

**PROMOTING SUSTAINABLE ENERGY  
PRODUCTION AND CONSUMPTION  
IN THE ARAB REGION**

**UNITED NATIONS  
ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA  
(UN/ESCWA)**

**March 2008**

## **PROMOTING SUSTAINABLE ENERGY PRODUCTION AND CONSUMPTION IN THE ARAB REGION**

### **1) Introduction**

The Arab oil and gas sectors represent the largest economic sector in the region and worldwide. It makes available a tremendous number of job opportunities in different fields, through its exploration, production, transportation, refinery and distribution activities. According to the International Labour Organization, ILO, each job in production or refining generates from one to four indirect jobs in industries that supply the needed inputs and that benefit from the value added by oil/gas activities.. The main features of this sector can be summarized in the following paragraphs:

- The Middle East holds some two-thirds of proven world oil reserves. The size of its reserves, combined with its low production cost, guarantees that the Middle East will continue play a pivotal role in global oil and natural gas markets. **Table 1** and **Table 2** represent the status of crude oil and natural gas in the Arab region.

**Table 1 : Status of Crude Oil in Arab Countries**

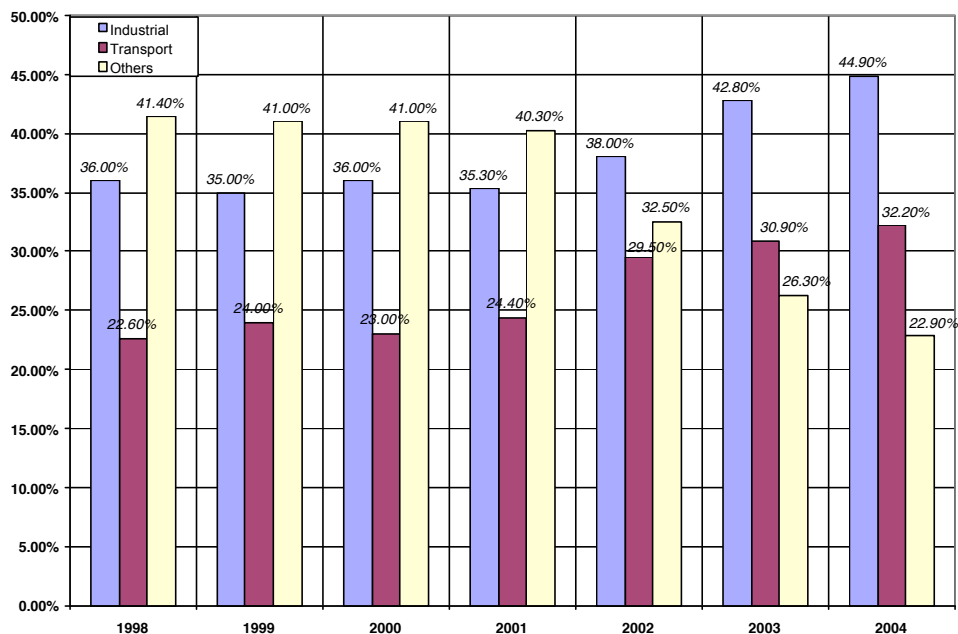
<b>Year</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>Annual Average Change Rate %</b>
<b>Production</b> (1000 boe/d)	20625.0	18998.0	20599.0	22217.0	22746.0	23093.0	2.46
<b>Consumption</b> (1000 boe/d)	3841.8	4091.4	4105.1	4442.8	4697.1	4963.4	5.29
<b>Reserve</b> (Billion barrels )	669.6	652.5	652.4	663.8	667.6	670.6	0.52
<b>(Reserve/Production) Years</b>	88.9	94.1	86.8	81.9	80.4	79.6	-----

**Table 2 : Status of Natural Gas in Arab Countries**

Year	2001	2002	2003	2004	2005	2006	Annual Average Change Rate %
<b>Production (BCM)</b>	271.9	287.9	301.8	322.9	362.3	387.7	7.38
<b>Consumption (Thousands boe/d )</b>	2959.6	3064	3183.9	3511.2	3739	3902	5.71
<b>Reserve (Thousands boe )</b>	52248	52835	53061	53286	53110	53318	0.41
<b>(Reserve/Production) Years</b>	232	221	211	199	177	166	----

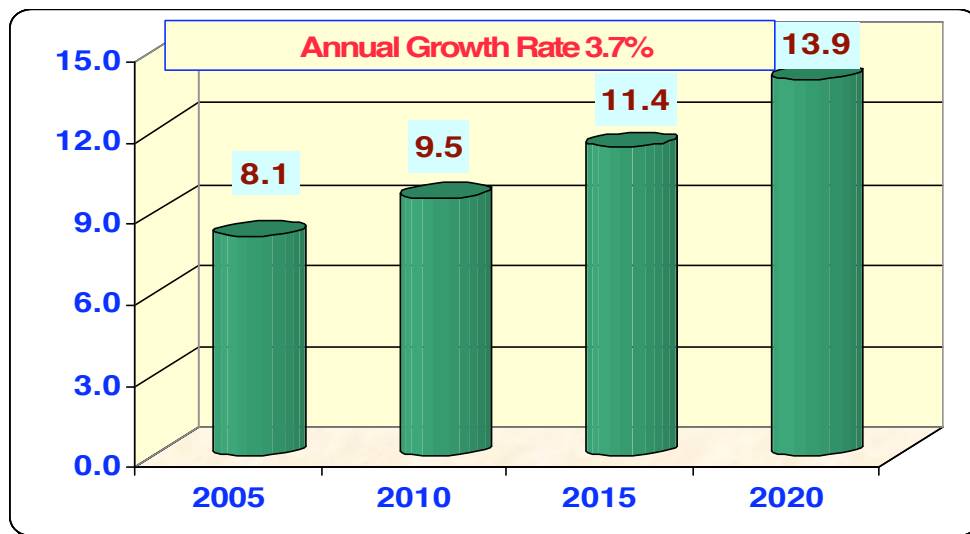
- o Energy consumption in the Arab countries indicates that the sharp rise in energy consumption began in 2004, estimated at 8.5%, did not continue at the same rate in 2005, and 2006, which were 6.7%, and 6.8%, respectively. In addition, it reached two times the production rate. **Figure 1** represents the energy consumption by sector in the region.

**Figure 1: Energy Consumption by Sector in Arab Countries, from 1998 to 2004**

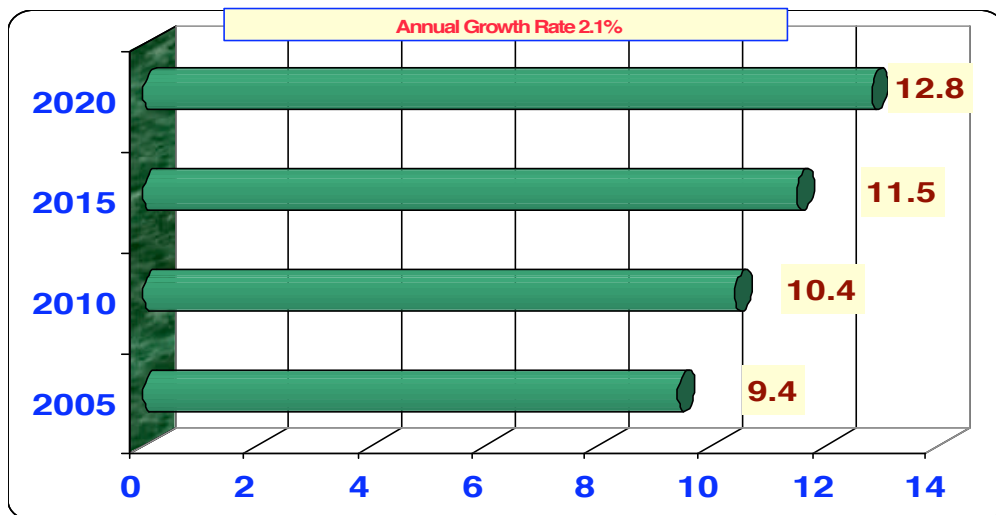


- The average energy intensity in the region is 0.51 Kgoe/US\$ compared to a world average of 0.32 Kgoe/US\$. This means that energy consumption pattern in the Arab region is not sustainable, consequently there is a need for energy efficiency and energy conservation programs. **Figure 2** and **Figure 3** indicate an annual growth rate of 3.7% and 2.1% for the total energy consumption and energy consumption per capita till the year 2020 (OAPEC paper 2006).

**Figure 2: Forecast of Total Energy Consumption in the Arab Region**

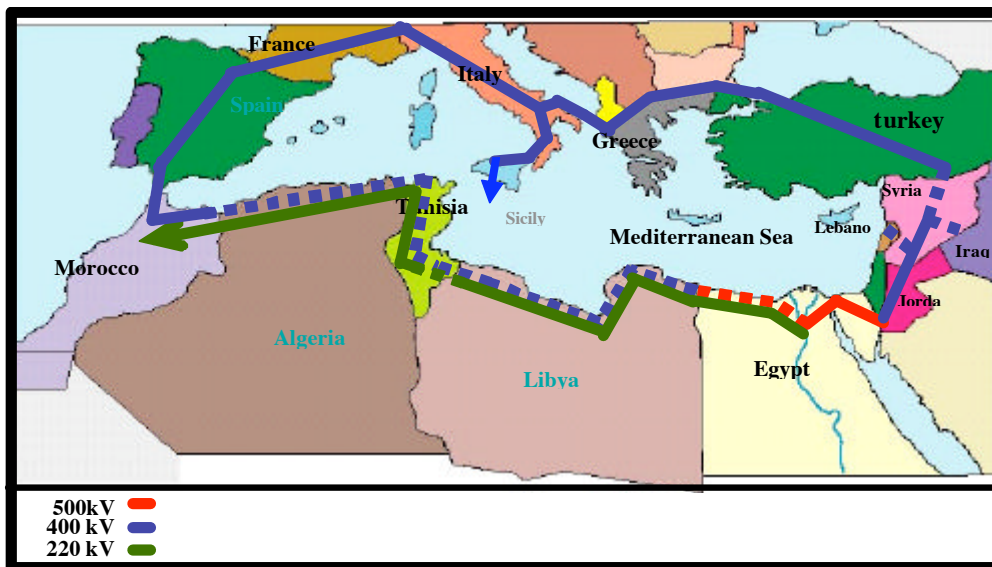


**Figure 3: Forecast of Energy Consumption Per Capita in the Arab Region**



- Oil and N.G. play major roles in meeting the energy needs of the industrial sector, and both of them are almost the sole energy source in the Arab countries. In addition, the oil and gas sector represents the largest economic sectors in the Gulf countries and the region as a whole.
- Natural gas shares with 43.9% of the total energy consumption in 2006, and it can be considered as a positive step towards using a more cleaner fuel compared with oil.
- The electricity sector has a total installed capacities in 2006 reached 136784 MW. Such a huge capacity is dominated by thermal power stations counting for more than 92%. The highest installed electric power capacities are in Saudi Arabia 35885 MW, Egypt 19766 MW, UAE 17280 MW and Kuwait 10763 MW <sup>[1]</sup>.
- Electrical grid interconnection projects between the Arab countries have made considerable progress in recent years. Several phases of the project for electrical grid connections have been implemented between the countries of the seven party grid projects, namely Egypt, Jordan, Syria, Lebanon, Iraq, Libya and Turkey as shown in **Figure 4**.

**Figure 4: Map for Electric Grid Interconnection Projects Among Arab Countries**



---

1) OAPEEC (2007), "Annual Statistical Report -2007"

- The share of renewable energy resources for electricity generation represents around 7%, mainly from hydro 6.98%, and partially from solar and wind energy.
- RE activities in the Arab countries are currently concentrated in most of the North Africa countries; Egypt, Morocco, Tunisia, in addition to some of the pilot projects in other countries e.g. Jordan, Syria. Meanwhile, activities of RE in the Gulf area is only limited in the R&D phase.
- The opportunities for implementing renewable energy projects in the Arab countries are highly linked with the possibilities to mitigate barriers. Briefly, the main barriers are : Investment cost; Technical know-how; Lack of awareness; Economic/financial barriers; Conditions of local funds; Absence of re standards.
- The main financing sources of RE in the Arab countries are foreign funds, meanwhile local finance scheme doesn't offer the requested support for RE applications.
- Although the efforts devoted by the Arab countries during the last two decades to develop and promote the energy sector sustainability have not been sufficient, but it created massive human expertise, local capabilities in the relevant fields. Such human expertise and national institutional capacities can be a motive power to support energy sector efforts for achieving sustainability. Meanwhile, the available regional and sub-regional mechanisms, in relevant areas, can link forces for enhancing regional cooperation in the field.
- As a result of these energy activities, environmental impacts can be represented in CO<sub>2</sub> emissions. The top Arabian five CO<sub>2</sub> emitters for the year 2006 are Saudi Arabia, Egypt, UAE, Iraq, and Algeria, as shown in **Table 3**. Meanwhile, the top CO<sub>2</sub> emitters worldwide for the year 2005 are; USA, China, Russia, Japan, and India.

Table 3: Arabian and World's Top Five CO<sub>2</sub> Emitters

Country	2006	Country	2005
	<i>Mt CO<sub>2</sub></i>		<i>Mt CO<sub>2</sub></i>
<b>Saudi Arabia</b>	320	<b>USA</b>	5800
<b>Egypt</b>	148	<b>China</b>	5100
<b>UAE</b>	110	<b>Russia</b>	1500
<b>Iraq</b>	85	<b>Japan</b>	1200
<b>Algeria</b>	84	<b>India</b>	1100

While the GDP of the Arab countries is sensitive to exports of the oil and natural gas petroleum sectors, it is interesting to find out some of the oil exporting as well as oil non-exporting countries in the Arab region shared the same GDP rate of growth in our baseline year 2005, giving a clear indication that there is a need for change in some of these countries in the way they are pursuing the economic growth. The Arab countries can be divided into three groups on the basis of GDP in constant prices in 2005, as follows:

- Countries with a growth rate between 5.0% and 8.2%: The 11 countries in this group are Algeria, Bahrain, Egypt, Jordan, Libya, Mauritania, Qatar, Saudi Arabia, Sudan, Tunisia, and the UAE.
- Countries with a growth rate between 3.2% and 4.9%: The five countries in this group are Djibouti, Kuwait, Oman, Syria, and Yemen.
- Countries with modest growth: The two countries in this group are Lebanon, with a rate of 0.5%, and Morocco, with a rate of 1.6%.

Over the past 20 years, the Arab energy sector has exerted strenuous efforts to formulate and apply a variety of policies aimed at contributing to the achievement of sustainable development in the countries of the region. Those policies largely concentrate on changing unsustainable patterns of energy production and consumption in various sectors and, in particular, on the five basic issues in the field of energy that were identified by the Johannesburg Plan for sustainable development, namely, enhancing access to energy services; energy efficiency; renewable energy; cleaner fossil fuel technologies; and energy and transport. To varying degrees, the Arab countries have achieved perceptible progress, albeit insufficient, in each of those fields. This Chapter highlights the current policies and best practices adopted and/or implemented in the energy field in the Arab countries.

## **2) Experience with Energy-Related Policies in the Arab Region**

Studying the applied energy policies in the Arab countries concludes that each country has adopted different bundle of energy policies, which reflects the the bundle components differs from country to another. Reason for varying applied policies backs mainly to the situation of energy resources mix in each country. Based on the data represented in Table (1) below, the following facts have been observed;

- For energy to be a support for SD, it is requested to concentrate on delivering energy services that can meet the needs of the people, using a variety of technologies and fuels tailored to local conditions, rather than simply working towards increasing energy supplies.
- Only five countries are applying policy of using the advanced fossil fuels, meanwhile other countries are using either mix between HFO and N.G. or HFO which has worse effects on environment than HFO. In spite of environmental legislations are existing in all of the Arab countries, but it is effectively applied. So, expanding the use of cleaner technologies and fuels including the switch to natural gas, especially in the

electricity generation and transportation sectors, and the increase reliance on the cleaner fuels in the transportation sector, particularly, the unleaded fuel.

- Privatization did not apply in most of the Arab countries, and there is a need to spread it in the Arab energy sector. So, reform process is required to improve the development prospects of the Arab countries.
- Both energy efficiency and conservation procedures need to be effectively applied in different sectors, and develop standards on both the demand and supply sides.
- Fossil fuel subsidy is one of the main barriers facing promoting and using RE applications either in residential or industrial sectors.

**Table (4): Status of Applying Energy Policies in the Arab Countries**

<b>Applied Policy</b> <b>Country</b>	<b>Maximizing Petroleum Products</b>	<b>Cleaner Fossil Fuels</b>	<b>Privatization</b>	<b>Energy Conservation</b>	<b>Energy Efficiency</b>	<b>Renewable Energy</b>	<b>Environmental Legislations</b>	<b>Fossil Fuel and Electricity Tariffs</b>
<b>Algeria</b>	Exporter (N.G.)	Group I	Not Yet	Partially Applied	Partially Applied	SWHs	Exist	Subsidized
<b>Egypt</b>	Exporter (N.G.)	Group II	Partially Applied	Partially Applied	Partially Applied	Large Scale Wind Projects	Exist	Subsidized
<b>Iraq</b>	Exporter (Oil)	Group III	Not Yet	Partially Applied	Partially Applied	N/A	Exist	Subsidized
<b>Jordan</b>	Fully Importer	Group II	Partially Applied	Partially Applied	Partially Applied	SWHs	Exist	No Subsidy
<b>Kuwait</b>	Exporter (Oil)	Group I	Not Yet	Partially Applied	Partially Applied	N/A	Exist	Subsidized
<b>Lebanon</b>	Fully Importer	Group II	Not Yet	Partially Applied	Partially Applied	N/A	Exist	Partially Subsidized
<b>Libya</b>	Exporter (Oil)	Group III	Not Yet	Partially Applied	Partially Applied	N/A	Exist	Subsidized
<b>Morocco</b>	Fully Importer	Group III	Partially Applied	Partially Applied	Partially Applied	Large Scale Wind Projects	Exist	No Subsidy
<b>Oman</b>	Exporter (Oil)	Group I	Partially Applied	Partially Applied	Partially Applied	N/A	Exist	Subsidized
<b>Palestine</b>	Fully Importer	Group III	Not Yet	Partially Applied	Partially Applied	SWHs	Exist	No Subsidy
<b>Qatar</b>	Exporter (N.G.)	Group I	Partially Applied	Partially Applied	Partially Applied	N/A	Exist	Subsidized



<b>Applied Policy</b>	<b>Maximizing Petroleum Products</b>	<b>Cleaner Fossil Fuels</b>	<b>Privatization</b>	<b>Energy Conservation</b>	<b>Energy Efficiency</b>	<b>Renewable Energy</b>	<b>Environmental Legislations</b>	<b>Fossil Fuel and Electricity Tariffs</b>
<b>Country</b>								
<b>Saudi Arabia</b>	Exporter (Oil)	Group I	Partially Applied	Partially Applied	Partially Applied	N/A	Exist	Subsidized
<b>Sudan</b>	Partially importer	Group III	Not Yet	Partially Applied	Partially Applied	N/A	Exist	Partially Subsidized
<b>Syria</b>	Partially	Group II	Not Yet	Partially Applied	Partially Applied	SWHs	Exist	Partially Subsidized
<b>Yemen</b>	Partially Importer	Group III	Not Yet	Partially Applied	Partially Applied	N/A	Exist	Subsidized

- Renewable energy programs in the Arab countries are still under developing, in addition these programs are implemented in several ways; through direct foreign funding and technical assistance. The share of local funds is minor compared with foreign funds. In addition, expanding information exchange on technology options, their costs and availability for application as well as financial resources and technology transfer modalities.
- Regional cooperation between the Arab countries and their neighbours; e.g. European countries in the north of the Mediterranean Sea and Asian countries, could be within regional or international frameworks. Electricity interconnections and capacity building will provide milestones in cooperation. Such cooperation can make use of the diversification of the existing national expertise and resources in the Arab countries relevant to SD. It also includes: integrating markets and expanding cross border energy trade, particularly through electric grid interconnections and natural gas networking.
- A capacity-building activity in the fields of energy conservation, energy efficiency, and RE can be implemented between Arab countries to assist governments in developing and adopting policies, measures and best practices for these fields.
- The Arab power sectors need to acknowledge that they are operating in a tight and difficult credit market. Hence, 'going local' or 'regional' is being emphasized as a new potential source of funding, as it helps to overcome present problems of currency risks and the reluctance of mature markets investors.
- Supporting activities targeting the localization of energy equipment, especially renewable energy technologies is a must, particularly in the field of wind energy.

- Taking into account the economic, social and technological interests at stake, of primary importance to further evaluate the prospects of hydrogen as a new energy carrier and synergies which will necessarily develop with electricity.

### **3) Conclusion & Recommendations**

Based on the findings of this study, it can be concluded that the Arab energy market unsustainable consumption pattern is mainly fueled by low energy prices due to subsidies and increasing energy demand due to large industrial investments with no concern over the sustainability of oil and natural gas production patterns.

Another principal conclusion that emerges from this report is that; the oil market appears to rise to a new level in terms of demand, supply tightness and therefore prices. However, another conclusion is that uncertainty has not been reduced; only the probabilities of the future direction of prices have been rearranged.

Also countries depending on the revenues of commodity exports are requested to pursue policies to diversify their economies and energy resources. Although, much has been achieved in some countries, but efforts need to be redoubled and not just in those not blessed with hydrocarbon reserves. Obviously in the oil and gas rich countries, diversification must be built on this endowment and comparative advantage, and this is manifestly taking place in many Arab countries.

Natural gas should be looked upon as a gateway towards the energies of the future, including hydrogen. Innovating technologies, combining renewable energies (solar and wind energies for instance) and natural gas will increasingly contribute to the response to sustainable development issues. However, in the years ahead, the rate of growth in the gas market will remain very closely conditioned by the industry's ability to invest massively, to replace existing systems and to build new infrastructure and production capacities. Closer cooperation between all the players along the gas chain will accordingly be essential.

The above mentioned observations should be well analyzed and included in drafting an appropriate strategy that could lead the Arab region towards Sustainable consumption and production patterns in the energy sector. The specific goals of such strategy should include:

Goal I: Improve the efficiency of the energy system by making more productive use of energy resources to enhance the overall economic performance while protecting the environment.

This can be achieved through:-

- 1.1 Restructuring the national electric utility systems by unbundling its different services especially before any attempts of privatization, and use current subsidies to build a strong infrastructure that allow for easy implementation of IERP and DSM projects in all sectors; Develop advanced fossil fueled power plants that use CHP, Cogeneration, and CCPP, and develop reliable new energy production technologies.

- 1.2 Adopt and implement more energy efficient transportation systems, industrial, and building technologies, cleaner fossil fuel standards, which could also contribute towards protecting the environment from GHG emissions, ozone depletion, and acid rains.
- 1.3 Utilize new effective energy-efficient approaches such as the “Whole System Design” approach, the “Process Integration” approach, The Dynamic Strategic Fit (DSF) concept; Introduce renewable proven technologies, and/or at RD&D levels to take the lead.
- 1.4 Capacity building for energy managers and high level decision makers in the areas of Integrated Energy Resource Management (IERM), IERP, and Energy Balance in order to allow for robust national energy plans that are realistic and practical.
- 1.5 Creation and dissemination of software and Decision-support systems (DSS) within the countries of the region to apply the above tools (IERM, IERP, DSM).

Goal II: Ensure energy national future independence. This can be achieved through the following two objectives:

- 2.1 Increase and stabilize domestic production, diversify energy dependence by seriously investigating alternative energy resources including derivatives of oil and gas, which could lead to better energy consumption patterns and energy conservation.
- 2.2 Ensure reliable electric/gas supply, refining, and emergency response plans.
- 2.3 Pursue research and engineering in alternative energy resources such as solar, wind, bio fuel, and fuel cells technologies.
- 2.4 Develop long-term options, such as hydrogen-based systems, and ethanol.

Goal III: Advocate for the utilization of practical approaches to achieve the sought results such as:

- 3.1 Implementing Environment Management Systems, through acquiring ISO 14001, and which can easily be integrated with an existing ISO 9001 quality management system.
- 3.2 Develop Capacities for implementing the Energy Efficiency Roadmap shown in the figure (5) below .

In general, actions to promote effective energy policies in Arab countries must be better coordinated to be consistent to allow for better use of their expected produced synergies.

Figure 5 : Framework of the Proposed Energy Efficiency Roadmap

