



## 10 Energy

### Introduction

Energy constitutes the stepping stone for the advancement and prosperity of the society where it should be made available in any manner required provided that it is environmentally safe and sustainable.

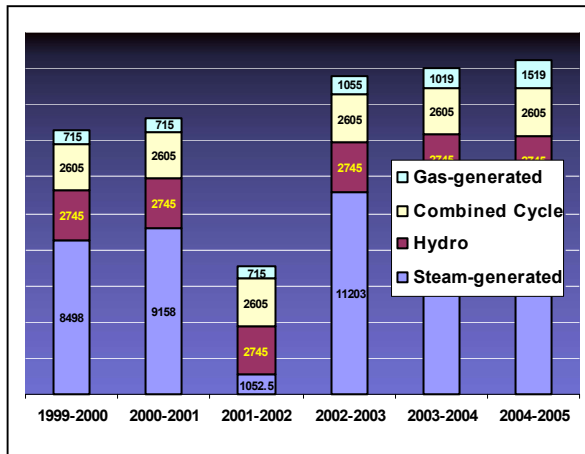
In cooperation with the Ministry of Petroleum and Mineral Wealth and the Ministry of Electricity and Energy, the Ministry of State for Environment Affairs has undertaken to prepare this Part of the report to include overall energy activities and their relation with the environment in the Arab Republic of Egypt, with particular emphasis on oil derivatives, natural gas and liquefied gas, transport, electricity, new and renewable energy sources, bearing in mind that the reference year differs from one source to another according to the latest data.

The report also contains an overview of the aspired goals as well as policies and procedures required to be pursued to help achieve these goals in order to address future challenges and continued increase of demand on energy, thus recommending provision of highly potential clean and safe alternative sources of energy.

### 1-Electric energy

#### A. Thermal Power Plants

Thermal power generation accounts for 71.6% of electricity production and is constantly increasing to match increased consumption one year after the other. The total electrical power reached 18549 MW in 2005 where 15734 MW thermal, 2745 MW Hydro and 45 MW wind in Zaafarana and Hurghada.



**Figure (10-1) Development of combined capacities according to the type of generation (MW)**

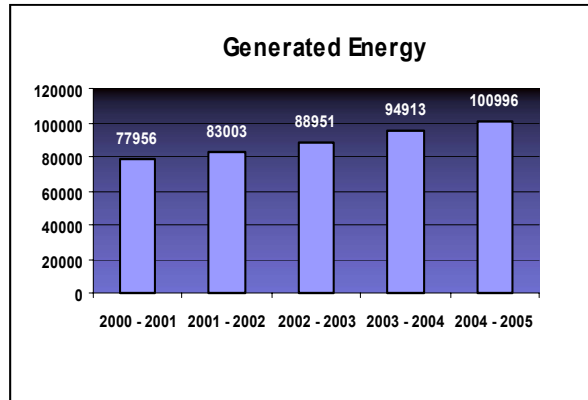
The Table (10-1) shows the distribution of generated electric energy (billion KWhr) according to the type of generation and ratio of development in 2005 compared to 2004.

**Table (10-1) Distribution of Generated Energy According to Type of Generation**

Statement	2003/2004	2004/2005	Development %
Steam-generated	50781	54300	6.9
Gas-generated	564	3360	496
Combined Cycle	16603	16900	1.8
Total Thermal Energy	67944	74560	9.7
Hydro	13019	12644	(2.9)
Winds (Zafarana)	368	523	42.1
Aggregate Grid Capacity	81335	87727	7.9
Purchased from industrial projects	7704	69	(11)
BOOT- Generated	13501	13200	(2.2)
<b>Total</b>	<b>94913</b>	<b>100996</b>	<b>6.4</b>

Source: Annual Report of the Egyptian Electricity Holding Company for 2005

Figure (10-2) points to the development of generated energy over the period from 2000 through 2005 where the total generated energy was estimated at 100996 k.w.h in 2005.



**Figure (10-2) Development of the Generated Energy (KWhr)**

Source: Annual Report of the Egyptian Electricity Holding Company for 2005

### Environmental Problems in the Electricity-Generation Sector

With the increased Egyptian stock of natural gas over the past five years, the natural gas replacement policy has been pursued for the operation of electricity generation stations in lieu of liquefied fuel (mazot) given its obvious advantage economically and environmentally.

In 2005, the ratio of utilizing natural gas as fuel for electricity generation stations has been reduced as it was put in stations connected to the gas grid at 81,2% whereas it reached (92%) in 2004 in accordance with the 2005 annual report of the Egyptian Electricity Holding Company.

This decrease in the ratio of natural gas utilization during 2005 can be attributed to the operation of a number of power stations using special mazot at the request of the

Ministry of Petroleum and Mineral Wealth to offset shortage in natural gas supplies as a result of the fire that swept Al Tamsah Field in August 2004 and lasted for 84 days.

Different recorded measurements of air pollution-monitoring stations in this area where mazot has been used in lieu of natural gas revealed the increased emission concentrations resulting from mazot-burning fuels.

Figure (10-3) Comparison of the total average of sulphur oxide gases to sulphur dioxide gases during 2004 and 2005:

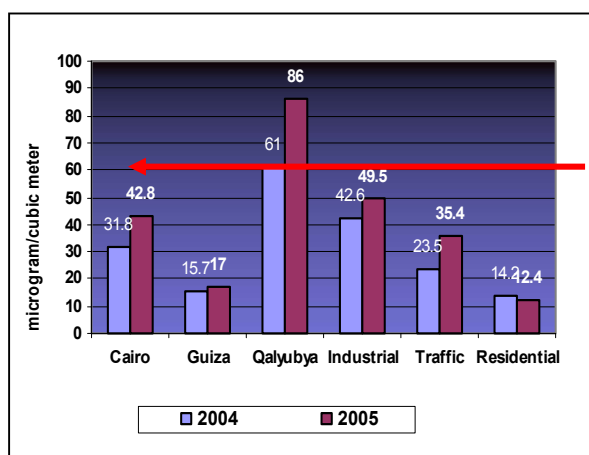


Figure (10-3) Comparison of the total average of sulphur oxide gases to sulphur dioxide gases during 2004 and 2005

Table (10-2) shows that the rate of utilizing natural gas as fuel has decreased in 2005 by 5.9% while the rate of utilizing mazot for the same period has doubled by 224.5% and also the ordinary and special solar by 557% and 75% respectively.

Table (10-2) Consumed Fuel As Per Type

Statement	03/04	04/05	Development Percentage%
Mazot 1000 tons	1213	3936	224.5
Natural Gas million m <sup>3</sup>	16294	15334	(5.9)
Ordinary Solar Ton	4375	28778	557.8
Special Solar Ton	35026	61324	75
Total 1000 Tons o.e	15261	17028	11.6

Source: Annual report of the Egyptian Electricity Holding Company for 2005

## B-Hydro Power Plants

The significance of considering water sources as a permanent and renewable source of energy is derived from the unending hydrological circulation in the universe (evaporation of water from oceans and seas – condensation – rains – rivers and streams- etc...) not to mention its economic feasibility. Hydro energy in 2005 is regarded as among the cleanest power generation sources and represents around 14.7% of the total generated energy in Egypt. The High Dam power-generating station is deemed the largest hydro station in Africa with a total capacity of 2100 megawatts. Generated energy is transferred from 12 turbines to load centers along overhead transmission lines 500 k.v. and 132 k.v. The erection of the new Nagaa Hamadi hydro station with a 64 megawatt combined capacity is underway.

**Table (10-3) Generated Hydro-electric Energy (GWhr)**

Statement	03/04	04/05	Development Percentage %
High Dam	9374	9049	(3.5)
Aswan Dam1	1492	1497	0.3
Aswan Dam2	1690	1663	(1.6)
Esna	446	420	(5.8)
Nagaa Hamadi	17	15	(11.8)
Total	13019	12644	(2.9)

Source: Annual report of the Egyptian Electricity Holding Company for 2005

## C- Renewable Energy Sources

### (1) Solar Energy

Consultancy services related to the first solar thermal project with a capacity of 150 MW where 30 MW solar in the Kremat Region, are being provided in collaboration with the Global Environment Facility and the World Bank. It is planned that the project be implemented and operated by mid 2009 with its production capacity expected to reach 985 GWhr according to the reference year.

### (2) Wind Energy

The price of selling energy produced from Zafarana – based wind farms to the Egyptian Electricity Transfer Company has been adjusted to become 12 piaster /KWhr instead of 10 piaster /KWhr in December 2005. Further, the Ministry of Petroleum and Mineral Wealth grants the Renewable Energy Support Fund a subsidy worth 2 piaster /KWhr to foster the contribution of renewable energy to saving consumption of fossil fuel and promoting its export. The New and Renewable Energy Agency had signed two agreements on selling reduced carbon dioxide emission certificates (the certificate is equal to 1 ton of carbon

dioxide, the emission of which can be avoided). The first agreement was concluded with the Japanese side regarding a wind farm with a capacity of 120 MW in Zafarana region on the Suez Gulf Coast valued at \$7.75/certificate. The second agreement was concluded on 14/9/2005 with the Danish side regarding a wind farm with a capacity of 120 MW in Zafarana region on the Suez Gulf to sell reduced emission certificates to the Danish Aid Agency at a value worth 7 Euros that is the equivalent of \$ 8,3 per certificate. It is anticipated that the two wind farms will annually share in saving fossil oil by around 100,000 and 91,000 tons of oil equivalent respectively besides preventing carbon dioxide emissions by almost 248,000 and 230,000 tons of carbon dioxide respectively.

Returns of reduced emission certificate sales according to the two agreements were calculated to find out a range between 1 piaster/KWhr and 1.15 piaster/KWhr Based on the above mentioned, the return of selling the produced energy unit from the wind farms in December 2005 was raised by 5.15 piaster /KWhr (2 piaster from the Ministry of Petroleum, 2 piaster from the Ministry of Electricity and Energy, and 1.15 piaster from certificate sale proceeds). Thus it can be said that the return of selling the energy unit produced from the two Danish and Japanese Projects has risen by 50% reaching 15.15 piaster /KWhr against the 10 piaster /KWhr return of selling the energy unit produced by previous projects, which led to significant improvement in the indicators of economic and environmental feasibility of wind farms and the reduction of the cost of the financial gap between the returns of produced energy unit sales and their production cost to approximately 3 piaster /Kwhr,

that does not only render the wind turbines competitive of gaseous turbines but also probably offer the cheapest alternative since electricity prices are traditionally on the ascent as a result of continuous fossil fuel price hikes.

## 2– Oil and Gas

### A. Exploration and Production

In 2004, intense activity in the field of exploration had been evidently demonstrated as 27 raw oil discoveries contributed to the addition of confirmed reserve with a capacity of 290 million barrels. Moreover, the total gas production during 2004 had amounted to approximately 1.3 trillion cubic feet while the confirmed gas reserve had reached 65 trillion cubic feet on 30/6/2004, 6.6 trillion cubic feet of which as reserve added.

In the field of exploratory digging, the total three-dimension seismic area in different gas regions reached 2137 sq.km. Also the total two-dimension seismic area amounted to 1169 sq.km.. Moreover, 26 wells were dug to make 16 new natural gas discoveries, 8 of which in the Mediterranean Sea, 6 in the Western Sahara and 2 in the Nile Delta with success score in this domain of 88%.

The Mediterranean Sea is at the helm of natural gas-producing regions by 60%, followed by the Western Sahara by 24% then Suez Gulf by 10% then Delta by 6%.

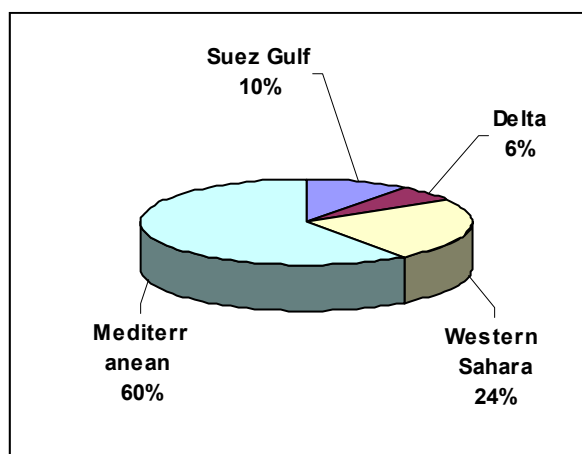


Figure (10-4) Ratio of Regions' Contribution To Natural Gas Production

Source: 2004 Annual Report of the Egyptian Natural Gas Holding Company

### B. Consumption

Natural gas uses had vastly progressed in 2004 where its local consumption amounted to 30.8 billion m<sup>3</sup>.

- (1) The electricity sector is considered the largest gas-consuming sector in Egypt. Gas accounts for 92% of total fuel uses of power stations. Gas consumption of this sector in 2004 had reached approximately 19,5 billion cubic meter that is 63% of the total gas consumption nationwide.
- (2) In 2005, the proportion of gas utilization as fuel at the level of power-generating stations had decreased to reach (81.2%) in those connected to the national gas pipeline network. This decrease has been explained in the previous part of this chapter.
- (3) Consumption in different industries had reached around 7.9 billion m<sup>3</sup> that is accounting for 25% of the total gas consumption nationwide compared to 7.2 billion m<sup>3</sup> during 2003. Natural gas is also used as a raw material in petro-

chemicals industry.

(4) Household gas consumption had amounted to 594.9 billion m<sup>3</sup> compared to 511.55 during 2003. It is noted that 11 gas-transporting and distributing companies mostly from the private sector are in place and operate in accordance with agreements concluded and under which these companies are entitled to connect and market gas to consumers with end users numbering up till June 2004 almost 2 million household, commercial and industrial customers.

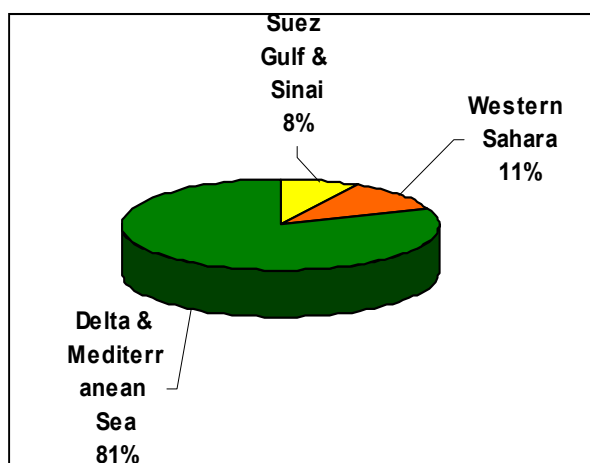


Figure (10-5) Natural Gas Production

Source: The 2004 Annual Report of the Egyptian Natural Gas

### 3- Transport sector

The transport sector is of paramount importance whether from the national economy perspective or with regard to its energy consumption since it ranks second after the industrial sector with a 28% of the total final consumption.

With respect to consumption of oil products, this sector ranks first consuming approximately 10.8 million tons of oil equivalent which represents around 40,4% of the total 27.6 million tons of oil equivalent in 2004/2005.

With the continuous increase in the number

of vehicles and the growing transport movement in Egypt, it has become highly important to search for means of reducing fuel consumption and rationalizing energy in this sector. The Energy Planning Agency had undertaken to set in motion some studies in this regard primarily a recently conducted study (December 2005) on “Sustainable Development of Transport and Traffic Systems Within Cities and Its Impact on Energy and Environment” (the City of Alexandria for example).

The given study had brought to light the prospect of creating power savings in energy consumption in the transport sector in Alexandria ranging between 24% and 42% in compliance with alternatives proposed in the study for transport and traffic planning in Alexandria up till 2017 in addition to other studies that underlined the presence of high consumed fuel waste reaching 25% due to traffic jams and lack of organization of the traffic movement in the capital’s streets.

### State Efforts Towards Drawing Utmost Benefit from Available Energy Potential and Capabilities

#### 1-Industrial companies emitting polluting gases

Companies establish commercial electricity-generating stations with a capacity of 15 megawatts to benefit from leakage of surplus gases in generating electric power which originally used to be burnt and lost.

The cost-benefit analysis of environmental impacts resulting from the operation of these stations indicate the economic and environmental feasibility of such ventures in view of their low capital cost by 20% compared to conventional stations, because it is needless to purchase steam-driving

boilers and given its gratuitous fuel operation.

During 2005, the Ministry of State for Environment Affairs had given 5 initial approvals to include 6 similar projects to be tabled as part of the Clean Development Mechanism (CDM) for the following companies: Abu Zaabal Fertilizers Company for 6-13 megawatt expansions in the affiliated power station, the Sendian Paper Company (14 MW), Misr-Monefia Weaving Company (1.3 MW), El Mohandes Food Company (0.4 MW) and Samad Co. Fertilizers Company (1.5 MW).

## **2- Adoption of the Clearing System for the Intensive Energy Consumption Companies**

A pilot model project that can be undertaken and simulated by industrial companies with intense consumption of electric energy, a case in point is the Arab Organization for Industry (AOI) that tendered a global bid for the provision of a wind farm with an 18 MW capacity to produce an electric energy equal to that consumed by its factories and production units, that is equivalent to 66 million KWhr so that the turnout of this farm is connected to the grid. The idea of the project was initially dwelt on the technology transfer and know-how on manufacturing and assembling wind turbines and finding workload for the AOI plants, thus setting an example to be followed by major industrial firms and organizations.

The idea of the Project is built around clearing with a view to concluding an agreement with the Egyptian Electricity Holding Company to buy the difference between the generated energy and the electric energy consumed by factories of the Arab Organization for Industrialization

measured to be 15 million KWhr which decreases gradually as a result of its annual consumption increase to become equal in 2006. However the Project was suspended due to the inability of AOI to obtain the license authorizing it to run the subject activity- i.e. production of electric energy within the Arab Republic of Egypt- thus providing for one of the reasons that led to the establishment of the Electricity Utility Regulation Agency for the protection of the consumer which is designed to granting any legal entity an official approval to run activities related to production, transport, or distribution of electric energy in Egypt.

## **3-Heat Recovery**

A number of plants, hospitals and hotels with fossil fuel-operated water boilers were in place. These systems could be upgraded to benefit from waste heat recovery. This adjustment is expected to lead to the reduction in the quantity of power purchased from the grid and the exclusion of any mazot-operated thermal boilers.

## Future Plan 2007-2012

The current fuel price hikes makes it imperative for the State to enact legislation for the rationalization and improvement of the efficiency of utilizing energy and renewable sources of energy for the purpose of achieving sustainable development and avoiding the drain-off of natural resources, besides reducing energy consumption and green-effect gas emissions while providing fresh job opportunities.

In this respect, the Ministry of State for Environment Affairs will prepare a draft law mandating that newly-established residential compounds and non-residential buildings whose consumption exceeds 500 tons of oil equivalent /year or whose total surface area is above 15000 cubic meters shall be subject to the energy audits before issuing their construction licenses. The same shall apply to new factories whose consumption exceeds 1000 tons of oil equivalent/year as investors shall be obligated to submit the energy certificate as a precondition for obtaining the license and which shall include a detailed analysis of the expected energy consumption in the new facility and how far it is in conformity with applicable standards as well as proposed improvements and adjustments as far as the design of the new building components was concerned (thermal insulation of ceilings and walls, water pipe network, type and thickness of glazing used and its number of layers, efficiency of water heating and warming boilers for hotels, hospitals, clubs, commercial buildings, and central air conditioning and illumination systems, etc...). Concerning existing buildings and factories, a priority-based review shall be proposed alongside a 5-year time period from the date of issuance of the law for the adjustment of their positions.

Certified energy auditors shall be responsible for issuing these certificates. In the event of the owner's default on abiding by energy certificate terms upon the completion of the construction of the building, he shall be fined and accordingly not allowed to sell or lease the building pending the implementation of requested corrective procedures.

The Ministry also shall prepare guidelines on energy audits in addition to the preparation; training and building of technical capacities of certified energy auditors to make sure those in charge are adequately qualified to assess the scientific aspect of the literature and to detect potential environmental implications.

As included among its priorities in the forthcoming period, the Ministry shall develop orientation programs for investors and agencies concerned besides the induction of relevant concepts in university curricula especially departments of architecture, electricity and urban planning in faculties of engineering.

Annex (10-1) indicates a defined perception in connection with applicable proposals in the area of energy and environment.

## References

- (1) European Union Member States Directives no 91/2002 released by the European Parliament on 16 December 2002 on Building and Establishment Energy Efficiency.
- (2) Annual Report of the Egyptian Electricity Holding Company for 2005.
- (3) Annual Report for 2004 of the Egyptian Natural Gas Holding Company.
- (4) Annual Report for 2003/2004 of the Egyptian General Petroleum Authority