

Distr.
GENERAL
E/ESCWA/ENR/1997/1/Add.1
18 December 1996
ORIGINAL: ENGLISH

ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA

**ASSESSMENT OF PRIVATIZATION
OF THE ELECTRIC POWER SECTOR IN SELECTED
ESCWA MEMBER COUNTRIES**

VOLUME II

CASE-STUDY OF EGYPT

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97-0003

Foreword

The importance of the role of electrical energy in socio-economic development cannot be overemphasized. Electrical energy can be easily converted to any other form of energy, transmitted long distances and distributed over large areas. It can cross countries without being subjected to any border-crossing formalities. It is therefore a tradable commodity as well as a service rendered to consumers.

However, the provision of electricity requires large investments in establishing, operating and maintaining electric power generation, transmission and distribution systems and the related facilities. A projected investment of about US\$ 1,500 billion will be needed between 1995 and 2010 to finance the electric power expansion projects in developing countries. The share of the ESCWA region¹ in this investment is estimated at US\$ 90 billion. It is clear that the required investment in the power sector is huge. The ability of the concerned Governments to provide this funding in the amount required is severely limited and the international funding institutions have neither the will nor the capability to provide soft loans for power projects. Therefore, the only viable option is to involve private investment in the power sector. Consequently, new financing modalities are needed to pool all available resources to ensure an acceptable level of risk. Different modalities are evolving worldwide, and countries should select carefully the modality most appropriate for their requirements.

In spite of the fact that there are growing efforts in most of the ESCWA member countries to promote more involvement of the private sector in various economic activities and infrastructure projects, the privatization of the power sector is still an evolving process and its logistics need to be more carefully studied.

Some ESCWA member States have already taken steps to privatize the electric power sector. The ESCWA secretariat has assumed the responsibility of studying the experiences in the region and of presenting a synthesis of these studies to the other member States so that each ESCWA member can benefit from the experience of the others. To that end, the ESCWA secretariat commissioned a group of experts to prepare four studies on the project. The experts have different backgrounds and work experience in both the public and private sectors. The first study is an overview of the whole issue of privatizing the electric power sector, including a summary of the present situation, projected future developments in the power sector and the approaches of the three selected countries to privatization of this sector. The other three studies commissioned are case-studies of three selected member countries: Egypt, Jordan and Yemen. The four experts and the ESCWA regional adviser on energy held a two-day round table discussion in Cairo on 28 and 29 November 1996, to exchange views in order to coordinate the content of the four studies and to discuss the conclusions of the studies.


The four studies have been revised by ESCWA secretariat staff and are presented in separate volumes:

1. **Volume I. *Assessment of Privatization of the Electric Power Sector in Selected ESCWA Member Countries, An Overview.*** This volume depends mainly on the contributions of Salah Afifi, the ex-Regional Director of Westinghouse Company and the present Chairman of the International Business Network (IBN) Egypt and Emad El-Sharkawi, the former Chairman of the Egypt Electricity Authority.

¹ The ESCWA members are Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, the Syrian Arab Republic, the United Arab Emirates and Yemen.

2. **Volume II.** *Assessment of Privatization of the Electric Power Sector in Selected ESCWA Member Countries, Case-study of Egypt.* This volume was prepared by Emad El-Sharkawi, the former Chairman of the Egypt Electricity Authority.
3. **Volume III.** *Assessment of Privatization of the Electric Power Sector in Selected ESCWA Member Countries, Case-study of Jordan.* This volume is based mainly on the study prepared by Mohammed Azzam, Director of Planning of the Jordanian Electricity Authority/National Electricity Power Company.
4. **Volume IV.** *Assessment of Privatization of the Electric Power Sector in Selected ESCWA Member Countries, Case-study of Yemen.* This volume is based mainly on the study prepared by Abdel Moati Al-Jonaid, Deputy Director of Technical Affairs of the Yemeni Public Electricity Cooperation.

Finally, on behalf of ESCWA, I am pleased to acknowledge the valuable contributions made by the four consultants and the ESCWA staff members to the present publication.


Hazem El-Beblawi
Executive Secretary

PREFACE

The three case-studies included in the assessment of privatization of the electric power sector in selected ESCWA member countries include a brief description of the economic conditions in the respective countries and the policies towards economic reforms, with special emphasis on privatization. The present study provides a description of Egypt's power sector (generation, transmission, distribution and institutional framework), the laws and regulations governing its role, and the present and future situation with respect to private investment in power generation. The study focuses on the new policies being developed to encourage and increase private sector involvement in this sector, detailing the forms and modalities employed to facilitate coordination between private investors and the various energy authorities; the benefits, constraints and obstacles of this approach to the provision of electric power are then evaluated. The final chapter summarizes the conclusions of the study and provides a list of recommendations.

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ABBREVIATIONS

BLT	Build-lease-transfer
BO	Build-own
BOO	Build-own-operate
BOOT	Build-own-operate-transfer
CPI	Consumer price index
EEA	Egyptian Electricity Authority
EGEAS	Electric Generation Expansion Analysis System
ERSAP	Economic reform and structural adjustment programme
GCC	Gulf Cooperation Council
GDP	Gross domestic product
HCCED	Holding Company for Construction and Electricity Distribution
HPPA	Hydro-Power Projects Authority
IPPs	Independent power producers
LOLP	Loss of load probability
MEAD	Model for Analysis of Energy Demand
MOEE	Ministry of Electricity and Energy
NMA	Nuclear Materials Authority
NPPA	Nuclear Power Plants Authority
NUPS	National Unified Power System
PPA	Power Purchase Agreement
RATS	Regression analysis for time series
REA	Rural Electrification Authority

INTRODUCTION

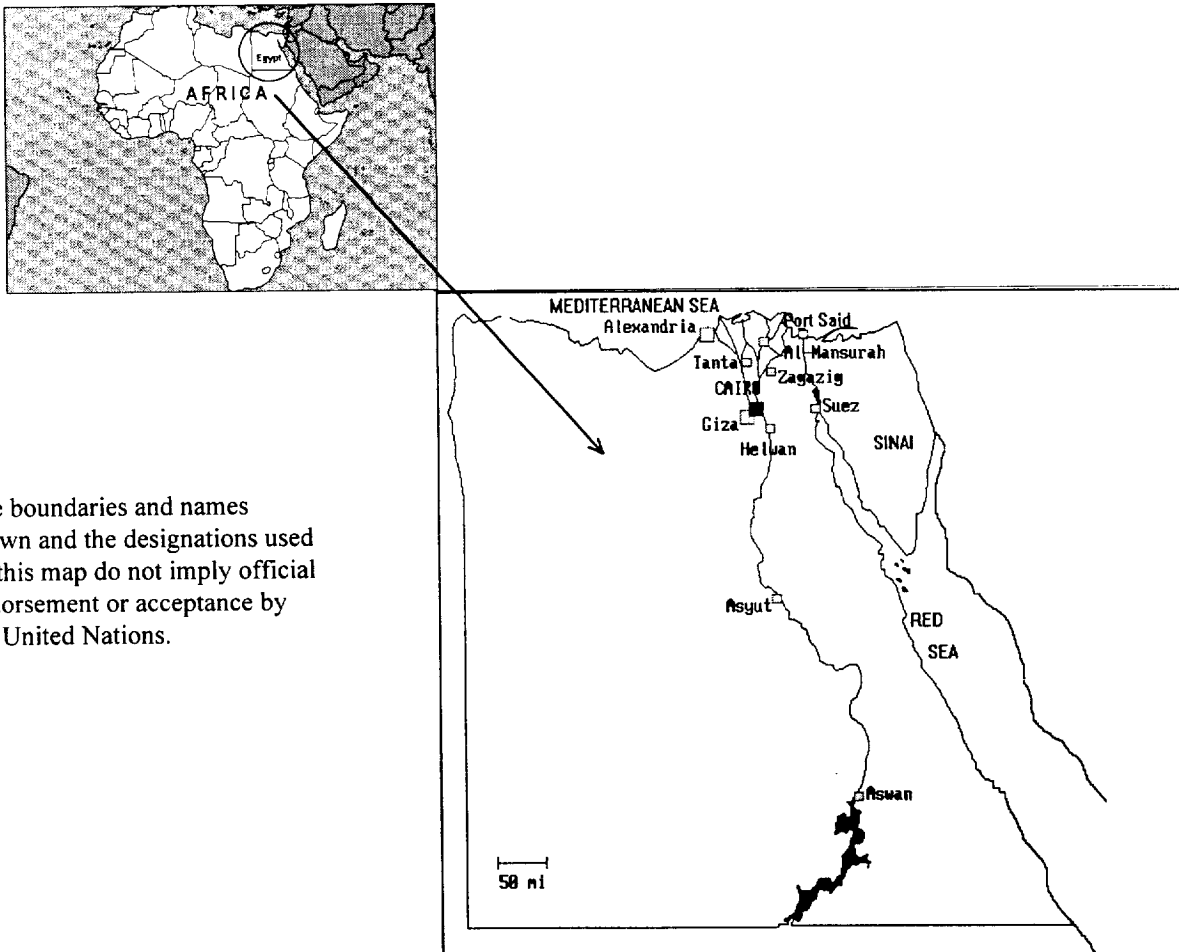
The Arab Republic of Egypt is situated at the north-east corner of the African continent. The Sinai Peninsula, which occupies the north-east part of Egypt, is the gateway to Asia. The country is bordered by the Mediterranean Sea to the north, the Gulf of Aqaba and the Red Sea to the east, Sudan to the south, and the Libyan Arab Jamahiriya to the west (see figure I).

Though Egypt's total land area comprises about 1 million square kilometres (km²), only about 6% of this is used for habitation and economic activities, mainly around the Nile valley and delta. The Nile River runs the length of the country from the Sudanese border in the south to an area north of Cairo, where it branches into two (forming the Nile delta) and continues to flow into the estuaries of the Mediterranean Sea. The rest of the country is mainly desert. The climate is arid but temperate, with hot summers and cooler winters the norm, though the northern coast generally enjoys the mild weather typical of Mediterranean countries all year round.

The population of Egypt is currently about 62 million, with an annual growth rate of about 2.2 per cent. Nearly half the population live in the urban centres, mostly in and around Cairo, Alexandria, Port Said, Isma'iliya, Suez, Tanta, El Mansura, Zagazig, Asyut and Aswan (see figure I). The population of metropolitan Cairo is now over 12 million—around 20 per cent of the national total.

The need for arable land is critical; agricultural activities are confined to only about 3 per cent (6 million feddan or 2.5 million hectares) of the country's total land area. Large-scale land reclamation projects have been carried out over the last 30 years, but the net agricultural area has remained the same, as urbanization and village expansion have tended to involve settlement and building in the old, fertile areas of the Nile valley and delta.

Figure I. Egypt and the African continent



I. THE ROLE OF ENERGY IN EGYPT'S ECONOMY

Like many developing countries, Egypt has witnessed relatively high growth rates in energy consumption over the past two decades. Energy plays an important role in the economic and social development of the country, and its availability will constitute an important element in development efforts during the first quarter of the twenty-first century.

With Egypt's high population growth rate, urban areas will expand further, the demand for both habitable and agricultural land will rise, and industrial expansion will occur in response to the growing needs of greater numbers of people; as a consequence, Egypt's energy requirements will rise substantially.

One of Egypt's primary development objectives is to stabilize the growth of its urban centres by accommodating the increased population in new satellite cities and on new agricultural land reclaimed from the desert. Unprecedented measures are required to redistribute the population and to develop the facilities, services and infrastructure required to support it. The social, cultural, technological, economic, infrastructure and energy-supply challenges involved in achieving such a goal are both tremendous and complex.

Egypt's capacity for expanding traditional agricultural production is limited, so the focus is now on the second development objective: to achieve economic expansion by increasing industrial production and developing service sector activities to the point where they become major sources of income for the country.

The realization of these two objectives depends to a great extent on the availability of a reliable and sustainable energy supply; careful planning is thus needed in the energy sector to ensure that Egypt's economic and social development requirements can be met.

The remainder of this study examines the present situation in the power sector and the anticipated role of independent power producers (IPPs) from the private sector in power-generation projects.

II. OVERVIEW OF ECONOMIC PERFORMANCE

Like many developing countries, Egypt is under a number of constraints deriving from the fact that it has insufficient natural resources to meet its socio-economic development requirements, particularly in the light of its rapid population growth.

In 1974 Egypt's economy experienced a dramatic shift as traditional socially oriented strategies were replaced with more open, market-oriented policies—a radical change which required the country to seek new trading and investment partners. Between 1974 and 1980, Egypt experienced unprecedented rates of economic growth in production, investment, consumption, exports and imports. One of the primary goals of the new approach was to turn Egypt into a modern, prosperous and progressive country by the year 2000.

The main economic stimulus for Egypt's new development programme was the very rapid growth of external resources which became available to the country after 1974. First came large capital inflows, mainly in the form of remittances from Egyptians working abroad, and particularly from those employed in the Gulf Cooperation Council (GCC) countries. Shortly thereafter, new sources of foreign exchange evolved which reduced the account deficit while allowing imports to grow at an even faster rate. Petroleum exports became increasingly important, with production climbing from 7 million tons in the early 1970s to 32 million tons in 1981. The rapid rise in oil production (resulting from an intensive exploration programme), coupled with a surge in oil prices on the world market in 1979, enabled Egypt to become a significant net oil exporter and made petroleum exports a prime source of revenues. With the reopening of the Suez Canal in 1975, revenues from international trade and shipping rose dramatically to become another important source of income for the country. Tourism policies were liberalized during the 1970s, and this sector flourished, bringing in additional revenues.

These external resources collectively grew at a rate of about 40 per cent per year between 1974 and 1980. Their share in gross domestic product (GDP) rose from 6 per cent before 1974 to about 45 per cent in 1980. The inflow of foreign exchange resources contributed to the rapid growth of the Egyptian economy. The large increase in exports allowed for both a higher rate of capacity utilization in industry and increased output. The rate of growth was high in the commodity-producing sector and even higher in the distribution sector. Even agriculture, which suffered greatly from production and price controls, grew relatively rapidly owing to the investments made in this sector during the same period.

The external resource boom showed its first signs of weakening at the beginning of the summer in 1981, triggered by a global drop in oil prices; though the volume of production and exports grew, the increase in earnings from the latter was relatively modest. Workers' remittances and tourism revenues began to fall at about the same time, with the result that a negative balance was recorded for fiscal year 1981/82.

This downward trend was contained somewhat during 1982/83 in spite of a further decline in oil prices, largely because the Government took steps to curb imports (particularly of consumer goods), to liberalize the terms on which banks could attract workers' remittances from abroad, and to curb the growth of both current and capital public expenditures. As a result of these measures, the overall balance of payments showed a surplus in 1982/83 which allowed Egypt to rebuild substantial reserves and reduce its short-term debts.

These short-term stabilization efforts were accompanied by a number of corrective measures. The most significant changes related to the foreign trade regime. The Government allowed exporters to take advantage of the most favourable exchange rate and simultaneously took steps to reduce export controls and strengthen export promotion. At the same time, the commercial bank exchange rate was adjusted to reflect the market rate, which attracted additional remittances from abroad and led to a more justifiable exchange rate structure for price-sensitive imports. The Government also took significant steps to simplify and strengthen investment incentives for foreign and domestic private investors by reducing customs duties on

* The fiscal year covers the period from July to June.

imported equipment and exempting projects set up in the new cities from paying taxes for periods of between five and ten years. (These new cities have been established by the Government with the infrastructure and utilities necessary to set up new projects, and land allotments have been sold to investors at convenient prices.) Allowing foreign investors to transfer their profits overseas constituted another investment incentive. Finally, a special council was set up by the Government to encourage exports and to handle the bureaucratic and other difficulties that might hinder the export process.

During the First Five-Year Plan (1982/83-1986/87), the Egyptian economy took advantage of the momentum of the oil boom and managed to maintain overall growth through expansionary economic policies. Real GDP growth averaged 6.1 per cent per year during the period 1982-1987 and 5.5 per cent between 1986 and 1990.

In comparison with the 1970s, the pace of economic progress was remarkably slow during the period covered by the Second Five-Year Plan (1987/88-1991/92), with GDP growing by only 4 per cent in real terms. Several factors were responsible for the sluggish economic growth experienced during this period, including the following:

(a) The failure of the economy to adjust itself to external shocks. The decline in oil prices and the rise in interest rates led to massive increases in fiscal and external debt and a substantial reduction in capital inflows;

(b) The effect of the Gulf crisis and war on Egypt's foreign exchange earnings, particularly tourism revenues and workers' remittances;

(c) The stagnation of the economy, with inflation rates of over 20 per cent a year and persistently high unemployment figures of up to 14.8 per cent (1986/87);

(d) The uncertainties that shaped the investment climate following the initiation of the first phase of the economic reform and structural adjustment programme (ERSAP-1).

In 1991, the Government adopted an ERSAP which aimed at restoring financial balances and promoting economic growth through the development of a decentralized, outward-oriented, market-based economic system in which the private sector was expected to play a more active role.

Some remarkable results have been achieved in recent years in terms of macroeconomic stabilization, leading to a noticeable reduction in the fiscal budget deficit from 17 to 1.5 per cent of GDP during the period 1991/92-1994/95. Fiscal and monetary policies succeeded in pushing down inflation, measured by the consumer price index (CPI), from about 20 per cent in 1990/91 to 8.4 per cent in 1994/95.

An elaborate financial liberalization package of policies and measures has also been implemented. The interest rate reform policy has played a crucial role in reducing the rate of inflation. Decelerating inflation and maintaining a reasonably constant nominal exchange rate between the Egyptian pound and the US dollar (since December 1995, US\$ 1 = LE 3.395) has contributed to boosting the credibility of the Egyptian economic stabilization programme. The measures have also been instrumental in encouraging a portfolio shift from dollar-dominated assets to domestic currency assets. As a result of positive monetary performance, capital inflows have grown, and nearly \$18.4 billion in net reserves has been accumulated, equivalent to 18 months of imports. With regard to price reforms, substantial progress has been achieved in liberalizing the prices of energy, industrial and agricultural products in an effort to improve the economy's allocative efficiency.

Despite these encouraging improvements in performance, the stabilization policy has had the effect of slowing down growth; annual rates averaged less than 2 per cent throughout the period 1991/92-1993/94 before increasing to 4.7 per cent in 1994/95. During the same period, gross domestic investment and savings ratios declined significantly. According to the Central Bank of Egypt, the share of investment and savings in GDP dropped from 20 and 7 per cent to 17 and 6 per cent respectively.

At the sectoral level, growth has been uneven. Structural adjustment and liberalization measures have paid off in agriculture, which remains the most important sector, accounting for 16.3 per cent of GDP and 32 per cent of total employment in 1994/95. The industrial sector exhibited the highest growth rate—7.7 per cent, compared with 2.9 per cent for agriculture and 5 per cent for services—and represented nearly 17 per cent of GDP and 13.7 per cent of total employment in 1994/95. The service sector doubled its growth rate from 2.5 per cent in 1993/94 to 5 per cent in 1994/95, though its share in GDP remained almost constant at around 32.8 per cent.

Significant efforts have also been undertaken to liberalize foreign trade by reducing import tariff rates (which now range from 5 to 70 per cent), eliminating most of the quantitative restrictions, and removing an array of bureaucratic non-tariff barriers impeding trade.

A positive change has occurred in the external trade situation, with the deficit in the overall balance of payments prior to 1990/91 shifting to a surplus which declined from an average of \$5 billion during the period 1991-1993 to an average of \$1.2 billion between 1993 and 1995. The current account deficit (excluding official transfers) also fell, declining from 6.8 per cent of GDP in 1990/91 to an estimated 1.7 per cent in 1994/95.

Despite the implementation of the reform measures mentioned above, private sector performance during the period 1991/92-1993/94 did not show substantial improvement. In an effort to activate private sector development, the Egyptian Government initiated a plan for gradual privatization. The most significant structural reforms related to the industrial sector are included in Law No. 203 of 1991 and Law No. 95 of 1992. The first law restructured public sector companies so that full privatization could begin, while the second established the legal foundation for a modern capital market and stock exchange. In adopting these laws and ensuring the implementation and enforcement of their provisions and regulations, the Government of Egypt has confirmed its commitment to develop a private sector-driven market economy.

In addition to providing for a modern stock exchange, Law No. 95 of 1992 sets the legal framework for establishing modern brokerage firms, mutual funds, employee-shareholder associations, venture capital, and the clearance-and-settlements company needed for the stock exchange.

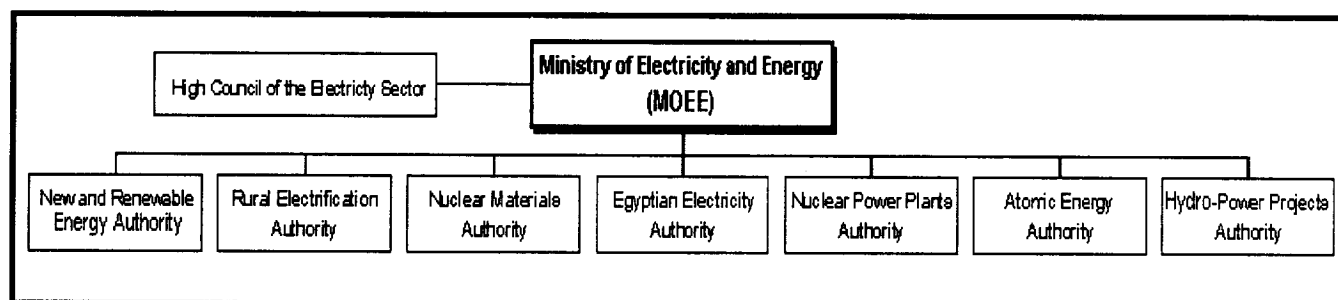
Under Law No. 203 of 1991 for the restructuring of public enterprises, the Government's industrial portfolio of 314 companies was reorganized. The technical ministries relinquished control of the companies, which were then placed under the management of newly established economic holding companies rather than the existing sector monopoly organizations. The holding companies, which report to the new Ministry of Public Enterprises Sector, have been directed to maximize profits by applying sound economic and commercial principles and practices, which includes evaluating and responding to market conditions. The holding companies and their affiliated operating companies are not covered by the Government budget, nor are they eligible for concessionary credit. The management staff of these companies are employed on a contractual basis for three years and are offered performance incentives. New boards of directors have also been appointed which include some members from the private sector. As a result of the liberalization activities described above, the share of private sector participation in GDP amounted to 65 per cent in 1995/96.

III. THE POWER SECTOR

A. INSTITUTIONAL ASPECTS

The electricity sector's main objective is to provide a secure and reliable supply of electricity at minimum cost to Egypt's population and the different sectors of the economy. In order to fulfil such a commitment, the Government has adopted a strategy since the beginning of the 1980s which focuses on the use of different technologies in power generation and transmission, institution-building, enhancing the utilization of new and renewable energy resources, the electrification of all villages and rural attachments, encouraging local industries to manufacture electrical equipment, and promoting electric power interconnections with neighbouring countries. A schematic representation of the Egyptian electricity sector is shown in figure II.

Figure II. Schematic representation of the electricity sector in Egypt



In 1991, Egypt's electricity distribution and construction companies were transferred to the Ministry of Public Enterprises Sector as part of the Government's efforts to privatize their activities. The roles of the different authorities and entities are described briefly in the subsections below.

1. *The Egyptian Electricity Authority*

The Egyptian Electricity Authority (EEA) is the country's national utility agency and is responsible for electricity production, transmission and distribution, as well as bulk sales. The EEA is responsible for assessing electrical energy resources, estimating the electricity requirements of the different sectors of the economy, and planning the most economical and reliable medium- and long-term system expansions to meet future energy demands.

Energy efficiency and conservation among both suppliers and end-users are among the most important goals to be achieved by the EEA over the next decade and beyond. The impact of electricity generation and utilization is recognized as an important issue and is being given serious consideration by the EEA.

A certain rate of economic growth must be achieved in order to provide a decent standard of living for Egypt's growing population. Part of this economic growth process is based on the optimal use of energy by the different sectors of the economy. Until 1980, the EEA was the sole provider of electric power and was responsible for all electricity generation, transmission and distribution (including sales) to both large commercial operations and individual consumers. In the early 1980s seven independent distribution companies were established (and an eighth set up in 1988) in selected areas of Egypt to ensure coverage of the entire country, and these companies set about selling electric energy to small and medium-sized commercial, industrial and domestic consumers. The distribution and sale of high voltage electricity to large consumers is still handled by the seven EEA electricity zones which cover the entire country.

2. The Rural Electrification Authority

The Rural Electrification Authority (REA) is responsible for planning and building high voltage subtransmission, medium voltage and low voltage networks in the rural towns and villages of Egypt (all areas outside Cairo and Alexandria).

3. The Hydro-Power Projects Authority

The Hydro Power Projects Authority (HPPA) is responsible for carrying out studies for hydro-power, mini hydro-power and pumped storage projects and supervising their construction and commissioning up to the operation stage, at which point the projects are handed over to the EEA.

4. The Nuclear Power Plants Authority

The Nuclear Power Plants Authority (NPPA) is responsible for all aspects of nuclear powerplant projects. Presently, the NPPA is engaged in studying sites, making decisions regarding the appropriate type of plant, preparing tender documents, and handling the bidding and contract negotiations for the first nuclear powerplant (at the time of writing, construction had not yet begun).

5. The Atomic Energy Authority

The Atomic Energy Authority (AEA) is responsible for conducting research and is involved in different activities related to applications in this field such as radiation technology, the control of radiation levels, regulatory procedures and the training of personnel.

6. The Nuclear Materials Authority

The Nuclear Materials Authority (NMA) is responsible for carrying out studies to determine potential uses for nuclear materials in the country and for processing nuclear materials.

7. The New and Renewable Energy Authority

The New and Renewable Energy Authority (NREA) is responsible for the study, promotion and development of new and renewable energy resources and for maximizing their application in technoeconomic fields.

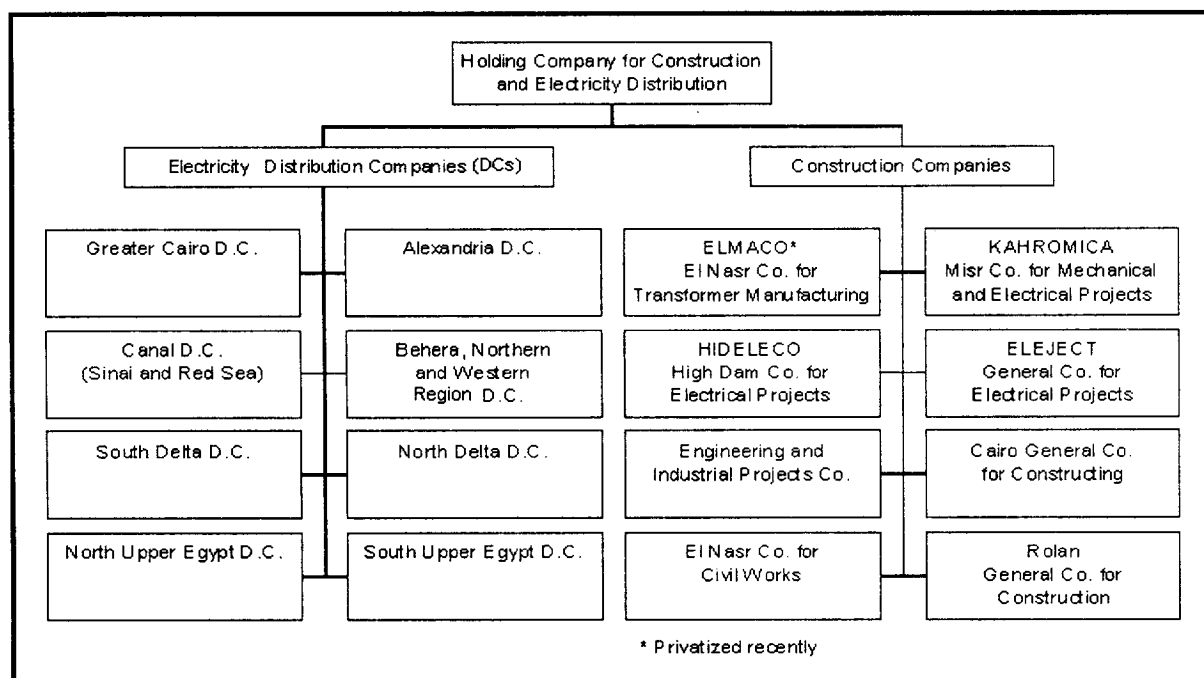
8. The Holding Company for Construction and Electricity Distribution

The Holding Company for Construction and Electricity Distribution (HCCED) owns eight affiliated companies for electricity distribution, three companies for the construction of electricity projects, one company for the manufacture of transformers, and four companies for civil contracting works (see figure III).

The electricity distribution companies are responsible for distributing and selling electric power of low and medium voltage to consumers all over the country. These companies purchase electric energy from the EEA in bulk at medium voltage (11 or 22 kilovolts [kV]).

Since 1991 the HCCED has reported to the Minister of Public Enterprises Sector in preparation for the privatization of the affiliated activities. Close coordination is maintained between the electricity distribution companies, the EEA and the REA.

Figure III. Schematic representation of the Holding Company for Construction and Electricity Distribution in Egypt



B. PEAK LOAD AND ENERGY GENERATED

The Egyptian Electricity Authority's peak demand for electricity increased from 3,250 megawatts (MW) in 1981 to 8,400 MW in 1995, an annual average growth rate of 7.1 per cent.

The electrical energy produced over the same period increased by an average of 8.3 per cent a year, or from 18 terawatt-hours (TWh) in 1981 to 55 TWh in 1995. Annual per capita electricity consumption also increased, rising from 640 kilowatt-hours (kWh) in 1981 to 750 kWh in 1995.

C. EXISTING POWER GENERATION PLANTS

The national power system of the EEA currently comprises 22 powerplants interconnected by a national grid. The main sources of electric power are water (hydro-power), natural gas and oil. The total installed capacity of the EEA powerplants in 1981 was 4,900 MW, with hydro-power accounting for 2,445 MW. By 1995, total installed capacity had increased to about 13,500 MW, with thermal plants responsible for the largest share and hydro-powerplants accounting for only 2,805 MW. In other words, about 80 per cent of the electricity generated now comes from thermal plants (steam and combustion turbines) which run mainly on heavy fuel oil and/or natural gas, 20 per cent comes from hydro-powerplants, and a small amount (about 0.5 TWh per year) is generated by diesel engines using light fuel oil to serve remote and isolated desert areas. Combined-cycle powerplants now account for about 20 per cent of total thermal installed capacity; this reflects a major improvement in the overall generation efficiency of the EEA system, evidenced by the drastic reduction in specific fuel consumption per kWh of generated energy.

The total available capacity of the EEA powerplants is constrained by a number of factors: water discharge for the irrigation regime places constraints on hydro-power generation; ambient (summer/winter) temperatures affect the capacity and output of the combustion turbines; and the derating of some old steam units occurs as a result of ageing.

D. ELECTRICITY CONSUMPTION BY THE VARIOUS SECTORS

The industrial sector currently consumes the highest proportion of electricity in Egypt (50 per cent of all electrical power produced), followed by the residential and commercial sectors (a combined total of 35 per cent), the governmental and tertiary/services sectors (10 per cent), and the agricultural and land reclamation sector (5 per cent).

E. THE NATIONAL ELECTRIC POWER SYSTEM

The Egyptian Electricity Authority's extra high voltage network of 500 kV was introduced in the late 1960s with the completion of the Aswan High Dam. Electric power was transferred from the Dam's powerplant to the load centres via the newly constructed 500-kV, 220-kV and 132-kV networks in Upper Egypt and via the 220-kV network for the Cairo area and Lower Egypt (the delta region). The National Unified Power System (NUPS) was subsequently established to cover most of the urban and rural areas of the country. As a result of the extensive rural electrification programme begun in 1971 and the progressive expansions of the networks, 97 per cent of the inhabited areas have been electrified, and the entire population of Egypt is expected to be covered by the year 2000.

The capacity of the 500-kV, 220-kV and 132-kV substations was increased from about 7,800 megavolt-amperes (MVA) in 1981 to over 25,000 MVA in 1995 (see table 1), and the associated transmission lines were extended from 5,680 km to over 11,000 km during the same period (see table 2).

TABLE 1. THE EVOLUTION OF SUBSTATION CAPACITIES FOR THE PERIOD 1980/81-1994/95
(Megavolt-amperes)

Fiscal year ^{a/}	500 kV ^{b/}	220 kV ^{b/}	132 kV ^{b/}
1980/81	3 280	3 330	1 227
1981/82	3 280	3 620	1 377
1982/83	3 280	3 970	1 395
1983/84	3 280	5 280	1 936
1984/85	3 280	6 390	2 006
1985/86	3 280	9 615	2 192
1986/87	3 280	9 665	2 402
1987/88	3 280	10 495	2 402
1988/89	4 530	11 930	2 536
1989/90	5 280	12 430	2 589
1990/91	5 280	12 430	2 589
1991/92	5 280	13 445	2 589
1992/93	6 280	14 115	2 731
1993/94	6 280	14 955	2 731
1994/95	6 280	15 810	2 792

a/ July/June.

b/ Kilovolts (referring to the type of substation).

The extra high voltage (500 kV) network is continuously expanding to cover new areas so that large blocks of power can be reliably transferred to the load centres in and around Greater Cairo, to the Suez Canal zone, and across Sinai to effectively interconnect Egypt to Jordan and to the Syrian Arab Republic and Turkey, as explained in chapter V below.



TABLE 2. THE EVOLUTION OF TRANSMISSION LINE LENGTHS FOR THE PERIOD 1980/81-1994/95
(Kilometres)

Fiscal year ^{a/}	500 kV ^{b/}	220 kV ^{b/}	132 kV ^{b/}
1980/81	1 576	2 015	2 093
1981/82	1 576	2 211	2 093
1982/83	1 576	2 449	2 093
1983/84	1 576	2 973	2 125
1984/85	1 576	3 386	2 188
1985/86	1 576	3 742	2 188
1986/87	1 576	4 009	2 195
1987/88	1 576	4 299	2 195
1988/89	1 576	4 659	2 200
1989/90	1 594	4 720	2 200
1990/91	1 594	4 821	2 200
1991/92	1 617	5 560	2 231
1992/93	1 736	5 979	2 261
1993/94	1 736	6 798	2 479
1994/95	1 736	7 279	2 536

a/ July/June.

b/ Kilovolts (referring to the type of transmission line).

F. THE ENERGY EFFICIENCY IMPROVEMENT PROGRAMME OF THE EGYPTIAN ELECTRICITY AUTHORITY

Optimal utilization of installed capacity requires, among other things, a reduction in system losses and the more efficient use of electrical energy by the end-user. Increasing the efficiency of the power system therefore involves making improvements in both supply-side and demand-side efficiencies.

On the supply side, measures undertaken to improve economic and technical efficiency have included maximizing the use of both hydro-power and natural gas resources to reduce greenhouse gas emissions and free more oil for export. Further, rehabilitating old powerplant units has directly resulted in increasing their operational efficiencies, and converting open-cycle combustion turbines to combined-cycle turbines has contributed significantly to fuel savings and an increase in overall efficiency. All of these efforts, along with the introduction of large units, led to a reduction in the Electricity Authority's average specific fuel consumption between 1981 and 1995, from 346 grams (gm)/kWh to 227 gm/kWh, resulting in a considerable savings in fuel consumption over time.

The efficiency of the transmission and distribution systems has been improved through a programme for reducing losses within these networks. Facilitating the availability and installation of the required equipment has also allowed for the correction of the power factor, contributing further to system efficiency. Between 1981 and 1995, total losses in the NUPS declined from 19 to 13 per cent.

IV. PLANS FOR THE NATIONAL UNIFIED POWER SYSTEM

A. PROJECTIONS FOR PEAK LOAD AND ENERGY GENERATION

Peak load and electrical energy generation forecasts for the coming years constitute the basis for a number of important decisions which must be taken. The EEA, in cooperation with various international institutions and firms, has developed several different load and energy forecasting methodologies and models, including the following:

- (a) The Growth Rate of Specific Consumption (GR-SC) model;
- (b) The end-use method;
- (c) The econometric method, embodied in the regression analysis for time series (RATS) model;
- (d) The Model for the Analysis of Energy Demand (MAED), module I: energy demand calculations.

All of these models have been tried and tested by the EEA over a period of time, and the econometric method has proved the most appropriate, as it uses statistical methods to forecast load and energy requirements as a function of economic and demographic variables. Using this method, it is projected that by the year 2020, peak load will have reached 32,420 MW, with an average annual growth rate of 5.5 per cent, and electrical energy demand will total 200 Twh, growing at a rate of 5 per cent per year. Table 3 shows the peak load and the electrical energy generated in Egypt annually for the period 1981-1996, and table 4 provides the corresponding projected values up to the year 2017.

TABLE 3. PEAK LOAD AND ELECTRICAL ENERGY GENERATED FOR THE PERIOD
1980/81-1995/96

Fiscal year (July/June)	Peak load (megawatts)	Energy generated annually (gigawatt-hours)
1980/81	3 306	19 870
1981/82	3 694	21 895
1982/83	3 981	24 537
1983/84	4 672	27 691
1984/85	5 158	30 064
1985/86	5 361	32 244
1986/87	6 803	35 202
1987/88	6 152	37 845
1988/89	6 279	39 580
1989/90	6 664	41 649
1990/91	7 004	43 478
1991/92	7 215	45 482
1992/93	7 503	47 096
1993/94	7 657	48 604
1994/95	8 150	51 318
1995/96	8 491	54 477

TABLE 4. FORECASTS FOR ANNUAL PEAK LOAD AND ELECTRICAL ENERGY GENERATION TO THE YEAR 2017

Fiscal year (July/June)	Peak load (megawatts)	Annual energy generated (gigawatt-hours)
1996/97	9 040	57 420
1997/98	9 630	61 215
1998/99	10 240	65 150
1999/2000	10 940	69 700
2000/01	11 670	74 425
2001/02	12 430	79 330
2002/03	13 170	84 165
2003/04	13 940	89 150
2004/05	14 730	94 310
2005/06	15 595	99 950
2006/07	16 505	105 890
2007/08	17 455	112 090
2008/09	18 460	118 645
2009/10	19 520	125 585
2010/11	20 400	131 240
2011/12	21 315	137 140
2012/13	22 275	143 310
2013/14	23 280	149 760
2014/15	24 325	156 500
2015/16	25 420	163 540
2016/17	26 560	170 900

B. POWER GENERATION EXPANSION UP TO THE YEAR 2017

The basic objective of the EEA power generation expansion plan is to provide sufficient generation capacity to meet demand, taking into account the various factors related to the Authority's system reserve requirements and the economical operation of the system.

The installed reserve of the EEA exists to allow for changes in the available capacity of the hydro-powerplants according to irrigation requirements, scheduled maintenance, unplanned/forced outages, and daily and seasonal fluctuations in customer demand, and also to satisfy operational and spinning reserve requirements. The amount of reserve is primarily a function of the number, size and reliability of the installed generating units and their scheduled maintenance requirements. The loss of load probability (LOLP) determines the amount of reserve required.

The Monte Carlo technique is used in conjunction with the appropriate computer software to evaluate the different outage probabilities and reserve requirements for the NUPS. Current results indicate that a reserve capacity level of 17.25 per cent of the peak load is required, which corresponds to an LOLP level of one day every three years (or more precisely, one day every thousand days). A conservative (minimum) reserve level of 15 per cent is applied by the EEA in both planning (projections) and practice.

The EEA has learned from experience that specific plans for the construction of a new facility should be drawn up at least 8 to 10 years before the actual required date of commissioning, as it takes a relatively long time to carry out feasibility and site studies, close the financial package, finalize the engineering designs, and construct the plant.

TABLE 5. EGYPTIAN ELECTRICITY AUTHORITY POWER GENERATION EXPANSION PLAN TO THE YEAR 2017

Plant	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Talkha extension																					
Asyut												325									
Cairo West							325	325													
Mahmudiya CC ^{a/}																					
Damanhur CC																					
Cairo South CC																					
Kureimat	650	650								650											
Sidi Kreir			325	325																	
Suez Gulf									325	325											
Ayon Musa					325	325															
Ataqa pump storage							325	325													
Cairo North GT ^{b/} /CC							2*100	2*100	2*300												
Delta North CC													300		300						
Nubaria CC										300	300										
Damanhur extension												325									
Sidi Kreir (phase 2)					2*325																
Dhaba'a																					
El-Tabbin GT										2*325	100					2*100					
Mahmudiya GT													3*100	100							
Zafarana												650	650	2*650							
Delta North ST ^{c/}															650	650					
Safaga																650	650	650			
Suif CC																300	2*300	300			300
Talkha GT																	100	100	2*100		
El Shabab																				5*100	2*100
Kafr el Dauwar																				650	650
Total	650	650	325	325	325	975	850	850	1 125	1 275	1 050	1 300	1 250	1 400	950	950	950	1 350	1 150	1 150	1 150

Source: Egypt, Ministry of Electricity and Energy, Egyptian Electricity Authority, Planning and Economic Studies Department, "Load and energy forecast for the period 1995/96 - 2009/10" (June 1996).

a/ Combined-cycle units.

b/ Gas turbine units.

c/ Steam units.

The EEA currently uses a state-of-the-art optimization model known as the Electric Generation Expansion Analysis System (EGEAS) to identify the most economical means of expanding generation; detailed variable operating costs are determined based on probabilistic economic dispatch and fixed costs through the use of levelized fixed-charge rates. The tentative plan for expanding generation within the NUPS up to the year 2017 is shown in table 5.

It should be noted here that the expansion programme takes into account the powerplants which are to be built by private power producers (PPPs), also known as independent power producers (IPPs); the first of these plants is expected to come on line sometime during 2001/02. The implementation dates can be moved up for the IPPs and their share in the generation expansion plan increased once they prove themselves in terms of performance, efficiency and reliability.

V. ELECTRIC POWER INTERCONNECTIONS WITH NEIGHBOURING COUNTRIES

A. THE BENEFITS OF ELECTRIC POWER INTERCONNECTIONS

Since the early 1980s the EEA has been promoting cross-border trade in electrical energy as a means of contributing to economic development. Just and equitable trade relationships strengthen economic cooperation at both the regional and interregional levels, which is why the EEA has given the establishment of electrical interconnections between Egypt and its neighbouring countries such high priority among its strategic goals.

The economic benefits from electric power system interconnections accrue mainly from the decreases in reserve capacity and the exchange of low-cost energy owing to the differences in production costs and the diversity of loads in the time domain. The technical benefits are largely associated with the increased availability and reliability of power supplied through the interconnected systems under both normal and emergency operating conditions.

B. ELECTRIC POWER INTERCONNECTION SCHEMES

Egypt, which forms part of North Africa and the Mediterranean region and is also the centre of the Arab world, occupies a strategic geographic position and can therefore play a prominent role in enhancing cooperation in the field of electrical energy.

A number of electric power interconnection projects are currently being implemented or have been agreed upon between Egypt and its neighbours. Through the extension of the Electricity Authority's NUPS, it will be possible to connect Africa with Asia across Sinai and then with Europe through various Arab countries and Turkey. These interconnection projects are described briefly in the subsections below.

1. *Egypt/Jordan interconnection scheme*

The Egypt/Jordan interconnection project is currently being implemented. It includes the construction of a 500-kV transmission line which extends from Suez to Taba (over Sinai) on the Egyptian side, crosses the Aqaba straits via a 400-kV submarine cable 13 km long laid at a depth of 850 metres, then connects with the 400-kV Jordanian system in Aqaba. The project is expected to be completed sometime during 1997/98.

2. *Arab Mashreq interconnection project*

Jordan, the Syrian Arab Republic, Lebanon, Iraq and Turkey will be interconnected through 400-kV transmission lines about 600 km long. This project will be linked with the Egypt/Jordan scheme, allowing the eastern Mediterranean countries to be linked with Europe via Turkey.

3. *Egypt/Libyan Arab Jamahiriya interconnection project*

The present stage of this project comprises a 220-kV interconnection between El Salloum on the Egyptian border and Tubruq in the Libyan Arab Jamahiriya. The project will be commissioned by 1997/98 and will allow for the transfer of about 180 MW of power. There are plans to upgrade this interconnection by introducing a 500-kV line in north-west Egypt to link with the future extra high voltage (400- or 500-kV) Libyan electric power network. Studies are now being carried out for this second stage, which will constitute an important link in the interconnection scheme for the Maghreb countries (North Africa) described below.

4. *Arab Maghreb interconnection forming the North Africa network*

A 220-kV interconnection project is also being carried out between the Libyan Arab Jamahiriya and Tunisia. Interconnections already exist between Tunisia, Algeria and Morocco at 220 kV, and a cable is currently being laid between Morocco and Spain; therefore, once the Libyan/Tunisian route is completed, the Egyptian and Maghreb networks will form the major part of the south-western Mediterranean countries' grid leading to south-west Europe.

Another planned interconnection currently being studied is one linking Tunisia to Sicily and then to the Italian mainland, and from there to the rest of Europe.

5. *The Mediterranean Basin Power Pool*

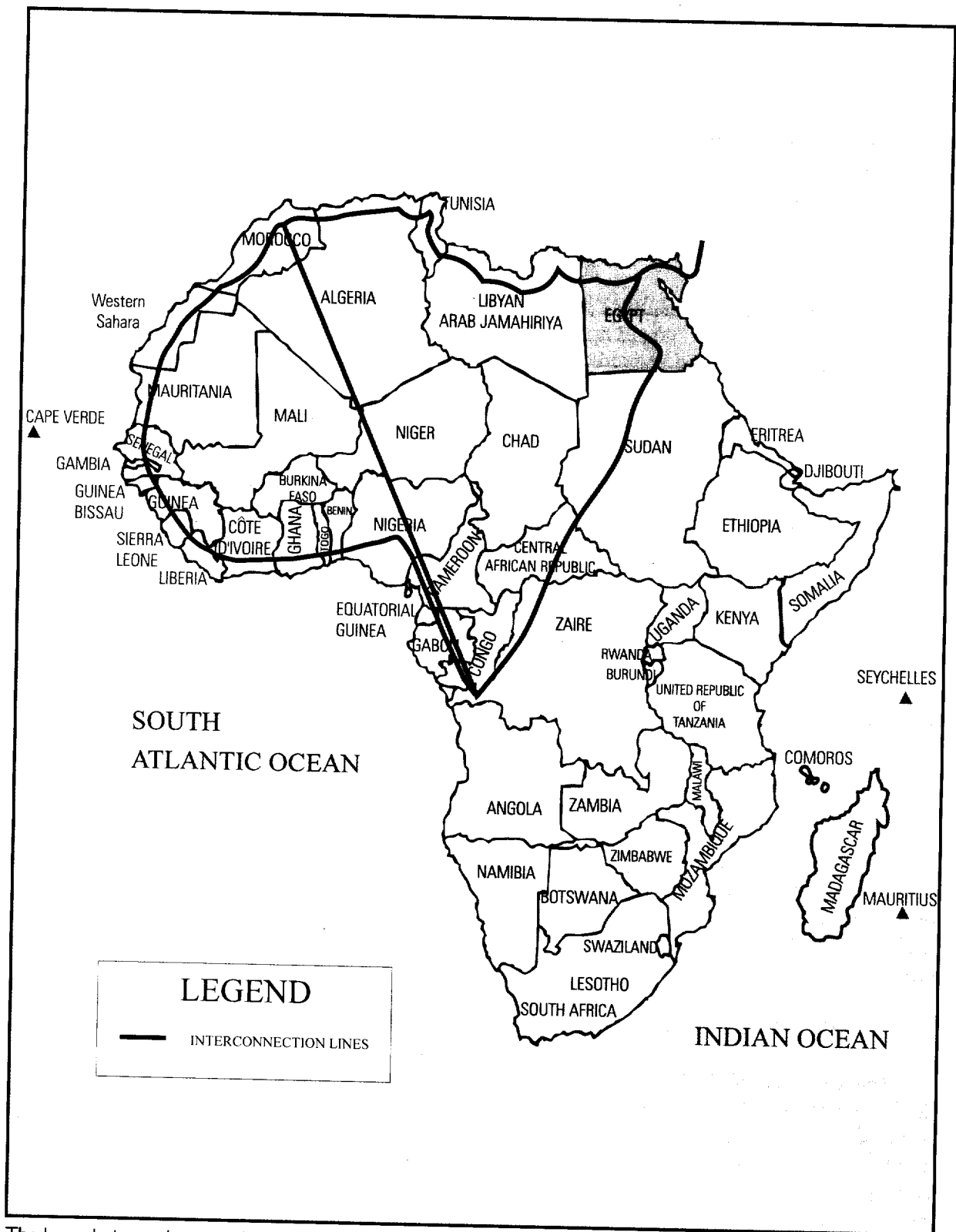
The Mediterranean Basin Power Pool (MPP) will be formed through the integration of the electric power systems of the Mediterranean countries, including those along the northern coast, from Spain to Greece, and those along the southern and eastern coasts, from Morocco to Turkey. The integration of these systems will be achieved through the linkage of the Morocco/Spain interconnection (under implementation), the existing Greece/Italy interconnection, and the future Greece/Albania/Bosnia-Herzegovina interconnection.

6. *Egypt/Zaire interconnection scheme*

This particular scheme must be considered to appreciate the full potential of the future interconnections and the role they are expected to play in the generation expansion plans. Zaire is one of the most promising hydro-power sites in the world, with a power potential of more than 50,000 MW at Inga on the Zaire River. An ambitious project for interconnecting the electric power systems of Egypt and Zaire is now in the feasibility-study stage. This project, which involves transferring huge amounts of power to African countries and the surplus to European countries, is considered by the EEA to be one of the major challenges of the twenty-first century.

A preliminary study has proven the economic feasibility of the project; transmitted power of 17,200 MW could be delivered, which would cover about 20 per cent of the peak demand of Egypt, Zaire, the Central African Republic, Sudan and Chad—the five countries which lie along the route of the interconnection scheme (see figure IV). This long transmission distance is expected to require the use of high voltage direct current (HVDC) at ± 800 kV, with a four-circuit transmission line and eight conductors each. The study results indicate that the cost of the energy supplied at the final stage could amount to between \$0.032 and \$0.042 per kWh in the final stage using the technologies available today.

Over 10,000 MW of this transmitted power could be delivered through Europe through the Mediterranean basin interconnections via the Turkey/Greece, Morocco/Spain and Tunisia/Sicily/mainland Italy links. This huge project is expected to contribute to the sustainable development of the African countries and to provide Europe with a cheaper and cleaner source of energy, alleviating some of its environmental problems associated with the use of coal and nuclear power. There are plans to expand the Zaire hydro-power development project and produce another 20,000 MW to supply the southern African States, further enhancing the feasibility and versatility of the project.



The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

VI. POWER SECTOR REFORMS IN EGYPT

A. EGYPTIAN ELECTRICITY AUTHORITY INVESTMENT PLAN (1997-2007)

In order to meet the increasing demand for electricity associated with Egypt's growing population and its ambitious five-year plans for social and economic development (1997-2002 and 2002-2007), the EEA has to extend its networks and increase the installed capacity of its powerplants on a continuous basis. Table 6 shows the total annual investment required for the EEA to implement its projects (improving and/or increasing generation and transmission, establishing control and training centres and so on) during the period 1997/98 to 2007/08.

TABLE 6. TOTAL INVESTMENT REQUIRED TO IMPLEMENT EGYPTIAN
ELECTRICITY AUTHORITY PROJECTS
(Millions of Egyptian pounds)*

Fiscal year (July/June)	Investment required	
	Local	Foreign
1997/98	641	1 460
1998/99	429	1 147
1999/2000	490	986
2000/01	588	1 198
2001/02	757	1 120
2002/03	610	1 103
Subtotal (1997/98-2002/03)	3 515	7 015
2003/04	1 009	1 356
2004/05	1 610	2 155
2005/06	1 955	2 817
2006/07	1 511	2 238
2007/08	1 265	1 897
Subtotal (2003/04-2007/08)	7 350	10 463
Total (1997/98-2007/08)	10 865	17 478

* US\$ 1 = LE 3.37 at the time of writing.

Note: Totals may not add precisely because of rounding.

It can be seen from table 6 that the EEA requires about \$8.5 billion to finance its expansion programme over the next decade. The EEA has traditionally relied on bilateral and international borrowing to finance its projects, which has contributed significantly to Egypt's external debt. In the last decade, however, steps have been taken to promote private sector, foreign and other forms of participation in such projects.

B. REGULATIONS GOVERNING THE ROLE OF THE STATE IN THE POWER SECTOR

The EEA, established by Law No. 12 of 1976, was granted the exclusive (monopoly) right to produce and generate electric power, to transmit it to different parts of the country, and to distribute and sell it to consumers (see annex I). In 1984, article 2 of Law No. 12 of 1976 was amended to transfer the electricity distribution and sales functions of the EEA to public sector distribution companies established in different geographical areas to cover all parts to the country (see annex II). In 1989, the Government of Egypt issued an investment law (Law No. 230 of 1989) allowing private investment in infrastructure projects.

The existing laws pertaining to the electric power sector have been surveyed to ensure that there are no articles which discourage, hinder or prohibit the participation of PPPs in Egypt. In June 1996, articles 2 and 7 of Law No. 12 of 1976 were amended by Law No. 100 of 1996 (see annex III) to allow the EEA to purchase the energy generated by PPPs and sell it to its own consumers, and to permit private sector developers worldwide (chosen through an internationally competitive tender process) to participate in Egyptian power-generation projects. In addition to abolishing the EEA monopoly on power generation, the amendment exempts private developers from paying certain charges.

Efforts are currently under way in Parliament to introduce electricity legislation which provides for the establishment of an independent regulatory agency to defend consumer rights and create the necessary climate for fair competition.

C. THE PRESENT ROLE OF THE PRIVATE SECTOR IN ELECTRIC POWER GENERATION

As previously mentioned, about \$8.5 billion (including \$5 billion in foreign exchange) is required over the next decade to meet the growing demand for electricity in Egypt. The Government has recognized that the traditional public sector cannot continue to finance, through borrowing, all of the investments required to meet the demand for electrical energy and has therefore taken steps to attract private investors. The Government recognizes that privatization, which constitutes one of the main pillars of Egypt's economic reform programme, will contribute to sustainable economic development and progress.

In the light of these developments, the EEA has adopted a new policy which aims at allowing private investors (whether Egyptian, foreign or a combination of the two) to build and operate plants for electric power production. The new policy is applied using the build-own-operate-transfer (BOOT) arrangement.

A two-stage plan has been designed for the power sector to cover demand during the period 2001-2007. The first stage is expected to require a total investment of about \$1.5 billion for the construction of the following powerplants between 2001 and 2004:

- (a) 2x325-MW dual-firing (gas/oil) steam units along the north-west Mediterranean coast of Egypt;
- (b) 2x325-MW pumped storage units on Mount 'Ataqa at the Gulf of Suez;
- (c) A 300-MW wind farm in Zafarana along the west coast of the Gulf of Suez.

The second stage requires an estimated total of \$2 billion to finance the construction of the following powerplants during the period 2004-2007:

- (a) 4x325-MW steam units;
- (b) 4x300-MW combined-cycle units.

In effect, the PPPs will be responsible for constructing steam powerplants and combined-cycle plants with a total installed capacity of about 2,000 MW and 1,200 MW respectively over the next 10 years. The private sector investment required for power generation, pumping storage and wind farms for the period 2001-2007 is estimated at \$3.5 billion.

In the meantime, the EEA will be expected to prepare all of the necessary extensions required by the network projects to interconnect all of these powerplants for their integration into the NUPS so that the bulk energy generated can be transmitted to the load centres.

Private sector participation in the power generation programme from 2001 to 2007 will be assessed to determine whether the projects were completed on schedule and to evaluate their level of economic efficiency and operational reliability. A successful evaluation will raise the level of confidence in PPPs, leading to greater private sector participation during the period 2007-2017.

D. FIRST-STAGE IMPLEMENTATION OF THE PLAN FOR PRIVATE SECTOR PARTICIPATION

In 1994, the Egyptian Electricity Authority prepared a plan for private sector participation in power-generation projects based on the BOOT arrangement. As mentioned, the first stage of the plan will require about \$1.5 billion. The plan divides this stage into four phases and identifies the anticipated dates of completion for each phase, as follows:

- (a) Phase I: the selection of a consultant through international bidding (by April 1996);
- (b) Phase II: the preparation of tender documents for inviting developers through international bidding (by December 1996);
- (c) Phase III: bid evaluation and selection, followed by contract negotiations with the successful developer (by July 1997);
- (d) Phase IV: the completion of construction and the commissioning of the three first-stage projects (2001-2004).

At the time of writing, the EEA had selected a consultant through international bidding to assist in the following:

- (a) Reviewing the existing laws to ensure that there are no articles which discourage, hinder or prohibit the involvement of the private sector in producing electric power;
- (b) Selecting an appropriate site for the first powerplant;
- (c) Preparing the request-for-proposal (RFP) documents to be issued to interested potential developers on the short list;
- (d) Evaluating the bids received and selecting the best from among them;
- (e) Providing technical and financial advice during negotiations with the winning bidder up through the financial closure of the project.

The consultant has been working very closely with a team from the EEA; by November 1996, a number of tasks had been completed which related to the following:

- (a) Legal issues. In June 1996, the People's Assembly approved a revision of Law No. 12 of 1976 which permits the private sector to build, own and operate powerplants and to sell the electricity produced to the EEA;
- (b) Site selection. A site selection study was carried out, and Sidi Kreir was identified as the most appropriate location for the first plant based on economic, technical and environmental considerations and the selection criteria established by the EEA and the consultant;

(c) Preparation of the tender document:

- (i) In June 1996, a notice was placed in national and international newspapers describing the project and requesting information from interested developers. Fifty-four responses were received and screened, and 34 developers were selected to submit their prequalifications;
- (ii) A request for prequalifications was prepared and sent to the 34 developers. The developers formed consortiums, and by 31 October 1996, 19 had responded to the prequalification request. The submissions are currently being evaluated, and a small number will be placed on a short list to receive the RFP documents.

E. POLICIES FOR THE INCREASED INVOLVEMENT OF PRIVATE INVESTORS
IN POWER GENERATION

Power projects are generally considered capital intensive, and most developing countries are facing great difficulties in financing them. However, the EEA has established a solid reputation in the execution of projects and has not experienced many problems in this respect; grants and long-term soft loans have traditionally been provided by various bilateral and multilateral donors and by international lending institutions such as the World Bank, the African Development Bank and the European Investment Bank.

The Egyptian Government is in the process of reforming the power sector as part of its wider economic reform programme but particularly within the context of its efforts to restructure the public enterprise sector. The Government is endeavouring to improve economic efficiency by gradually shifting to a system of incentives and privatization leading to a greater role for the private sector in the economy as a whole.

As stated previously, efforts are being made in Parliament to introduce legislation for the establishment of an independent regulatory agency for the electric power sector. Other efforts are currently aimed at introducing corporatization into the sector and establishing commercial relationships between the different operating entities. Finally, as mentioned above, the Government has initiated a process for promoting the involvement of new private/independent power producers in the sector.

Egypt's present policy aims at a general liberalization of the economy, with emphasis on privatization in tourism and in infrastructure projects (particularly those related to electric power generation). Under the new policy, local and international developers can bid competitively for the right to own and operate new power generation facilities (up to 30 per cent of total installed capacity until the year 2017; a higher proportion may be approved thereafter). Tables 7 and 8 show the new capacity additions to the NUPS and the share of private sector participation up to the year 2017.

As mentioned previously, the EEA no longer has exclusive control over power generation in Egypt. Industries and private development projects can now generate their own power; several of the former have started doing so. Two large industrial complexes—a petrochemical plant near Alexandria and a large textile factory in the delta region—made cogeneration arrangements with the EEA a number of years ago and rely on the NUPS as an emergency or back-up supply. Two fertilizer factories are currently building cogeneration units as well. The sugar mills in Egypt will be a near-term source of approximately 60 MW for the NUPS based on the burning of bagasse (biomass), with the potential for an additional 300 MW in the future.

The liberalization of the economy appears to be stimulating private investment in industry. Several private cement plants are being considered, and a large, modern petroleum refinery is now under construction near Alexandria. Most of the refining industries produce process steam, and a number of them are considering cogeneration arrangements, particularly for their new extensions. More industrial companies in the business sector are being privatized, which will result in an increase in cogeneration projects, particularly where electric and steam energy can be combined for industrial processes.

TABLE 7. NEW CAPACITY ADDITIONS TO THE NATIONAL UNIFIED POWER SYSTEM
FOR THE PERIOD 1996-2017
(Megawatts)

Year	Added capacity	GT ^{a/} capacity	CC ^{b/} capacity	Steam 300 ^{c/} capacity	Steam 600 ^{d/} capacity	Pump storage
1996	450		150	300		
1997	650					
1998	650				650	
1999	325			325	650	
2000	325			325		
2001	325			325		
2002	975			975		
2003	850	200		325		325
2004	850	200		325		325
2005	1 125	200	600	325		
2006	1 275		300	325	650	
2007	1 050	100	300	650		
2008	1 300					
2009	1 250	300	300		1 300	
2010	1 400	100			650	
2011	950		300		1 300	
2012	950		300		650	
2013	950	300			650	
2014	1 350	100	600		650	
2015	1 150	200	300		650	
2016	1 150	500			650	
2017	1 150	200	300		650	

a/ Gas turbine units.

b/ Combined-cycle units.

c/ Dual-fired units (natural gas/heavy fuel oil).

d/ Dual-fired units (natural gas/heavy fuel oil).

A number of industrial companies in Egypt are embarking on modernization programmes and are rehabilitating, updating and/or replacing old equipment, including boilers. With many industries being privatized, this trend is creating significant business opportunities. Some international manufacturers have already entered into joint ventures with local investors to purchase local manufacturing companies and transform them into modern, profit-making concerns by making their operations more cost-effective; for example, boiler capacities are being increased, and cogeneration is being introduced if there is a reasonable expectation that financial outlays can be recovered within a relatively short period.

TABLE 8. PLANNED CAPACITY ADDITIONS FOR THE INDEPENDENT POWER PRODUCER PROJECTS (IPPPs)
FOR THE PERIOD 1996-2017
(Megawatts)

Year	Installed capacity	IPPP capacity	IPPP capacity (cumulative)	IPPP share (percentage)
1996	13 308			
1997	13 909			
1998	14 428			
1999	14 753			
2000	15 078			
2001	15 201			
2002	16 075	650	650	4.0
2003	16 769	325	975	5.8
2004	17 517	325	1 300	7.4
2005	18 476	925	2 225	12.0
2006	19 721	625	2 850	14.5
2007	20 559	950	3 800	18.5
2008	21 712	650	4 450	20.5
2009	22 902	650	5 100	22.3
2010	24 002	1 300	6 400	26.7
2011	24 952	—	6 400	25.6
2012	25 902	—	6 400	24.7
2013	26 852	650	7 050	26.3
2014	27 832	650	7 700	27.7
2015	28 762	650	8 350	29.0
2016	29 912	650	9 000	30.1
2017	31 062	—	9 000	29.0

Note: A dash (—) indicates that the amount is nil or negligible.

The tourist areas along the Red Sea coast and Sinai also represent strong market possibilities for private power producers. Combined power/desalinization plants in this region can offer high expected rates of return, particularly because tourist establishments pay high, non-subsidized prices for energy.

VII. CONCLUSIONS AND RECOMMENDATIONS

Egypt is at a crossroads in its transition from a centrally planned, inward-looking economy to one based on free-market principles. Since 1991, the country has been pursuing a reform programme driven by deregulation, restructuring and privatization. The Government's plan aims to direct the traditional public sector towards greater autonomy and to increase private sector participation in energy operations. Within this broad framework, the Government's energy objectives are as follows:

- (a) To meet domestic energy needs in a cost-effective manner;
- (b) To overcome the major impediments to improving overall sector efficiency;
- (c) To maximize exportable surpluses to bring in valuable foreign exchange;
- (d) To increase the role of the private sector in energy sector operations.

Over the past several years, the electricity sector (and the energy sector in general) has seen several notable achievements, including the following:

- (a) A significant improvement in the overall thermal efficiency of power generation from about 24 per cent in 1982 to around 40 per cent in 1996;
- (b) A reduction in system losses from approximately 18 per cent in 1984 to about 13 per cent in 1996;
- (c) The unbundling of power distribution by removing distribution companies from the vertically integrated structure of the EEA and placing them under the control and management of a holding company with the objective of privatizing them;
- (d) An increase in private sector participation in natural gas upstream operations stemming from the revision of the gas clause (with the producer's share of gas transferred at crude oil parity);
- (e) A gradual increase in the weighted average of electricity tariffs as a proportion of average long-run marginal cost, from under 50 per cent in 1990 to over 90 per cent in 1995 (based on marginal input fuel cost);
- (f) A gradual increase in the weighted average of petroleum products as a proportion of import parity prices (based on a comparison of retail prices with border prices) from below 25 per cent in 1990 to almost 100 per cent in 1995;
- (g) The initiation of IPP participation in power generation;
- (h) The establishment of a joint venture (a private sector export-oriented refinery) in the Alexandria area.

These achievements demonstrate the extent to which the energy sector is preparing itself to operate in a market-oriented environment. However, if Egypt is to take full advantage of its potential for reform, the sector will have to make further adjustments in order to create a more open energy market, a higher level of competition, and new opportunities for private sector participation.

The EEA has chosen to initiate private sector participation in the power programme by inviting IPPs to finance investments in power generation because, unlike other options such as the privatization of existing EEA plants, IPP facilities can be built from the ground up and developed even if a transparent regulatory mechanism is not yet in place. Any regulations which might apply can be incorporated into the contractual agreements between the IPPs, the EEA and the Government of Egypt.

In the absence of a fully developed regulatory framework for IPP projects, certain basic principles and guidelines need to be established. A private power policy must also be articulated at this stage. Finally, if IPP projects are to succeed, an enabling environment should be created which includes the following elements:

- (a) A legal regime which: allows for enforceable contracts, including mechanisms for the arbitration and swift resolution of disputes through an objective court system; provides for private sector ownership of power generation assets; empowers a State-owned utility to enter into power purchase agreements with IPPs; and assures owners of rights to revenues;
- (b) A satisfactory tariff system;
- (c) Policies that encourage local as well as foreign private investment in independent power production;
- (d) Clearly defined roles and responsibilities among agencies with respect to the granting of permits, clearances and approvals;
- (e) Well-articulated tax laws, import duties and incentives applicable to both local State-owned power utilities and IPPs.

Until these elements are in place, project documentation needs to be structured to fill the gaps. As stated above, a complete reformation of the sector and a full regulatory framework are not necessarily required for IPPs because much of the "regulation" occurs through contracts. What is needed, however, is an enabling environment, and the Government of Egypt has issued directives for coordination between the country's ministries and agencies to facilitate the required procedures and processes.

Although the first stage of the Egyptian IPP project began with a very large plant comprising two 300-MW units, the smaller (under 300 MW) projects have been more successful at reaching financial closure. The substantial financing required for large projects tends to intimidate lenders, and the increased problems of risk allocation among the parties often make these projects difficult to bring to financial closure.

For the first IPP project, the construction phase appears to represent the highest risk, as completion guarantees must be provided by either the lead sponsor or the supplier/construction contractor. More importantly, once the project is completed and operating, sufficient and reliable cash flows must be generated and secured.

The Egyptian Government, from a political perspective, is encouraging the participation of local capital in ensuring the sustainability of the IPP projects. Domestic private savings and local banks can be tapped for these projects as long as the local currency is fully convertible and the availability of foreign exchange in the domestic market is assured, since foreign costs represent nearly 70 per cent of the total project costs.

There are a number of risks in emerging markets such as Egypt, and financial packages need to be closely tailored to project and country needs, so it is generally both difficult and impractical to replicate one country's documentation for use elsewhere. What may be said of any country, however, is that a second IPP project is likely to benefit significantly from the lessons learned on the first. Utilities often need to learn how to become effective and knowledgeable buyers of private power from IPPs; once they have established a workable system, they can serve as examples for future IPP projects to follow.

It is generally preferable for private powerplants to be dispatchable, especially where the purchasing utilities assume the demand risk by signing "take or pay" contracts with the IPPs. In any case, steps should be taken to ensure that payments to IPPs are tied to optimal availability and performance levels.

IPP - public utility partnerships must make business sense for all involved, including the key participants, the investors and the country. A win/win situation must prevail; otherwise, no matter how elaborate the contracts are, the association will not run smoothly for the duration of the project.

Annexes

Annex I

**LAW NO. 12 OF 1976 FOR SETTING UP
THE EGYPTIAN ELECTRICITY AUTHORITY***

In the Name of the People

HIS EXCELLENCY, THE PRESIDENT OF THE REPUBLIC

The **People's Assembly** has approved of the following law which is hereby promulgated.

ARTICLE 1:

A public authority to be named "**Egyptian Electricity Authority**" shall be set up. It shall be a legal entity affiliated to the Ministry of Power and shall have its head office in the city of Cairo.

The said Authority shall be subject to the rules and regulations spelled out in this law.

ARTICLE 2:

The Authority shall be exclusively assigned the following duties:

- (a) Implementation of the projects related to production of electric power, its transmission and distribution throughout the Republic;
- (b) Management of electric power stations, their operation and maintenance, as well as regulation of the loads on the main networks throughout the Republic;
- (c) Distribution of electric power and its sale throughout the Republic;
- (d) Carrying out of studies and research regarding everything connected with the Authority's activities;
- (e) Rendering of expert advice and implementing which fall within the Authority's jurisdiction, whether internal or external, and with the Authority's capabilities and experience or which are attainable through it.

ARTICLE 3:

The Authority's capital is composed of:

1. The funds of the Egyptian Electricity Authority founded by virtue of **Republican Decree No. 3726 of 1965**;
2. The funds to be appropriated by the State.

* Official translation; issued as submitted.

ARTICLE 4:

The Authority's revenues are made up of:

1. The sums appropriated by the State.
2. Proceeds of the sale of electric energy.
3. The price differential resulting from sale of electric current at prices lower than the approved tariff for development purposes which are borne by the Public Treasury.
4. Proceeds of the Authority's activities and in consideration of works and services rendered to third parties internally or externally.
5. Loans advanced to the Authority by the State.
6. Credit facilities secured by the Authority.
7. Donations and grants-in-aid.

ARTICLE 5:

The Authority shall have a special budget to be prepared in advance with the rules set out in its status without being restricted by the laws and regulations governing preparation of the State budget. Also, the Authority shall have a special account for depositing its revenue, and any surplus in the Authority's budget shall be carried forward from year to year.

ARTICLE 6:

The Council of Ministers shall set the interest rate of the loans to be advanced by the State to the Authority.

ARTICLE 7:

The Authority shall be entitled to engage in all actions and deeds designed to accomplish the purposes for which it is set up, including direct contracting with individuals, companies, banks as well as local and foreign organizations, in consonance with the rules set forth in the Authority's statutes.

ARTICLE 8:

The Authority is entitled, within the boundaries of its budget, to import itself or through another party without an import permit, its requirements of production, materials and instruments, tools, spare parts, and means of transportation required for its activities in conformity with the rules as set by the Authority's statutes, without being restricted by the laws and regulations governing importation of foreign currency.

ARTICLE 9:

The Authority's imports of equipment, instruments and materials required for its projects shall be exempt from customs duties and other taxes and dues. Also, imports by companies, organizations and bodies with the Authority of instruments, equipment, tools, motor vehicles, materials, and other movables are exempted from customs duties and other taxes and dues, provided that they are subject to inspection and the Authority's declaration that the exempted commodities are imported and required for its project's

implementation. Such exempted commodities shall be liable to the payment of taxes and dues in respect thereof if they are disposed of to another party within five years from the date of their enjoying the franchise.

Also, interest on loans external credit facilities contracted for by the Authority shall be exempted from taxes.

ARTICLE 10:

The Authority shall have a Board of Directors. Its Chairman shall be appointed by Republican Decree, which shall also set his salary; whereas appointment of Members of the Board shall be by an Order of the Prime Minister upon the recommendation of the Minister of Energy.

ARTICLE 11:

The Board of Directors is the supreme body responsible for the management of the Authority's affairs. It discharges its functions as laid down in this Law. It has the discretion to take whatever decisions it deems for the attainment of the objective for which the Authority was founded, particularly:

1. Approval of the Authority's regulative structure.
2. Proposal of the tariff for the distribution and sale of electric energy to the various users of electricity after seeking the opinion of the Central Agency for Accountancy and the costings to be approved by the Electricity Sector Higher Council and the competent Ministerial Committee.

The said tariff shall not be enforced until after its approval by the Council of Ministers.
3. Approval of the Authority's annual draft budget and its draft balance sheet.
4. Transfer of credit from one item to another within the boundary of the same category.
5. Laying down the Authority's internal regulations related to financial, accounting, administrative, trading, technical and supply matters, as well as other general organization regulations.
6. Framing the regulation related to the Authority's personnel, including social insurance, travelling allowance and transportation expense.
7. Formulating a system for surveillance and standards of performance in accordance with economic criteria.
8. Proposing the contracting for loans.
9. Accepting donations and grants-in-aid offered the Authority which are not inconsistent with its aims and purposes.
10. Reviewing the periodical reports to be submitted concerning the progress of works at the Authority and its financial position.
11. Reviewing whatever the Minister of Energy or the Chairman of the Board deems to submit to the Board regarding issues falling within his competence.

The Board may set up from among its members a committee or more to be entrusted temporarily with some of its assignments.

The Board is entitled to delegate one of its assignments upon its members or entrust to him a certain mission.

ARTICLE 12:

The Board meets at least once a month upon the invitation of its Chairman, provided that a quorum of the majority of its members are present. Its resolutions are passed with the absolute majority of its members. When the votes for and against are equal, the Chairman shall have the deciding vote. In the case of absence of the Board Chairman, the Board elects a substitute. The Board is entitled to invite whoever it deems to attend its meetings in an advisory capacity without having the right to cast their votes.

ARTICLE 13:

The Authority's Board Chairman shall communicate to the Minister of Energy the Board's resolutions within three days from their adoption for their approval. The said resolutions shall be considered enforceable unless the Minister objects to them in writing to the Authority's Board within thirty days from the date of his receiving them.

ARTICLE 14:

The Authority's Board Chairman is assigned the following duties:

1. Execution of the Board's resolutions;
2. Management of the Authority, development of its system of works, and establishing its organization;
3. Supplying the Minister of Energy and the State bodies with information, details and documents they request.

The Authority's Board Chairman may delegate upon a Director or more some of these assignments.

ARTICLE 15:

The Authority's Board Chairman shall represent it at the courts of law in its relations with other parties.

ARTICLE 16:

The Minister of Energy shall nominate a delegate to replace the Chairman temporarily in the event of his absence or should his post be rendered vacant.

ARTICLE 17:

The Authority's Board may, with the consent of the Minister of Energy, dispose of the foreign currency allotted to the Authority in favor of the State's monetary budget, or the foreign currency accruing from the loans advanced to it, or resulting from its activity, or in consideration of the works and services it renders to other parties, or the donations and grants-in-aid it receives, in accordance with the rules set out in the statutes.

ARTICLE 18:

The decisions of the public utility respecting the real estate required for the Authority's projects rest with the Minister of Energy. The provisions of the Law regulating the expropriation of property for public or utility improvements shall apply.

ARTICLE 19:

In order to acquire its rights, the Authority may take legal proceedings to serve attachments in accordance with the provisions of Attachments Law.

ARTICLE 20:

The Authority's statutes shall be issued by Republican Decree without being restricted by the State's rules and regulations applicable in the Government machinery, within six months from the date of publication of this Law in the Official Gazette. The statutes shall take into consideration the following:

- First:** Linking the wage to productivity.
- Second:** The maximum pay scale annexed to **Law No. 58 of 1971** related to the Government's civil servants.
- Third:** The additional and incentive bonuses and allowances to be set for the Authority's personnel should not exceed double the salaries set for them.
- Fourth:** The main principles of the standard social insurance scheme as spelled out by **Law No. 79 of 1975**.
- Fifth:** Travelling allowances and transportation expenses of the Authority's personnel according to the hierarchy of their grades and original salaries should not exceed the actual expenses they incur.
- Sixth:** Adoption of the rules of the standard accounting system.
- Seventh:** No direct contract awards are to be made except to monopolistic foreign firms or those with specialized international expertise or in case of urgency, subject to the approval of the Minister of Energy.
- Eighth:** Adopt the most up-to-date procurement contract rules applied in similar projects.

ARTICLE 21:

The Authority shall supersede the General Egyptian Electricity Corporation (GEEC) set up in virtue of **Republican Decree No. 3726 of 1965** as regards its rights and obligations.

ARTICLE 22:

The GEEC personnel shall be transferred to the Authority without taking any further measure.

ARTICLE 23:

Presidential Decree No. 3726 of 1965, setting up the GEEC, is hereby canceled, as well as any other provision contrary to the ruling of this Law.

ARTICLE 24:

The Minister of Energy shall issue the necessary Orders for the execution of this Law.

ARTICLE 25:

The Law shall be published in the Official Gazette, and shall become operative as from the date of its publication.

This Law shall be embossed with the State Seal, and shall be executed as one of its laws.

Published on **February 12, 1976**.

Annex II

**LAW NO. 36 OF 1984
MODIFYING SOME ARTICLES OF LAW NO. 12 OF 1976
CREATING THE EGYPTIAN ELECTRICITY AUTHORITY***

In the Name of the People

His Excellency, The President of the Republic

The **People's Assembly** has approved of the following law which is hereby promulgated.

ARTICLE I

Articles 2 and 4 of Law No. 12 of 1976 creating the Egyptian Electricity Authority will be replaced by the following articles:

Article 2: The Authority shall be assigned the following duties:

(a) The implementation of projects related to the generation of electric energy by thermal (fossil) power station and its transmission and sale to electricity distribution companies and the major end users at high and extra high voltages.

(b) Implement Renewable Energy Project.

(c) Operation and maintenance of generating plants and transmission systems.

(d) Rationalizing the loads of the principal networks of the country.

(e) Carrying out studies and researching of its specialized activities and also undertake testing in the field of electric energy.

Article 4: The Authority revenues shall consist of :

1. The funds appropriated to it by the State;
2. The proceeds from the sale of electric energy;
3. The price differential resulting from the sale of electric energy at prices committed to by the Treasury for development purposes and which are below the name of tariff;
4. Loans provided by the State;
5. Credit facilities obtained by the Authority;
6. Payment received by the authorities for conducting testing in the field of electric energy;
7. Grants and donations.

* Official translation; issued as submitted.

ARTICLE II

All that contradicts the above in the previous law is abrogated.

ARTICLE III

This law shall be published in the Official Gazette and shall become effective on the day following such publication.

The law shall be embossed with the State Seal and be enforced as one of its laws.

Issued by the President's Office on **March 27, 1984.**

Hosny Mubarak

**LAW NO. 100 OF THE YEAR 1996
AMENDING CERTAIN PROVISIONS OF LAW NO. 12
OF THE YEAR 1976
CONCERNING THE ESTABLISHMENT OF THE
EGYPTIAN ELECTRICITY AUTHORITY**

In the Name of The People

The President of The Republic

The People's Assembly passed the following Law and it is promulgated by us.

ARTICLE 1:

The texts of articles 2 and 7 of Law No. 12 of the year 1976 concerning the establishment of the Egyptian Electricity Authority shall be substituted by the following two texts:

ARTICLE 2:

The Authority shall be concerned with the following:

- (a) Executing projects connected with the production of electric power from thermal power stations;
- (b) Executing projects connected with the transmission of electric power;
- (c) Producing electric power from power generating stations;
- (d) Purchasing electric power produced from power generating stations which are established after authorization is given to local and foreign investors;
- (e) Executing electric power interconnection projects with other countries and exchanging electric power with them;
- (f) Managing, operating and maintaining power-generating stations and power transmission networks;
- (g) Transmitting and selling electric power in wholesale to electricity distribution companies and to the sites of main utilization at very high and extra high voltages;
- (h) Regulating the electric loads on the main networks throughout the Republic;
- (i) Carrying out planning studies and research in the fields of the Authority's specialization, as well as conducting tests of very high and ultra high voltages on electrical equipment.

* See the *Official Gazette*, No. 25 BIS/B (30 June 1996). (in Arabic)

ARTICLE 7:

The Authority is authorized to undertake any activities which will allow it to realize the goals and fulfil the purpose for which it is established. It may contract directly with persons, companies, banks, and local and foreign organizations in accordance with the rules to be determined in the internal regulations.

Public utility concessions may be granted to local and foreign investors for the establishment, management, operation, and maintenance of power-generating stations, without being restricted by the provisions of Law No. 129 of the year 1947 concerning public utility concessions and Law No. 61 of the year 1958 in respect of granting the concessions connected with the investment of natural resources and public utilities, and the amendment of the concession conditions subject to the following rules and procedures:

(a) The selection of those receiving concessions should be carried out within the context of free competition and transparency;

(b) The concession period should not exceed 99 years;

(c) The means of supervision and technical and financial monitoring should be defined and these activities carried out to ensure the efficient operation of the project.

The concession should only be issued or amended—within the context of the above-mentioned rules and regulations—by a decision of the Council of Ministers, upon the recommendation of the Minister of Electricity and Energy.

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