Renewable Energy Situation in the MEDREC Countries

September 2004

FOREWORD

The development and the diffusion of renewable energy resources and technologies will help realise important economic, environmental and social objectives in the future of industrialised and developing countries, representing a crucial element for achieving sustainable development.

The G8 Renewable Energy Task Force recommendations to overcome barriers to renewable energy deployment in developing countries, the 2002 World Summit on Sustainable Development agenda (Johannesburg) on energy for sustainable development and the 2004 International Conference for Renewable Energy (Bonn), represent concrete international commitments in tackling the global challenge of renewable energy penetration in the world energy portfolio.

The Mediterranean Renewable Energy Programme (MEDREP), a Type II Initiative launched by Italy in Johannesburg in 2002 for the promotion of renewable energy in the Mediterranean Region, represents a successful response to these challenges, promoting a broad partnership among Governments, international institutions and stakeholders with historic trade, cultural and social links.

In the framework of MEDREP, the Mediterranean Renewable Energy Centre (MEDREC) has been established in Tunis by a Memorandum of Understanding between the Italian Ministry for the Environment and Territory, the Tunisian Ministry for Industry and Energy, and the Tunisian Agency for Energy Efficiency.

MEDREC is a Centre for training, information dissemination, networking and development of pilot projects and the reference point for the MEDREP activities in the Maghreb countries. It involves experts from Algeria, Egypt, Libya, Italy, Morocco, Tunisia, OME and UNEP and represents an example of international co-operation that will lead to unprecedented results in the promotion of renewable energies in the Region.

MEDREC activities meet the need of the Maghreb countries to expand and modernise their energy systems and services, to diversify their economies creating new market opportunities and to provide a suitable solution to rural electrification.

The work presented in this document, carried out by the Directors and the experts of MEDREC Centre, refers to the regional and country basis situation of renewable energy in the MEDREC countries.

Starting from this work, the aim of MEDREP partners is to build a solid follow-up in their common approach to climate changes and for affordable and sustainable access to energy in the Mediterranean Region.

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AKNOWLEDGEMENTS

This document has been coordinated, managed and written by Houda Ben Jannet Allal, Deputy Director of MEDREC, and benefits from the inputs of the following experts: Lahrech Zakia, Ministry of Territory and Environment of Algeria, Rafik Youssef Georgy, New & Renewable Energy Authority of Egypt, Mohammed Bakri, Centre for Renewable Energy Development of Morocco, Imed Thabet, Agency for Energy Efficiency of Tunisia, Habib Elandaloussi and Rabia Ferroukhi, Observatoire Méditerranéen de l'Energie, Myriem Touhami and Sami Kamel, United Nations Environment Programme, Division for Technology, Industry and Economics.

The Technical Director of MEDREC, Sami Marrouki, and the Deputy Director Marco Polverari provided support and guidance.
Silvia Ferratini, Mario Lionetti and Silvia Vaghi, Italian Ministry for the Environment and Territory, have supported the start up and the designing phases of the work and the coordination of the activities.

Special thanks go to the following for their support to MEDREC activities: Mohammed Si Youcef, General Secretary, Ministry of Territory and Environment of Algeria, Hosni El Kholy, Executive Chairman of New & Renewable Energy Authority of Egypt, Omar M. I. Sudani, Secretary of the Peoples Committee, Environment General Authority of Libya, Mohammed Berdai, Director General, Centre for Renewable Energy Development of Morocco, Ezzedine Khalfallah, Director General, National Agency for Energy Efficiency of Tunisia, Giuseppe Maria Sfligiotti, Director General Observatoire Méditerranéen de l'Energie, Monique Barbut, Director, United Nations Environment Programme, Division for Technology, Industry and Economics.

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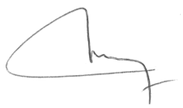

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ACRONYMS

CDER: Centre de Développement des Energies Renouvelables

CDM: Clean Development Mechanism

EC: European Commission

IEA: International Energy Energy

IMET: Italian Ministry for Environment and Territory

koe: kilo oil equivalent

kWh: kilowatt-hour

MEDREC: Mediterranean Renewable Energy Center

MEDREP: Mediterranean Renewable Energy Programme

MW: megawatt

NMCs: Northern Mediterranean countries

NREA: New and Renewable Energy Agency

OME: Observatoire Méditerranéen de l'Energie

PV: photovoltaic

REWP: Renewable Energy Working Party

REWP: Renewable Energy Working Party

SEMCs: Southern and Eastern Mediterranean Countries

SEMCs: Southern and Eastern Mediterranean Countries

TMIE: Tunisian Ministry for Industry and Energy

TPES: Total Primary Energy Supply

TWh: Terawatt-hour

UNEP: United Nations Environment Programme

Introduction

Renewable energy is inexhaustible and abundant.

Ultimately it was the origin of fossil fuels which became the basis on which the Industrial Revolution was built.

These sources of energy however will not last forever and have proven to be one of the main sources of our environmental problems. It is clear therefore that in due time renewable energies will dominate the world´s energy system, due to their inherent advantages such as mitigation of climate change, generation of employment and reduction of poverty, as well as increased energy security and supply (J. Goldemberg, 2004).

The Mediterranean region is endowed with high potential of renewable energy resources. However, the full potential and advantages of renewables are hindered at present in this region (as it is the case almost everywhere) due to the existance of many barriers, amongst which the institutional barriers and the prices of fossil fuels that do not always reflect their full cost.

Prices of conventional energy sources are often subsidized in Southern and Eastern Mediterranean countries and the "externalities" associated with the use of such resources, such as additional health and environmental costs are not considered. Removing subsidies from fossil fuels would make renewables competitive in many areas. For renewable energies to achieve their market potential, policy frameworks and financial instruments are necessary to give financiers the necessary assurance and incentives to shift investment away from carbon-emitting conventional technologies to large-scale investment in clean energy systems (V. Sonntag-O'Brien, BASE & E. Usher, UNEP, 2004).

Generally speaking the use of renewables might benefit from bilateral and regional cooperation.

A regional cooperation in the field of renewable energy in the Mediterranean region is necessary and can significantly benefit both to the sustainable development of the region while playing an important role in meeting the Kyoto targets in the region.

After the Johannesburg World Summit for Sustainable Development (WSSD), a number of programs to that effect were presented to the United Nations Secretariat to promote sustainable energy programs in developing countries, 23 of these with energy as a central focus.

These partnerships included the Mediterranean Renewable Energy Partnership (MEDREP[1]) launched by Italy aiming for the development of a sustainable renewable energy market in the Mediterranean region.

In the framework of MEDREP, the Italian Ministry for Environment and Territory (IMET), the Ministry for Industry and Energy

of Tunisia (TMIE) and the Tunisian National Agency for Energy Conservation (ANME), recently established in Tunis the Mediterranean Renewable Energy Center (MEDREC), a Centre for training, information dissemination, networking and development of pilot projects in the field of renewable energies.

The Centre also plays the role of reference point for the programmes carried out by the partners.

This report has been prepared in the framework of the permanent activities of MEDREC.

The objective is to give a synthetic analysis of the renewable energy market in the MEDREC countries[2] and the prospects foreseen by the each of them.

The first part deals with the energy and renewable energy contest and current situation at the regional level and the second part presents a country-based analysis.
The report will be regularly updated.

[1] *The partners of MEDREP are: the Italian Ministry of the Environment and Territory (IMET), the Ministry of Territory and Environment of Algeria, the New & Renewable Energy Authority of Egypt (NREA), the Environment General Authority of Libya (EGA), the Ministry for Resources and Infrastructure of Malta, the Centre for Renewable Energy Development (CDER) of Morocco, the Ministry for Industry and Energy of Tunisia (TMIE), the Tunisian National Agency for Energy Conservation (ANME), the Ministry of Water and Environment of Yemen, the French Agency for Environment and Energy Management (ADEME), the International Energy Agency (IEA), the International Solar Energy Society-Italy (ISES ITALY), the Mediterranean Association of the National Agencies for Energy Conservation (MEDENER), the Observatoire Méditerranéen de l'Energie (OME), the Regional Environmental Centre for Central and Eastern Europe (REC), the United Nations Environment Programme (UNEP) and the World Bank.Other partners will also shortly be involved in the partnership, being MEDREP a co-operative programme with Countries bordering on both the North and the South of the Mediterranean. MEDREP is committed to develop and reinforce potential synergies with other initiatives and partnerships in the sector of renewable energies, such as JREC (Joint Renewable Energy Coalition) and REEEP (Renewable Energy and Energy Efficiency Partnership).*

[2] *The MEDREC countries are: Algeria, Egypt, Libya, Morocco and Tunisia.*

PART 1

THE REGIONAL CONTEXT

Chapter I.

The energy context in the MEDREC countries

Despite being neighbours and grouped around a commonly shared sea, the Mare Nostrum, the MEDREC countries are not equally endowed with energy resources. Algeria, Libya and Egypt are hydrocarbon exporting countries while Tunisia (small producer) and to a much greater degree Morocco are energy dependent.

The MEDREC are facing rapid demographic growth combined with relatively low incomes, rapid urbanisation and strong socio-economic development needs. This translates in new and growing demand for energy services and related infrastructures. Indeed, in all countries, energy demand and especially electricity are increasing rapidly. However, all of them have important potential for improving their energy use and efficiency, thereby strengthening the security of their supply while contributing to a more sustainable energy development path.

The population of the MEDREC countries was 143 million in 2002, and is expected to increase to 187 million in 2020 according to the United Nations (Plan Bleu). The medium GDP per capita amounted to 1,662 US $ (1995) in 2002, to be compared with 20,000 US$ in countries of the Northern shore of the Mediterranean. Moreover, the urban populations are expected to increase more rapidly. The majority of these populations are and will be located in costal regions, which will become more and more over crowded and ecologically threatened. This double phenomenon of urbanisation and littoral concentration will have a marked influence on the nature of energy use in the future.

Table 1 Population of the MEDREC Countries

						Annual growth rate	
M people	**1990**	**2000**	**2002**	**2010**	**2020**	**1990-2000**	**2000-2010**
Algeria	24.9	30.4	31.3	34.9	39.9	2.0%	1.4%
Egypt	52.4	64.0	66.4	78.2	89.6	2.0%	2.0%
Libya	4.4	5.3	5.4	7.2	8.3	1.9%	3.1%
Morocco	24.0	28.7	29.6	32.3	36.3	1.8%	1.2%
Tunisia	8.2	9.6	9.8	10.9	12.3	1.6%	1.3%
MEDREC	**113.9**	**138**	**143**	**163.5**	**186.4**	**1.9%**	**1.8%**

Sources: UN, AIE

1.1. Diversity of situation vis-à-vis conventional energy resources

The Southern and Eastern Mediterranean countries (SEMCs) have important oil reserves amounting to more than 6000 Mt but the situation varies significantly between countries. Indeed, some two thirds of total reserves are located in Libya, a quarter in Algeria and minor quantities in Egypt and Syria. Thus, oil reserves in Mediterranean region are mostly concentrated in the MEDREC countries (see Figure 1). There may still be a further 3000-6000 Mt of oil resources to de discovered in these countries.

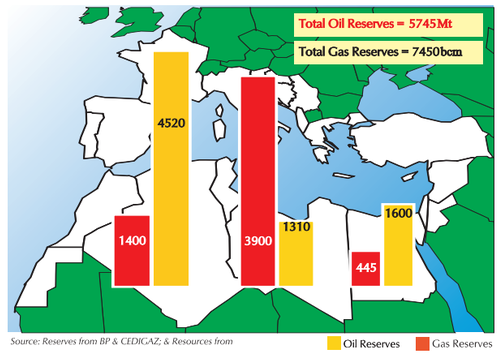
In 2002, the three MEDREC hydrocarbon producing countries exported some 132 Mt of hydrocarbon liquids, with Libya and Algeria each exporting some 60 Mt and Egypt 12 Mt. About two-thirds of these exports were destined to EU markets, accounting for 15% of their imports (see figure 2)

According to the recent «Medsupply» study coordinated by OME for DG-TREN, the region as a whole is expected to increase its total liquid hydrocarbon exports from some 150 Mt in 2002 to some 280 Mt by 2020. The situation, however, will vary between countries. Libya and Algeria could be expected to double their exports, while Egypt and Syria will become net oil importers due to the strong growth in domestic oil demand and a shrinking reserve base.

The MEDREC region is also endowed with significant proven gas reserves amounting to some 7500 bcm, two thirds of which are located in Algeria, and the rest in Egypt and Libya. Due to several large, still under-explored sedimentary basins (both onshore and offshore), many experts consider that there should be at least as many new gas reserves to be discovered as presently known. In 2002, more than 25% of total EU natural gas imports come from the MEDREC region, especially Algeria (see figure 2)

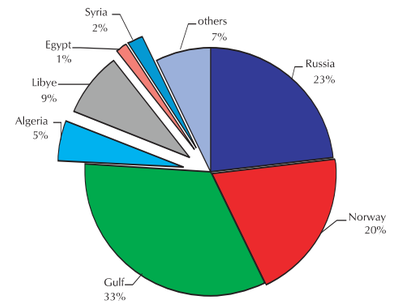
The «Medsupply» study has estimated that gas exports from SEMCs would increase from some 60 bcm in 2002 to some 180 bcm by 2020. Although only Algeria has been exporting significant volumes of gas, Libya and Egypt are expected to join the league of important gas suppliers by 2020. By then, gas exports potential should reach some 120 bcm in Algeria, 30 bcm in Egypt and 25 bcm in Libya.

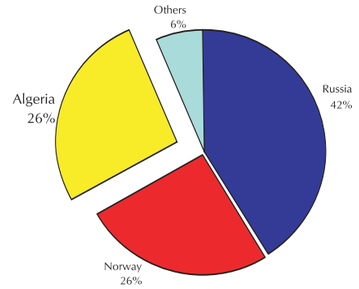
Figure 1 Oil (Mt) & Gas (bcm) Reserves in the MEDREC countries



Source: Reserves from BP & CEDIGAZ; & Resources from

Figure 2 EU15 Oil and Gas (bcm) imports in 2002





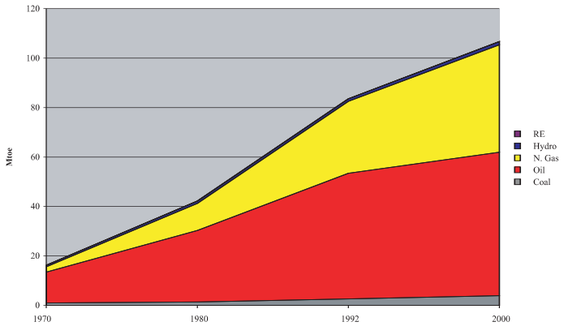
1.2. Common situation vis-à-vis energy demand trends

Primary energy demand in MEDREC countries has been growing very rapidly during the last decades from 42 Mtoe in 1970 to 107 in 2000 (see figure 3.). This trend is expected to continue and, according to OME scenarios, demand is expected to increase from 106 Mtoe in 2000 to some 157.4 Mtoe by 2010. This growth is, among other things, driven by the increase in electricity demand.

As illustrated in Figure 4, primary energy consumption in the MEDREC countries is dominated by hydrocarbon sources with more than 54% for oil and almost 41% for natural gas. The share for coal, hydro and renewable energy are respectively 3.6 %, 1.2% and 0.03%. The contribution of renewable energies in the energy balance of the region is marginal at present. But it should increase in a near future. Moreover, the share of natural gas is expected to increase more rapidly in the coming years because of the availability of resources and also its environmental friendly character.

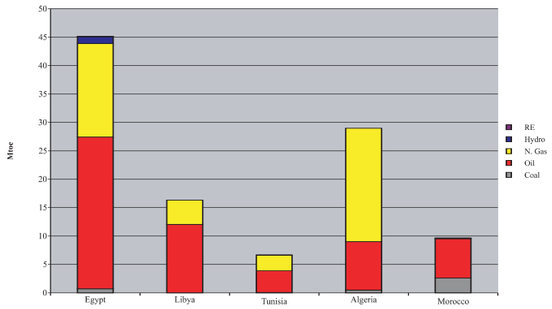
The situation by country varies and is linked to the energy situation of each country (see Figure 5). The energy context by country is detailed in Part 2 of the report. Morocco, energy dependent, consumes mostly oil and coal. In Algeria, energy consumption is dominated by gas and to a lesser extent oil. Finally, oil dominates consumption in Libya, Egypt and Tunisia.

Figure 3 Primary energy consumption in MEDREC countries (by source) in 2000



Source: OME

Figure 4 Primary energy consumption in MEDREC countries (by source) in 2000



Source: OME

It is important to underline that the average level of energy consumption per capita in the MEDREC region is much lower than that of the Northern Mediterranean countries (3 times in 2000; 12 times between France -4200 koe per capita- and Morocco -350 koe per capita - in the same year). This situation is worst for electricity consumption (4 times in 2000; 20 times between France -9000 kWh per capita- and Morocco -less than 500 kWh per capita- in the same year).

1.3. Spectacular electricity demand increase in all countries

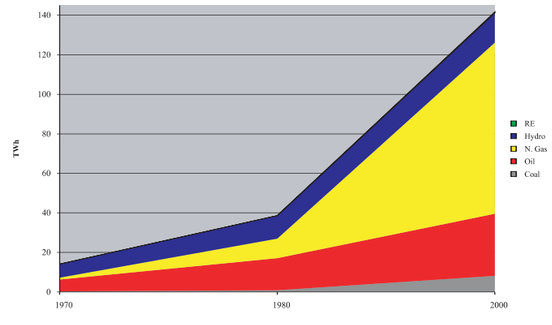
The analysis of the electricity consumption in the MEDREC countries during the last three decades indicates a spectacular increase (almost 10 times in 30 years) which is higher than the energy demand and GDP growths. This trend is expected to continue (6 to 7% average annual growth expected up to 2020).

As illustrated in Figure 6, power production in the MEDREC countries is dominated by hydrocarbon sources with 61.2 % for natural gas and 22.2 % for oil. The share for coal, hydro and renewable energy are respectively 5.7 %, 10.6% and 0.3%. The contribution of renewable energies in the power production of the region represents almost 11% of total power generation and is dominated by large hydro sources. However, this share should increase in a near future. The share of natural gas is also expected to increase in the near future because of the availability of resources as well as its environmental friendly character.

In order to meet the growing electricity demand, additional capacities have to be installed, which will require substantial energy and financial needs. Indeed, according to OME prospects, electricity generation in the MEDREC region will almost double by 2010, increasing from 141 TWh in 2000 to 245 TWh. This involves the construction of more than 23 000 MW capacity, the greatest part of which would be natural gas fuelled power stations given their low costs of and the availability of resources in the region.

In addition to new power generation capacity, it must be emphasized that it is equally important that electricity transmission and distribution networks be further developed, strengthened and reinforced. This includes also carrying on rural electrification policies with adequate funding mechanisms.

Figure 5 Power production in the MEDREC countries



Source: OME

Such infrastructure development (both for power generation and transmission/distribution networks) does require substantial, timely and sustained investments. Based on OME estimates and data collection from MEREC 'power industry, investment requirements for the electricity sector in these countries should represent more than 60% of total investment needs of the energy sector in the region. About 60% should be dedicated to power generation, 25% to electricity transmission and 15% to electricity distribution.

Therefore, in order to supply the MEDREC countries with sustainable electricity servic-

es, it is essential to develop a strong demand side management (DSM) strategy, promote clean electricity supply, optimise the electric supply networks and reinforce electric interconnections in the Mediterranean region.

Within this context, the MEDREC countries are facing three major challenges in the development of their electricity sector:

-The first concerns the difficulties of mobilising financial resources both for new power generation capacities and transmission/distribution networks;

-The second deals with electricity interconnections and creation of regional power markets (both South-South and South-North);

-Finally, the third addresses sustainable development (that is, the rational use of energy and renewable energy sources).

These three challenges can be perceived, in the framework of the Euro-Mediterranean Partnership as an opportunity for investment, an opportunity for the promotion of a Mediterranean regional interconnected market and an opportunity for the promotion of sustainable development. This situation also underlines the importance of regional initiatives such as MEDREP in addressing these issues, and is the case of its initiative to develop renewable energies, which will address at least two of the above mentioned challenges. Electricity being one of the essential factors for development, the Euro-Mediterranean region will gain from such enhanced co-operation.

In the following section, we review the situation of the Mediterranean electric interconnections. They allow - inter alia- the reduction of new power plants construction and savings on investments and fuels. When completed, the "Mediterranean Loop" will offer the opportunity to link all the Mediterranean countries with clean and green power, contributing hopefully to the stability and sustainable development of the region.

1.3. Situation and prospects of the electricity interconnection of the Mediterranean region

In 2000, electricity trade between Mediterranean countries and their neighbours reached 94 TWh, including: 74 TWh from France (including 25.5 TWh supplied directly to Mediterranean countries), 7.4 TWh exported by Spain (including 4.6 TWh to Portugal, 0.6 TWh to France and 2.2 TWh to Morocco), 4.7 TWh exported by Slovenia to Italy and 3.8 TWh exported by Portugal to Spain.

The total power exchanges between Mediterranean countries reached 45 TWh in 2000 (see details in the table below), of which only 5 TWh exchanged between Southern and Eastern Mediterranean Countries (SEMCs), and includes the exchanges with Europe (Morocco-Spain). This is due to the limited capacity of existing power interconnections in the SEMCs.

The largest share of the 5 TWh exchanged between SEMCs took place mainly between Morocco and Spain, Morocco-Algeria-Tunisia as well as Syria-Lebanon, Egypt-Libya and Egypt-Jordan.

In addition to the existing interconnections, namely those of the Maghreb, Algeria is already interconnected to Tunisia (4 connections) and to Morocco (2 connections), recent connections were brought into service, including those linking Spain to Morocco, Libya to Egypt, Egypt to Jordan, and Syria to Jordan and Lebanon.

Table 2- Electricity trade between Mediterranean Countries in 2000 (GWh)

Electrical Interconnections	Export	Import	**Total**
Portugal-Spain	3765	4597	**8362**
France-Spain	8447	587	**9034**
France-Italy	16142	393	**16535**
Itay-Slovenia/Croatia	73	4509	**4582**
Slovenia/Croatia-ExYoug./Macedonia	152	159	**311**
Greece-ExYoug./Macedonia	173	617	**790**
Greece-Albania	922	49	**971**
Albania- ExYoug./Macedonia	173	120	**293**
Spain-Morocco	2261	1	**2262**
Algeria-Morocco	99	65	**164**
Algeria-Tunisia	111	109	**220**
Egypt-Libya	111	128	**239**
Egypt-Jordan	217	53	**270**
Syria-Lebanon	1418		**1418**
TOTAL intra-Mediterranean	**34064**	**11387**	**45451**

Source: OME

In recent years, the SEMCs undertook to interconnect their power networks in order to further develop electricity exchanges. Among them, several interconnections are already in operation. (see table on the existing electrical interconnections in annex).

Several new interconnection projects are under way linking Tunisia to Libya (under construction), Tunisia to Algeria (fifth connection), Algeria to Morocco (third connection), and Syria to Turkey. Concerning the

interconnections presently planned at 220 kV, their voltage is planned to be increased to 400 kV at a later stage.

With the start-up of the Spain-Morocco link in 1997, the two Mediterranean shores are already interconnected. In the future, the interconnection of the two shores will be further strengthened with the doubling of the Spain-Morocco line, the new undersea cable from Algeria to Spain and the interconnection projects Turkey-Greece, Algeria-Italy and Tunisia-Italy.

Figure 6 Electric Interconnection in the Mediterranean Region

Source: OME & SYSTMED Group, 2003

Currently, the loop is still open. But the new projects will enable major SEMCs to interconnect as well as to connect with the European network following the completion of the "electrical loop" around the Mediterranean in 2005. OME is participating to the «MedRing[3]» study related to the behaviour of the "Mediterranean electrical loop" which is supported by the European Commission. The MedRing project (26 months study) is in progress and will be finished in May 2003. Thanks to the completion of "the Mediterranean electrical loop", an increase in Mediterranean electricity exchanges is expected by 2010. According to the estimations of the MedRing study, power exchange will increase from the current 45 TWh to 75 TWh by 2010. The economical benefits related to the reduction of production costs have been estimated by the same study in the order of 150-200 Millions of US$ per year.

To conclude, several kinds of benefits can be expected from interconnections. These are linked to the reduction in operating costs, lower investment costs in generation facilities, improvement of the security of supply, establishing competition, reduction in polluting gases emission, opportunities for green electricity trading and above all, linking all the countries (all in the same boat).

More generally, the SEMC are facing two major problems linked to the energy sector: how to meet the increasing demand for commercial energy for those with access (principally in the cities), and how to provide access to modern, efficient and clean forms of energy for the majority of the population in rural and isolated areas. Renewable energy technologies provide the best solution in many situations.

As for renewable energy, and as will be briefly detailed in the chapter 2, several projects carried out by the national agencies and companies and studies coordinated by the

Observatoire Méditerranéen de l'Energie[4] have revealed the large and untapped potential for the development of renewable energy that could be used to increase total energy supply especially, but not exclusively, by allowing access to energy to population with no access (mainly in rural areas and remote villages). The effective market penetration in most MEDREC countries in particular and in the SEMC in general, however, falls far below expectations.

[3]In the Med-Ring study project, most electricity companies from North, South and East Mediterranean are involved and almost all of them are OME members.
[4]These include in a chronological order: APAS, INTERSUDMED, IRESMED, MEMA, CDMED and MED 2010. These studies have been co-funded by the EC DG Research and performed by a Consortium of Euro-Mediterranean partners.

Chapter II.

Renewable Energy in the MEDREC region

2.1. Definitions of renewable energy

In general, the definition of renewable energy varies between countries and organisations. The various definitions for renewable sources are causing intensive disputes as the coverage of eligible renewable energy sources can make great difference in implementation of renewable promotion initiatives. This is mainly due to the fact that the definition of renewable energy is used in different connections. In a broad sense, renewable energy refers to sources that can be used as energy resources without their eventual depletion. For instance, the Renewable Energy Working Party (REWP) of the International Energy Agency has set down the following definition: "Renewable energy is energy that is derived from natural processes that are replenished constantly. In its various forms, it derives directly or indirectly from the sun, or from heat generated deep within the earth. Included in the definition is energy generated from solar, wind, biomass, geothermal, hydropower, and ocean energy and biofuels and hydrogen derived from renewable resources" (IEA, 2003).

In the context of the International Conference for Renewable Energies, Bonn 2004, renewable energy sources and technologies include: solar energy, wind energy, hydropower, biomass energy including bio-

fuels, and geothermal energy (ICRE, 2004).

However, the most notable feature of renewable energy sources is the diversity of sources/resources and technologies, making it difficult to define the coverage of renewable energy sources in a universal format.

The complexity increases when the definition is related to a time-bound target on renewable share on a global scale. The key issues triggering controversies on eligibility of different sources as renewables essentially originate from the understanding of two concepts: renewability and sustainability (NMC, 2004). The definitions of renewable energy sources adopted in this report as included in Box1.

Box 1. Renewable Energy Sources Definitions

Biofuels

All fuels generated from biomass, including solid (fuelwood, pellets), liquid (bioethanol, biodiesel, bio-oils), and gaseous (biogas, other gases).

Biomass

Biomass is defined as any plant matter used directly as fuel or converted into other forms before combustion. Included are wood, vegetal waste (including wood waste and crops used for energy production), animal materials/wastes, sulphite lyes and other solid biomass. It also includes charcoal produced from solid biomass.

Biomass use can roughly be divided into two categories, i.e. traditional use and modernised use of biomass. Modern biomass refers to more efficient and cleaner ways of using biomass for electricity generation, heat production and production of transportation fuels by adopting advanced technology such as gasification/pyrolisis, high efficient direct combustion, fermentation/hydrolysis and anaerobic digestion, rather than using biomass as fuelwood in a traditional way characterised by lower energy efficiency and indoor pollution. By traditional biomass we mean less efficient and more polluting combustion and other techniques (e.g. traditional stoves).

Geothermal

Geothermal energy is generated by converting hot water or steam from deep beneath the earth's surface into electricity. Geothermal energy can be used directly for heating or to produce electric power.

For electricity generation, unless the actual efficiency of the geothermal process is known, the quantity of geothermal energy input for electricity generation is inferred from the electricity production as geothermal plants assuming an average thermal efficiency of 10 per cent.

Primary production/consumption is directly used as heat for district heating, agriculture or greenhouses. Geothermal plants cause very little air pollution and have minimal impacts on the environment.

Hydroelectric

Dams provide electricity by guiding water down a chute and over a turbine at high speed. Hydropower does not produce any air emissions, but large dams have environmental issues such as flood control, water quality, and fish and wildlife habitat to deal with.

Hydro power plants have thus been divided into two categories: small-scale hydro power (SHP) and large-scale hydro power. There is no general international consensus on the definition of SHP; the upper limit varies between 2.5 and 25 MW in different countries, but a value of 10 MW is becoming generally accepted.

Ocean energy

There are seven quite different ocean energy resources that could conceivably be developed, namely: offshore wind, tidal/marine currents, wave energy, ocean thermal conversion (OTEC), tidal barrages, salinity gradient/osmotic energy and marine biomass fuels.

Solar

The sun's radiation is used directly to produce hot water and electricity in two ways. Photovoltaic (PV) systems turn sunlight into electricity directly by photovoltaic cells. Solar thermal systems use the sun's heat to heat water (solar water heating) by flat plate collectors, creating steam to turn a turbine and generator (solar thermal power).

Wind

Wind energy is the kinetic energy of moving air. Wind turbines use the wind to create electricity

2.2. Current situation of renewable energy in MEDREC countries

The MEDREC region has a vast potential for development of renewable energy due to the important renewable energy resources the region is endowed with (especially solar and wind). Moreover, in order to meet the energy (and more specifically electricity) needed for the social and economic development of the region, in a sustainable manner, it is essential to promote advanced and clean energy technologies, in particular renewable energy. The important role that renewable energy could play in contributing to the sustainable development of countries and to poverty alleviation have been confirmed in the Millennium Development Goals, in the Johannesburg World Summit on Sustainable Development and more recently in the International Conference on Renewable Energies (Bonn 2004).

This section analyses the current role of renewable energy in the MEDREC countries. Together these countries represent 60 per cent of the total SEMC population and 48 per cent of total energy consumption. The results

point to the minor role of renewable energy in their energy balances, except for high levels of biomass consumption (mainly non-commercial) in some countries. As for renewable energy-based power generation, it is essentially dominated by large hydro in Egypt. Excluding large hydro, the remaining renewable energy-based power generation reached 398 MW in 2000, with small hydro and wind taking up the largest share.

2.2.1. Present situation of renewable energy in the MEDREC countries

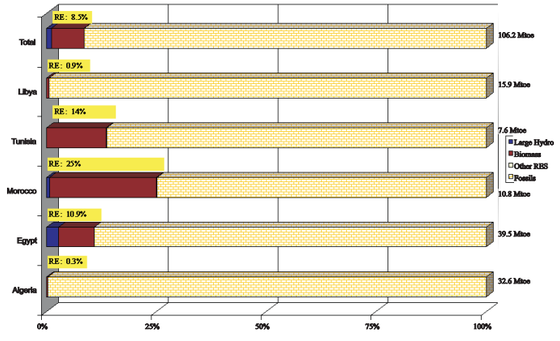
Contribution of renewable energy to the energy balance

In MEDREC countries, renewable energy sources represent 8.5 per cent of total primary energy supply (TPES) in 2000. This average for the group, however, hides large disparities between countries ranging from a share of 0.3 per cent of RES in TPES in Algeria to 25 per cent in Morocco (see Figure1).

The specificity of renewable energy consumption lies in the fact that a single source, namely biomass, remains the dominant renewable with 86 per cent of total consumption. Biomass mainly consists of fuel wood for households (Morocco and to a lesser degree Tunisia) as well as some agricultural wastes used by industry (Egypt). Morocco and Egypt together account for over 80 per cent of total biomass consumption, characterized almost exclusively by its non-commercial use.

The remaining 14 per cent share of renewable energy in TPES consists primarily of large hydro in Egypt (about 13 per cent) and less than 1 per cent shared between small hydro, wind, photovoltaic (PV) and solar thermal (including water heating applications). Concerning solar water heating (amounting to 0.03 Mtoe, that is 0.02 per cent of TPES), the total surface of solar panels is in the order of 0.427 million m2, (300,000 in Egypt, 45,000 in Morocco and 82,000 in Tunisia). Their use is expected to experience a large increase in the coming years.

Figure 6 Total TPES and share of renewable energy in 2000 (Mtoe and%)



Source: OME

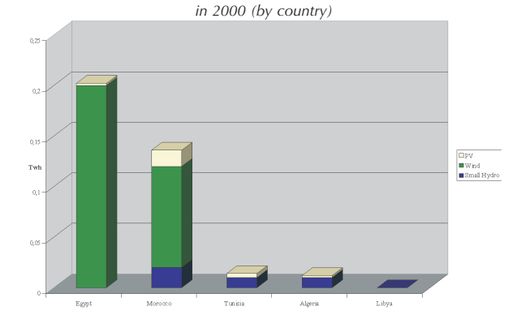
Renewable energy for power generation

Total renewable energy-based capacity for the selected SEMCs reached 4398 MW in 2000. It should be noted, however, that large hydro accounts for most of this capacity (95 per cent), with the greatest share located in Egypt (66 per cent) and to a much lesser degree in Morocco.

The remaining 232 MW capacity is dominated by small hydro and wind (see Figure 2). Concerning the small hydro, the majority of the sites are located in Algeria (42 MW), Morocco (30 MW), Tunisia (15 MW) while Egypt's small hydro power plants are all larger than 10 MW. Wind is still a new but marginal energy source in the region. Total installed capacity (134 MW) includes sites in Zaafarana (Egypt, total 70 MW), Tetouan (Morocco, 53 MW), Cap Bon (Tunisia, 10MW). Photovoltaic systems reached 11 MWp capacity. PV kits supplied a total of 61,400 households with electricity (50,000 in Morocco alone, 10,400 in Tunisia, 906 in Algeria and 120 in Egypt), representing 6.5 MWp. The remaining 4.4 MWp capacity concern other applications, including telecoms, schools, mosques, pumping water for agriculture, street lighting, etc.

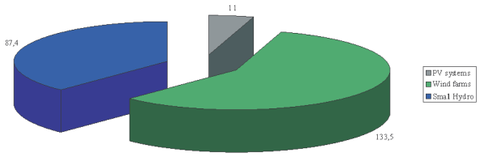
Total power generation from renewable energy accounted for 15.1 TWh in 2000, representing as much as 11 per cent of total power generation. Large hydro sources dominate the use of renewable energy in power generation (97 per cent), with Egypt and Morocco accounting for most of the large hydro based generation. Excluding large hydro, the level of RE-based generation falls to only about 0.5 TWh (0.4 per cent of total power generation). Egypt ranks first followed by Morocco, Tunisia and Algeria (see Figure 3). Noteworthy is the dominance of wind for RES (excl.LH)-based power generation in both Egypt and Morocco.

Figure 2a Renewable energy (excl.LH)-basedpower capacity and generation in 2000 (by country)



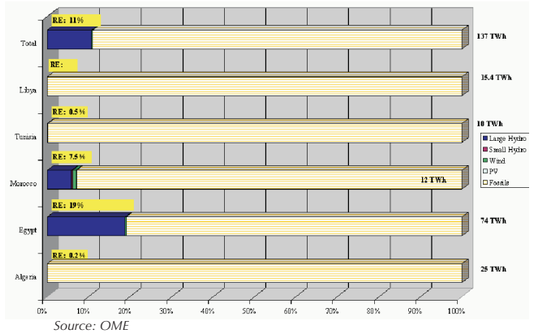
Source: OME

Figure 2b Renewable energy (excl.LH)-basedpower capacity and generation in 2000 (by source)



Source: OME

Figure 3 Total power gerneration and share of renewable energy in 2000 (TWh and %)



Source: OME

2.3. Prospects for renewable energy trading in the Mediterranean region

The European Union has adopted a directive on the promotion of electricity produced from renewable energy sources (RES) in the internal electricity market. It sets national indicative targets for future consumption of electricity produced from RES (see annex).