



EGYPT'S ENERGY PLANNING AND MANAGEMENT IN VIEW OF THE COMMITMENTS TO THE FRAMEWORK CONVENTION ON CLIMATE CHANGE

A.-G.S. EMARA, S.M. RASHAD
Atomic Energy Authority,
Cairo, Egypt

Abstract

Egypt has a rapidly growing population and per capita energy demand. As a signatory of the Framework Convention on Climate Change Egypt is making all efforts to comply with the obligations of the Convention. This paper summarizes the efforts carried out in the field of electricity generation and consumption. Plans implemented to improve energy efficiency and to achieve switching to non-carbon energy resources, such as solar, wind and biomass power, are outlined.

1. INTRODUCTION

Egypt has at present a population of 59 million which is expected to increase rapidly at a rate of 3.2% per annum. This gives rise to an ever increasing demand for energy resources to achieve social and economic development goals of the country. The assessment of energy resources, production, conversion, transmission and consumption patterns is basic for formulating and evaluating the efficiency of the structure of the energy sector and its interaction with other sectors of the economy.

For developing countries, such as Egypt, the demand for energy is rapidly growing and is exceeding that for developed countries. The environmental impact of energy production and use with the associated emissions of greenhouse gases, particularly CO₂, has created much attention and growing concern on both national and international levels. Reduction of total energy consumption is considered worldwide as an effective measure to curb greenhouse gas emissions. Efficiency increase by introduction of new and innovative technologies is a determining factor in achieving reduction of energy consumption. Energy intensity is an indicator of efficient energy use and is governed by the interplay between prices, technology, financial resources and environmental constraints. At present, some energy technologies which use energy more efficiently, are already available on the world market, provide energy from new and renewable sources and use fossil fuels in a cleaner and more environmentally benign way.

2. THE EARTH SUMMIT

In June 1992, the Earth Summit Conference took place in Rio de Janeiro, Brazil. At the conference two conventions were opened for signature:

- The Framework Convention on Climate Change [FCCC],
- The Convention on Biodiversity.

Presently (June 9th, 1994), there are 75 countries from all over the world who had already ratified the Framework Convention on Climate Change and are now legally bound by the terms of the convention. Egypt has signed the convention and it is now on its way to be ratified. The Egyptian Authorities have already adopted measures to comply with its obligations towards the terms of the convention. Efforts to reduce the environmental impact from the energy sector especially electricity production has been adopted. Different policies to achieve optimum production, transmission and end use of energy have been implemented.

3. ENVIRONMENTAL IMPACTS OF ENERGY PRODUCTION: THE GREENHOUSE EFFECT AND ENHANCED GLOBAL WARMING

Greenhouse gases such as water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), ozone (O₃), and chlorofluorocarbons (CFCs) as well as other less important trace gases, capture infrared radiation escaping from the earth's surface. As it is well known, the greenhouse effect is a natural phenomenon conceived by Fourier in 1827. The increase in concentration of greenhouse gases in the atmosphere is expected to result in a global warming effect. The most important aspect is that the enhanced greenhouse effect is expected to take place at a very rapid rate which will make it difficult and insurmountable to take appropriate countermeasures. In fact, the concentration of greenhouse gases has been steadily increasing since the industrial revolution. Data from the climate monitoring network show that the atmospheric concentration of CO₂ is increasing globally [1],[2]. At present the globally averaged CO₂ concentration is 353 ppmv. In the eighties (1980-1989) CO₂ levels have risen, on average by 1.4 ppmv per year. Compilation of available data suggests that in preindustrial times atmospheric CO₂ averaged 280 ppmv. In general, electricity generation accounts for 25-35% of global carbon emission at present. Combustion of fossil fuels currently releases nearly 6 Gt of carbon per year. Land use changes produce a net emission to the atmosphere of between 12 Gt of carbon per year. In the scientific community there exist two opinions: The Wait and See strategy and the No Regret Strategy. With the above facts in mind, Egypt is planning and managing its energy sector on the basis of a "No Regret Strategy".

4. SOME WORLDWIDE AGREED MEASURES TO ABATE EMISSIONS OF GREENHOUSE GASES, PARTICULARLY CO₂

It is understood that for the abatement of greenhouse gases a comprehensive approach should be adopted comprising implementation of a set of complementary measures. Some of the worldwide agreed measures to achieve the goal of curbing greenhouse gas emission are:

- Measures for energy conservation and efficiency improvement,
- Switching from fossil fuel dependence to other non-carbon based energy sources (renewable energy sources and nuclear energy), and
- Shift from high carbon content (oil, coal) to low carbon content energy sources (natural gas).

5. AN OVERVIEW OF ENERGY PLANNING AND PROSPECTS OF EGYPT

An attempt will be made to throw light on the efforts by the Egyptian Government in planning and management of the electricity sector to meet its obligations in view of the commitments to the FCCC.

Table I shows the expected development of the installed electric capacity in Egypt from 1992 to 2015 [3]. Though the shares of natural gas and heavy oil will decrease, they will remain to be the main components of the energy mix in Egypt. Egypt has no national coal deposits except the one in Magara (Sinai) which is only sufficient to operate a 1000 MW plant through out its life time. For nuclear power the value of 7% to 9% by 2015 appears might be over-optimistic. In our opinion there are many obstacles at national as well as at international level which hinder the decision to embark on nuclear energy.

At present, hydropower sources are completely exhausted and therefore the share of hydropower will drop to only 7% in 2015. In this connection it is worth mentioning that negotiations are going on between Egypt and Zaire aiming at interconnecting the electric grids of both countries. Zaire has an estimated hydropower capacity of 40,000 MW. The interconnection of the grids will be a substantial contribution to the efforts for curbing CO₂ emissions in Egypt.

Renewable energy sources other than hydropower are still in a premature stage. There are extensive plans to create an infrastructure for such energy sources and to create a market for their exploitation.

TABLE I. ELECTRICITY STATISTICS OF AND SHARE OF DIFFERENT ENERGY SOURCES IN THE EGYPTIAN ELECTRICITY PRODUCTION, 1992-2015

	1992	200	2005	2015
Installed capacity (MW)	11 910	16 557	21 821	36 145
Power generated (TWh)	46.5	68.7	92.6	154.5
Peak load (MW)	7 250	11 350	15 440	26 620
Hydropower (Egypt) (%)	22.44	16.4	10	7
Nuclear power (%)	-	-	7	9
Imp.coal&hydro (Africa) (%)	-	-	7	11
Natural gas & Heavy fuel oil (%)	77.56	83.6	73	68
New and renewable energy (%)	-	-	3	5
Total CO ₂ emission (Mtonnes)	22	33.0	40.86 ^a	62.1 ^a

^a These values are calculated under the assumption that there is no coal fuel; if there is the values will be 46.5 and 76.65, respectively.

6. SOME EXAMPLES OF MEASURES AND POLICIES ADOPTED BY EGYPT AIMING AT CURBING GREENHOUSE GAS EMISSIONS

6.1. Measures and policies related to energy conservation and efficiency improvement

Energy consumption in Egypt as a result of the adoption of the open door policy grew at a rate of 12% in the eighties. Such a rate could lead to the rapid depletion of the Egyptian energy resources. Various measures and adequate policies have been adopted to achieve energy conservation and efficiency improvement. For example:

6.1.1. Efficiency improvements in the production, transmission and distribution of electricity

This goal has been achieved through:

- replacement of open cycle generation systems by combined cycle systems (cc),
- construction of modern large capacity units (4 x 315 MW) (The Shoubra El-Kheima Power Plant),
- rehabilitation of old existing power plants.

It is interesting to point out that the specific fuel consumption for thermal power plants in Egypt has been decreased from 330 g/kW.h in 1982/1983 to 252 g/kW.h in 1991/1992. It is estimated that in 9 years fossil fuel savings would reach a value of 15.13 Mtoe [4]. Losses in transmission and electricity distribution have been decreased by installing the necessary capacitors. Transmission and distribution losses were estimated to be 22% in 1982 and decreased to 14.4% in 1990. The rehabilitation of old existing plants could also contribute to lowering fuel consumption

and to increased energy efficiency. Since 1989, the Egyptian Electricity Authority (EEA) has added about 1220 MW(cc) and 280 MW due to rehabilitation program [4].

In addition to the above measures, some other policies are currently applied. For example, public transport is being encouraged. Other efforts concern improvement of thermal insulation and the production of more efficient appliances.

The application of new tariff systems is considered to be of crucial importance. Energy prices in Egypt are still below the international level. It is planned to have the energy prices at an international level by 1995.

The energy rationalization procedures in 1991 in the power sectors have avoided emissions of about 6.07 Mtonnes of CO₂, and 452 and 47 ktonnes of SO₂ and NO_x, resp. [5].

6.1.2. Efficiency improvement in the industrial sector

The Egyptian industrial sector consumes 50% of the total national primary energy. About 20-30% of the industrial energy consumption used is wasted due to low maintenance, inefficient processes and other reasons [6]. Some energy-saving projects are being implemented in different sectors of the industry. The organization of energy planning is playing a leading role in this respect and is conducting industrial audits for different types of industries to identify energy conservation opportunities and their economic viability [6]. The "USAID" is financing an "Energy Conservation and Efficiency Project (ECEP)". The project is designed to help local industries to improve their overall energy efficiency and to introduce more energy efficient technologies in the industrial sector.

6.2. Switching from fuel dependence to other non-carbon based energy sources

This option comprises the use of nuclear energy and/or renewable energy sources. As mentioned above, the introduction of nuclear energy in Egypt is hindered by a number of obstacles including economic, social and political hindrances. The value of 7% nuclear capacity given in Table I is not based on a real analysis of the different factors affecting the decision about nuclear energy as an option of energy supply in Egypt. Renewable energy sources on the other hand are receiving much attention on both the governmental and private sector. The establishment of the "New and Renewable Energy Authority" (NREA) in 1986 is considered as an important step to create the necessary institutional capabilities for the development and promotion of renewable energy technologies. It is important to state that market penetration has been below expectations for some domestic solar water heater and some industrial process heat technologies. Efforts are under way to overcome market barriers and to promote the commercialization of different solar energy technologies (Table II). The potential annual energy saving by renewable energy technologies is estimated to be 33.0 Mtoe in 1990 and 60.0 Mtoe in 2005. In addition to solar thermal application some photovoltaic technologies were now in operation at Raz Ghareb and Hurghada. Biomass energy has also been given attention. More than 200 biogas digestors for rural areas have been demonstrated and improved designs were developed. Two (400 kW) wind farms are demonstrated and tested for water pumping and other purposes.

6.3. Shift from high-carbon content energy sources (oil and coal) to low-carbon content (natural gas)

A clear shift from oil to natural gas started in the early seventies. The share of natural gas in the energy mix has reached 38% in 1990 (Fig.1). It is estimated that the CO₂ emission from combustion of fossil fuel has increased from 3.79 Mtonnes in 1967 to 20.2 Mtonnes in 1990. The replacement of oil by natural gas has led to the avoidance of about 4 Mtonnes of CO₂ emissions per year.

TABLE II. PROJECTIONS BY NEW AND RENEWABLE SOURCES OF ENERGY (NSRE) OF ENERGY SAVING BY EGYPT (ktonnes per year)

Source: 1990 National Planning Institute study on self-sufficient policy in energy sector, Vol. 4

	Solar			Wind		Biomass		Total	NPE ^a Mtoe	Saving %
	D.S W.H	S.I P.H	1/elec gene	pum ping	2/elec gene	rural	urban			
1990	13.0	1.1	0.20	0.1	1.5	0.1	-	16.0	33	-
1995	114	115	4.0	3.0	24.0	25.0	15.0	300	39	0.075
2000	250	850	15.0	20.0	144	90	60	1429	48	3.0
2005	506	2050	54	50	320	160	120	3260	60	5.4

^a NPE = National Primary Energy.

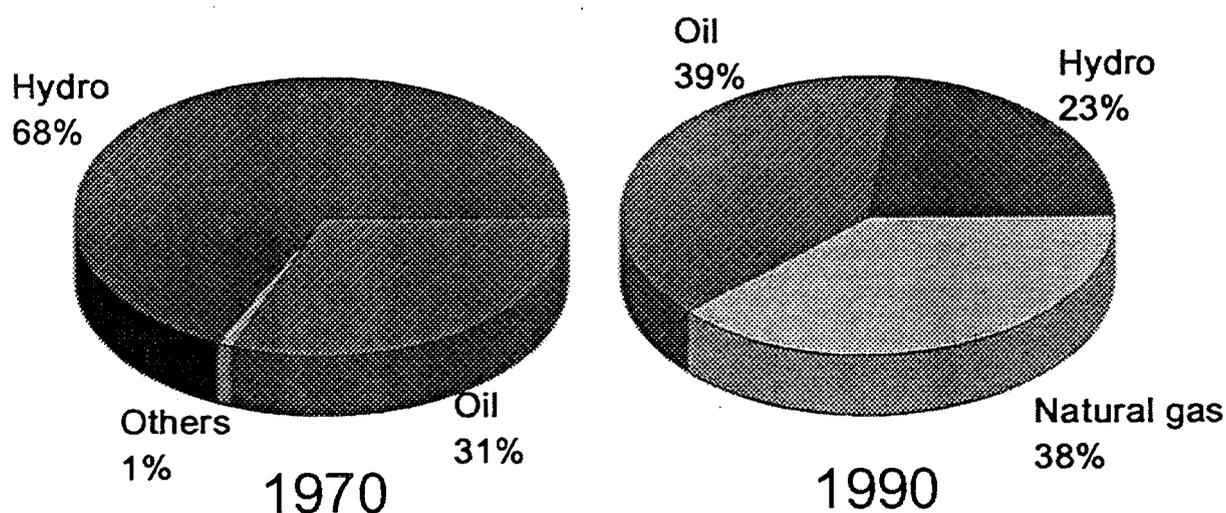


Fig.1. Fuel mix of Egyptian energy consumption, 1970 and 1990.

7. CONCLUSION

The Egyptian Government is quite aware of the seriousness of the problem of global warming. All measures to reduce greenhouse gas emission are incorporated in the planning and management procedures of the national energy plan.

REFERENCES

- [1] Electricity and The Environment, IAEA Bulletin Vol. 33 (1991), No.3, Vienna, Austria.
- [2] UNEP 1991, United Nations Environment Programme, Environmental Data Report; Basil, Blackwell, Oxford (1992).
- [3] RASHAD, S.M., and F.H. HAMMAD, Electricity and carbon dioxide emissions in Egypt. Fifth International Energy Conference ENERGEX 93, Seoul, Korea (October 1993).
- [4] YOUNES, H.A., Egypt Power Plant, UN seminar on Power Plant Operation, Maintenance, Rehabilitation and Distribution in the Arab Region and Turkey. Amman, Jordan (June 1992).
- [5] BEDROUS, M.A., *et al*, Potential of fossil power generation expansion with efficient environmental improvements, Egypt case. 15th congress of the world Energy Council, Madrid, Spain (September 1992).
- [6] YOUNES, H.A., *et al*, Egypt's prospects and programs for energy efficiency improvement and renewable energy development, WEC Committee on Energy Issues of Developing Countries, Cairo, Egypt (April 1993).