grids".

Med-TSO, based on the EU's ENTSO-E model, will serve as an interlocutor for ENTSO-E and the Association of Mediterranean Regulators for Electricity and Gas (MEDREG), as well as in initiatives such as DESERTEC. Members of Med-TSO[39] are Portugal, Spain, France, Italy, Slovenia, Greece, Montenegro, Albania, Turkey, Morocco, Algeria and Tunisia, with Algeria currently presiding. Egypt, Jordan, Lebanon and Libya have also asked to join.

4.6 RES4MED

RES4MED is an association set up at the end of 2011 by CESI, Edison, Enel Green Power, GSE, PwC and Politecnico di Milano.[40] RES4MED aims at promoting renewable energy sources and analysing the conditions for integrated electricity markets in the Mediterranean area. It is meant to be a think

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[39] See the Med-TSO (2012) presentation at the Mediterranean Energy Forum in Brussels, 20 June http://ec.europa.eu/energy/international/euromed_en.htm).

[40] Information in this section is based on the RES4MED website article (www.res4med.org/Pages/default.aspx).

tank on the energy context and prospects for regional Mediterranean energy systems, to improve the political, economic, industrial and social framework and to attract investments.

Asja Ambiente, Fondazione Bordoni and Terna Plus have subsequently joined as members while Althesys, RSE Ricerca di Sistema Energetico and Aper will act as affiliates. From its launch it will start a dialogue with other initiatives and institutional, industrial and financing stakeholders operating in the southern Mediterranean and in the Balkans.

RES4MED intends to be an additional reference point for southern Mediterranean and Balkan stakeholders and expects to play the role of 'network of networks' for the ongoing Mediterranean initiatives by

i) contributing to a faster deployment of RE plants and systems in order to satisfy southern and eastern countries' needs – both large-scale power and distributed energy;

ii) supporting the planning and design facets of additional national electric grids to supply an efficient distribution of clean energy towards local consumption centres;

iii) fostering medium-term regional interconnections between the southern EU, northern Africa and the Balkans in order to facilitate the import of part of the energy produced, also to increase the bankability of such projects; and

iv) considering the social and economic benefits for host countries.

The association will carry out the following activities:

- analysis of regulatory, technical and financial aspects;
- feasibility studies for the development of RE and energy efficiency projects;
- organisation of seminars, conferences and events, and the release of publications;
- collaboration within the main associations active in the energy field to develop technical and economic research synergies;
- training workshops to improve knowledge and technology transfers in RE and energy efficiency sectors; and
- experience exchange on existing projects by creating a dialogue platform.

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Appendix. The EuroMed Partnership in the field of energy

A1. The EuroMed Partnership

In November 1995, following a decision made by the European Council, a Euro-Mediterranean Conference of Foreign Affairs Ministers was held in Barcelona. It marked the launch of the Euro-Mediterranean Partnership, also known as the 'Barcelona process'. It was the first step towards a comprehensive EU policy for the region.[41]

The Barcelona Declaration laid down the foundations of a new regional relationship, aiming at achieving peace, stability and growth in the Mediterranean partner countries. It covers political, economic and social cooperation and represents a turning point in Euro-Mediterranean collaboration.

The partner countries participating in the Barcelona process are now part of the European Neighbourhood Policy (ENP) developed in 2004, following the enlargement of the EU, in order to avoid the emergence of new dividing lines in Europe. The ENP complements and reinforces the Barcelona process on a bilateral basis, through Action Plans agreed with the partner countries that take into account their specific needs and characteristics.

The policy is financed through the European Neighbourhood and Partnership Instrument (ENPI) and managed by EuropeAid, which is charged with turning policies taken on a political level into actions on the ground.

A new impetus was given to the Euro-Mediterranean Partnership in 2008 through the Union for the Mediterranean launched in Paris on July 13th.

The 27 EU member states and 9 Mediterranean partners (Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, the Occupied Palestinian Territory, Syria and Tunisia) participate in the EuroMed process.

Cyprus, Malta and Turkey are three countries that were part of the Barcelona process at its launch. However, Cyprus and Malta joined the EU in 2004, while in December 1999 at the Helsinki European Council, Turkey became a candidate country for EU accession and is now in accession talks.

The Barcelona Declaration promotes three partnership areas:

- a political and security dialogue to achieve a common area of peace and stability based on respect for human rights and democracy;
- an economic and financial partnership and the gradual establishment of a free trade area to create a zone of shared prosperity and to support economic transition in the partner states; and
- a social, cultural and human partnership to encourage understanding between peoples and cultures and exchanges between civil societies.

A2. EuroMed projects

A2.1 The Union for the Mediterranean

The Union for the Mediterranean (UfM) was launched in Paris on 13 July 2008 in a bid to give a new impulse to the Barcelona process and to promote economic integration and democratic reform within the Mediterranean region. The heads of state or government of 43 countries of the Mediterranean and the EU member states were present.[42]

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[41] See the website article by the EU Neighbourhood Info Center, "The EuroMed Partnership" (http://www.enpi-info.eu/medportal/content/340/About%20the%20EuroMed%20Partnership).

[42] See the website article by the EEAS, "Euro-Mediterranean Partnership (EUROMED)" (http://www.eeas.europa.eu/euromed/index_en.htm).

This re-launch was an opportunity to render relations more concrete and more visible, with the initiation of new regional and sub-regional projects with real relevance for the economies of the region. Projects address areas such as the economy, environment, energy, health, migration and culture.

Along with the 27 EU member states, 16 southern Mediterranean, African and Middle Eastern countries are members of the UfM: Albania, Algeria, Bosnia and Herzegovina, Croatia, Egypt, Israel, Jordan, Lebanon, Mauritania, Monaco, Montenegro, Morocco, the Palestinian Authority, Syria, Tunisia and Turkey.

Currently meetings are co-presided over by one Mediterranean and one EU country. As of September 2010, the UfM has also had a functional secretariat, based in Barcelona, a secretary-general and six deputy secretary-generals.

Following the entry into force of the Lisbon Treaty, governance from the EU side is to be rearranged with the establishment of the European External Action Service (EEAS).

The UfM has a number of key initiatives on its agenda:

- the de-pollution of the Mediterranean Sea, including coastal and protected marine areas;
- the establishment of maritime and land highways that connect ports and improve rail connections so as to facilitate movement of people and goods;
- a joint civil protection programme on prevention, preparation and response to natural and man-made disasters;
- a Mediterranean solar energy plan that explores opportunities for developing alternative energy sources in the region;
- a Euro-Mediterranean University, which was inaugurated in Slovenia in June 2008; and
- the Mediterranean Business Development Initiative, which supports small businesses operating in the region by first assessing their needs and then providing technical assistance and access to finance.

A2.2 The EuroMed Partnership's actions on energy

The EuroMed Partnership is organised into three main dimensions:[43]

- political and security dialogue, aimed at creating a common area of peace and stability underpinned by sustainable development, rule of law, democracy and human rights;
- economic and financial partnership, including the gradual establishment of a free-trade area aimed at promoting shared economic opportunity through sustainable and balanced socio-economic development; and
- social, cultural and human partnership, aimed at promoting understanding and intercultural dialogue between cultures, religions and people, and facilitating exchanges between civil society and ordinary citizens, particularly women and young people.

Energy is part of the "Economic and financial partnership" dimension. The Barcelona Declaration adopted at the Euro-Mediterranean Conference in 1995 refers to the energy issue as follows:

> The participants…acknowledge the pivotal role of the energy sector in the economic Euro Mediterranean partnership and decide to strengthen cooperation and intensify dialogue in the field of energy policies. They also decide to create the appropriate framework conditions

[43] See the website article by the EEAS, "The Barcelona Process" (http://www.eeas.europa.eu/euromed/barcelona_en.htm).

> for investments and the activities of energy companies, cooperating in creating the conditions enabling such companies to extend energy networks and promote link-ups.

With the introduction of European Neighbourhood Policy in 2004, the Barcelona process essentially became the multilateral forum of dialogue and cooperation between the EU and its Mediterranean partners, while complementary bilateral relations are managed mainly under the ENP and through Association Agreements signed with each partner country.

The EU works closely with each of its Mediterranean partners to establish support programmes for economic transition and reform, which take into account each country's specific needs and characteristics.

In 2005, the Barcelona summit agreed on a five-year work programme, which contained a strong commitment on energy:

> With a view to contributing to the above objectives and based on the Barcelona Declaration, Euro-Mediterranean partners will…[i]mplement sub-regional energy projects to promote a Euro-Mediterranean energy market, including the progressive integration of Mashrek-Maghreb electricity networks with the EU electricity network; the integration of Middle East gas networks, energy cooperation between Israel and the Palestinian Authority; and several important pipeline connections.[44]

A2.3 Some major regional projects on energy implemented within the framework of the EuroMed Partnership

a) Paving the Way for the Mediterranean Solar Plan

According to the brief report[45] on the website of the project "Paving the Way for the Mediterranean Solar Plan" (PWMSP), this initiative will go one decisive step further by defining large-scale projects harvesting renewable energy sources, in particular solar energy, for power generation, by developing electricity grid interconnections and by improving energy efficiency. The project supports the development of renewable sources in a modern and efficient energy regulatory framework in the Mediterranean partner countries and strengthens their cooperation with EU energy regulators.

- Countries involved: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Occupied Palestinian Territory, Syria and Tunisia; Libya recently joined the project
- Timeframe: 2010–13
- Budget: €5 million

The PWMSP addresses the nine southern Mediterranean partner countries of the European Union and will assist them in valorising the results that have been achieved so far and which are materialising in a number of ongoing initiatives, and bundle them for the creation of a framework and climate that is conducive for the MSP. It will provide the European Union and the Mediterranean partner countries a platform for dialogue and for the preparation of joint activity. The project will perform the necessary analytical work on the key issues involved and feed the results into the dialogue in order to facilitate progress through a well-informed debate.

The PWMSP concentrates on four thematic lines of activities, all designed to facilitate concrete actions under the MSP and to maximise their benefit for all parties involved. The first line of activities supports the Mediterranean partner countries in creating the appropriate, harmonised regulatory framework for RES-based investments in the power sector; the second line facilitates the transfer of

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[44] See EuroMed, "Five Year Work Programme", Final text, 2005 (http://www.eeas.europa.eu/euromed/summit1105/five_years_en.pdf).

[45] See Paving the Way for the Mediterranean Solar Plan, "Project Brief", PWMSP, Cairo (undated) (http://www.pavingtheway-msp.eu/fileadmin/paving-the-way/PWMSP-Project-Brief-Sept-2011.pdf).

know-how and experience between the Mediterranean partner countries themselves and with the EU member states and promotes cooperation in research, development and innovation and the transfer of clean technologies; the third line of activities supports the Mediterranean partner countries in implementing sustainable energy policies promoting the use of renewable energy sources in power generation and energy efficiency; and the fourth line helps to improve the economic and financial framework for investments in the use of renewable energy for power generation, in particular in solar energy. Completely interwoven into these four lines of activities are the horizontal activities evaluating the Mediterranean grid and the European electrical backbone, and the data and information collection for the implementation of the MSP.

The project unfolds in various types of activities, including the development of national and regional road maps for regulatory reform, for institutional development, and for transfer of knowledge, training courses, the development of study reports on various issues involved, regional and sub-regional workshops and seminars. The activities are implemented in close cooperation with national authorities and they involve the largest number of stakeholders concerned. Synergies are being sought with the activities of regional institutions like the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) and with other related projects. Close collaboration with other EU-funded projects, such as with the Mediterranean Regulators Association (MEDREG), Med-TSO (Mediterranean Association of Transmission System Operators), MED-EMIP (Euro-Mediterranean Energy Market Integration Project) and MED-ENEC II (Energy Efficiency in the Construction Sector) maximise synergies, avoid overlap and improve sustainability.

The project is financed by the European Commission and lasts three years, having started in September 2010. The consortium is led by the German consulting firm MVV decon and includes four more Euro-Mediterranean companies as well as two national, EU transmission system operators, TERNA (Italy) and RTE (France). A further member of the consortium is ENEA (Italy), which is one of the major, national EU energy agencies and, last but not least, the consortium is completed by Sonelgaz (Algeria), one of the major energy utility companies in the Mediterranean partner countries. Associated members of the consortium will contribute to the extensive know-how brought into the project, the most important among them being the Florence School of Regulation and GSE, an Italian institution designated for the promotion of RES.

The project resources include the full-time services of a team leader, a deputy team leader and the part-time services of a financial expert. In addition to these three key experts the project makes available a total of 1,200 working days of specialised experts. In each Mediterranean partner country, the project employs a national expert on a part-time basis as a country project coordinator.

Cairo is the location of the main project office and a satellite project office has been set up in Rabat. Project activities and events are held in different Mediterranean partner countries in accordance with thematic and logistical considerations.

b) Euro-Arab Mashreq Gas Market Project

This project supports the development of an integrated gas market in order to create a regional gas market and as a step towards integrating with the EU gas market.[46]

- Countries involved: Egypt, Iraq, Jordan, Lebanon, Syria and Turkey
- Timeframe: 2010–13
- Budget: €5 million EU contribution

The project aims at improving regional integration of the energy market in general and of the gas market in particular in the partner countries, in order to achieve legislative and regulatory

[46] See the website article by the EU Neighbourhood Info Center, "EAMGM II – Euro-Arab Mashreq Gas Market Project" (http://www.enpi-info.eu/mainmed.php?id_type=10&id=302).

harmonisation among them and with the EU. During the first phase, Iraq and Turkey participated as observers. In the Euro-Arab Mashreq Gas Market Project II, Iraq is a full partner.

Its main activities comprise assistance for preparatory legislative work and regulatory reforms as well as studies, including network development surveys and updates of the gas master plan. It also undertakes detailed economic and financial analyses for key investments, inter alia providing expert advice to determine which feasibility studies by international financial institutions (e.g. the European Investment Bank) would be necessary, along with training activities and study tours, including advanced training on regulation, legislation and management issues. Capacity and institutional building with the relevant energy stakeholders are also part of its activities. The project undertakes studies to expand the Arab Gas Pipeline, including connection to additional national networks, and contributes to developing gas flows among the Mashreq countries concerned, as well as to the EU.

c) Electricity market integration

This project supports the development of an integrated electricity market between Algeria, Morocco and Tunisia and between these three Maghreb countries and the EU.[47]

- Countries involved: Algeria, Morocco and Tunisia
- Timeframe: 2007–10
- Budget: €4.9 million (MEDA)

The project aims at harmonising the legislative and regulatory framework, as well as the industrial sectors, of the three beneficiary countries (Algeria, Morocco and Tunisia), in order to create an integrated electricity market. It supports the alignment of their legislative and regulatory frameworks with European standards in order to gradually integrate these electricity markets with that of the EU.

The project focuses on the development of an integrated electricity market among these three Maghreb countries through the adoption of a strategy, together with a plan of action, that will help them adapt their legislative and regulatory frameworks. It enhances the technical knowledge of the different actors, including regulators and ministries, with a view to creating a market that is compatible with the legislative framework of the EU's electricity market. Training of the actors of the electricity sector in beneficiary countries on technologies used in the EU and the best industrial and regulatory practices is also undertaken, along with the strengthening of the technical and managerial qualifications of the operators of their electricity markets.

d) MED-EMIP – Energy cooperation

The Euro-Mediterranean Energy Market Integration (MED-EMIP) project aims at creating a platform for energy policy dialogue and the exchange of experiences.[48]

- Countries involved: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Occupied Palestinian Territory, Syria, Tunisia and Turkey
- Timeframe: 2007–10
- Budget: €4.1 million (MEDA)

The project aims at enhancing the integration of the energy markets in the Euro-Med region and promoting improved security and sustainability. It supports the transfer of knowledge on issues related to renewable energy, encouraging its use in the Mediterranean partner countries.

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[47] See the website article by the EU Neighbourhood Info Center, "Electricity market integration" (http://www.enpi-info.eu/mainmed.php?id=25&id_type=10).

[48] See the website article by the EU Neighbourhood Info Center, "MED-EMIP – Energy cooperation" (http://enpi-info.eu/mainmed.php?id=26&id_type=10).

The project is establishing a regional platform for energy policy dialogue and exchanges of experience, secure energy supplies, diversified energy sources and reduction of the environmental impact of energy-related activities.

It promotes energy sector reform in the Mediterranean countries, with a shift towards sustainable and clean energy, facilitates dialogue in and among these countries to help them in achieving consistency, harmonisation and convergence of their national energy policies and institutional and legislative frameworks, and stimulates technology transfer and market development.

It provides an internet-based information system, including technical and management tools. Support for each partner country is based on the needs established during visits for meetings with the national authorities, in such fields as energy strategy formulation and legislative advice.

e) MED-ENEC II (Energy Efficiency in the Construction Sector)

This project encourages energy efficiency and the use of solar energy in the construction sector, through capacity building, fiscal and economic instruments and pilot projects.[49]

- Countries involved: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Occupied Palestinian Territory, Syria, Tunisia and Turkey
- Timeframe: 2009–13
- Budget: €5 million

The project encourages energy efficiency and the use of solar energy in the construction sector, playing a major role in the design and implementation of cooperation efforts between the EU and its Mediterranean Partners and among the Partners themselves.

The Energy Efficiency in the Construction Sector II (MED-ENEC) project, which follows on from MED-ENEC I, carried out between 2005 and 2009, also endeavours to raise public awareness and involve civil society in climate-oriented building techniques, energy efficiency and renewable energy use in buildings.

The project focuses on strengthening business services and supporting markets, improving institutional capacities and establishing favourable institutional structures as well as fiscal and economic instruments. Pilot projects are carried out to demonstrate best practices and for training purposes. Established dissemination structures are used to ensure knowledge transfer. To build capacity, it organises national and regional workshops and consulting events, while encouraging the creation of information, communication and cooperation networks. The project also offers instruments, standards and incentive measures to policy-makers, supports communities, real estate developers and building owners with comprehensive and cost-effective services.

f) MED-REG II – Energy regulators

This project supports the development of a modern and efficient energy regulatory framework in the Mediterranean partner countries and strengthens their cooperation with the EU's energy regulators.[50]

- Countries involved: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Occupied Palestinian Territory, Syria and Tunisia
- Timeframe: 2010–12
- Budget: €919,200

[49] See the website article by the EU Neighbourhood Info Center, "MED-ENEC II – Energy efficiency in construction" (http://www.enpi-info.eu/mainmed.php?id=303&id_type=10).

[50] See the website article by the EU Neighbourhood Info Center, "MED-REG II– Energy regulators" (http://www.enpi-info.eu/mainmed.php?id=304&id_type=10).

The project aims at strengthening cooperation between the EU's energy regulators and those of the Mediterranean partner countries by helping them to develop a modern and efficient regulatory framework. This is important for the setting-up of an integrated Euro-Mediterranean energy market. The project "Support to Cooperation between the Euro-Mediterranean Energy Regulators (MEDREG II)" endeavours to facilitate information exchanges and concerted approaches between EU and partner countries' regulators, and to assist the Mediterranean countries in establishing independent energy regulators, empowering those that already exist and developing the technical capacities of their staff.

The project focuses on the creation of a network for information exchanges and assistance between EU and Mediterranean partner countries' regulators. It supports the transfer of knowledge, as well as the signature of memoranda of understanding and/or recommendations on the minimum competencies and requirements that Euro-Mediterranean regulatory authorities would need in order to reach a consistent, harmonised and investment-friendly regulatory framework.

Its main activities are carried out through the General Assembly and ad hoc groups, comprising officials working within the national regulatory authorities. It will organise the training of Mediterranean regulatory authorities' staff by the Florence School of Regulation. MED-REG action will result in consolidation of the network of EuroMed energy regulators and implementation of minimum competences and organisational structures in Euro-Mediterranean regulatory authorities.

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
Budget and Funding	Total budget: €3,088,573 EC-DG RESEARCH contribution: €2,647,330
Duration	1 April 2010 – 31March 2013 (36 months)
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