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MEMORANDUM

TO : THE BOARD OF DIRECTORS

FROM :

Omar KABBAJ
President



SUBJECT : ENERGY SECTOR IMPACT STUDY IN EGYPT, MOROCCO
AND TUNISIA*

Please find attached hereto, the above-mentioned document.

Attch.

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**African Development
Bank**



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**ENERGY SECTOR IMPACT STUDY IN
EGYPT, MOROCCO AND TUNISIA**

OPERATIONS EVALUATION DEPARTMENT

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ANNEX

- 1: List of ADB project documents

This report was prepared by Messrs Gerald FOLEY (Team Leader), René MAILLET (Power Engineer) and Michael ZSCHIEGNER (Economist) of Nordic Consulting Group following the mission to Côte d'Ivoire, Egypt, Morocco and Tunisia from 19 October to 20 November 1997 under the supervision of Mr A. B. SEMANOU, Principal Evaluation Officer. Request for further information should be addressed to Mr. G. M. B. KARIISA, Director, OPEV (Extension 4052).



ABBREVIATIONS AND ACRONYMS

ADB	African Development Bank
EEA	Egyptian Electricity Authority
EIRR	economic internal rate of return
FIRR	financial internal rate of return
GDP	Gross Domestic Product
IPP	Independent Power Production
kgoe	kilograms oil equivalent
kin	kilometre
kV	kilovolt
kVA	kilovolt ampere
kWh	kilowatt hour
LPG	liquid petroleum gas
LRMC	Long run marginal cost
LV	low voltage
MV	medium voltage
MW	megawatt
ONE	Office National de l'Electricité
sq	square
STEG	Société Tunisienne de l'Electricité et du Gaz
ToR	Terms of Reference
UA	Unit of Account

PREFACE

The Energy Sector Impact Study in Egypt, Morocco and Tunisia was undertaken by the Nordic Consulting Group (NCG) on behalf of the Operations Evaluation Department of the African Development Bank (ADB). The purpose of impact evaluation study is to measure direct and indirect long-term development impact of Bank Group financed energy projects on the economy of the above-mentioned countries.

In accordance with the terms of the contract, a proposed methodological approach for carrying out the impact study was submitted to the ADB. This covered a range of possible steps to be taken depending on the type of project and the available information.

The mission visited the ADB in Abidjan on 19-20 October 1997. During this visit, the mission was informed that, of the projects listed in the TOR, only those for which a formal project completion report had been submitted to the Operations Evaluation Department, would fall within the scope of the study. The total number of such projects was sixteen and outline descriptions are given in the Basic Project Data section. The mission was given copies of the available project documents.

The proposed methodological approach was presented and explained by the mission and discussed with the ADB project officer. The mission emphasised the problems involved in assessing project impacts in the absence of adequate base-line studies carried out before project implementation. The mission also pointed out that detailed field studies could not be carried out within the timeframe or budget for the project as they would require extensive preparation and advance briefing of local collaborating organisations, as well as hiring and training of local staff.

The mission visited Egypt during the period 24-30 October 1997, Tunisia during the period 1-8 November 1997 and Morocco during the period 9-17 November. In each country, discussions were held with officials in the power utilities and ministries notified of the mission.

In each country, an Aide Memoire, setting out the main findings and conclusions of the mission was prepared and discussed with the relevant authorities before leaving the country. Where necessary, the Aide Memoire was amended and the final version was delivered to the authorities concerned. These Aide Memoires and an end-of-mission report were presented to the ADB in Abidjan on 20 November 1997.

The final report was prepared in accordance with the Guidelines and Format for Preparation of Impact Evaluation Reports which accompanied the Terms of Reference.

BASIC PROJECT DATA

The Energy Impact Study covered a total of sixteen projects in three countries. Basic project data are given below under the separate country headings. The dates refer to the year in which the loan was approved by the ADB.

EgyptEnergy Project I (1974)

Four 23.45 MW gas turbine generators in Port Said, Ismailia and Marsa Matrouh.
Total project cost UA14 million. ADB loan UA5.0 million.

Energy Project II (1975)

Four 66/11kV substations and transmission lines in association with Energy Project I.
Total project cost UA12.83 million. ADB loan UA5.05 million.

Energy Project III (1977)

5 MW gas turbine generator at Safaga, Hurghada, and Wadi El Natroun.
Total project cost UA13.1 million. ADB loan UA5.0 million.

Shoubra El-Kheima Project (1980)

25 MW emergency turbine with fuel tanks and pumps at Shoubra El Kheima power station.
Project cost UA18.64 million. ADB loan UA10 million.

Shoubra El-Kheima Interconnection Project (1983)

500 kV and 220 kV lines and substations to connect Shoubra El Kheima power station to UPS.
Total project cost UA154 million. ADB loan UA21.4 million.

Shoubra El-Kheima Unit No 4 (1985)

Additional 300 MW steam turbine generator at the Shoubra El Kheima power station.
Total project cost UA167.58 million. ADB loan UA30.63 million.

Damietta Power Station (1986)

1,125 MW combined cycle power plant, transmission line to UPS and gas supply line.
Total project cost UA353 million. ADB loan UA103 million.

Cairo West Power Station Extension (1988)

Two new 350 MW dual-fuel gas turbines at existing station.
Total project cost UA297.08 million. ADB loan UA252 million.

TunisiaElectricity I (1979)

Rural electrification in Sfax and Gafsa areas of southern Tunisia.
Total project cost UA 16.9 million. ADB loan UA8.0 million.

Electricity II (1982)

Rural electrification in Gabès, Gafsa, Medenine, Tattaouine, and Tozeur govemates in southern Tunisia.

Total project cost UA22.5 million. ADB loan UA10.08.

Electricity III project (1984)

Urban electrification in 150 municipalities in six major regions.

Total project cost UA42.96 million. ADB loan UA 20.67 million.

Electricity IV (1989)

Rural electrification in central and 'northern Tunisia.

Total project cost UA45.22 million. ADB loan UA28.44 million.

MoroccoElectricity II (1973)

150 kV and 60 kV transmission lines with associated substations in five provinces.

Total project cost UA6.172 million. ADB loan UA3.0 million.

Electricity IV (1979)

225 kV substation at Mohammedia power station, extension of a 225 kV substation at Zaer, and construction of 280 km of 225 kV transmission line.

Total project cost UA23.44 million. ADB loan UA7.6.

Electricity V (1981)

360 km of 225 kV line, construction of five new 225/60 kV substations and the reinforcement of four existing 225/60 kV substations.

Total project cost UA43.47 million. ADB loan UA10 million.

Electricity VII (1989)

Additions to the transmission system in the north-west, south-central and southern regions and 60 kV extensions to nine secondary localities.

Total project cost UA90.14 million. ADB loan UA39 million.

1. EVALUATION SUMMARY

1.1 Introduction

The purpose of the study was to assess the socio-economic impact of the sixteen ADB electricity-sector interventions on the target end-user groups in the three countries.

1.2 Objectives and Strategy of Operations under Review

The projects were all in the electricity sector and had the general objectives of contributing to the expansion and effective functioning of the national power utility in each of the three countries.

1.3 Cost, Financing and Time Frame

In Egypt, the total ADB loans to the study projects were UA445 million and their approval dates covered the period 1975-90. The loans covered about 27% of the costs of the projects supported and around 6% of the estimated overall investments in the electricity sector over the period.

In Tunisia, the total ADB loans to the study projects were UA67.19 million and their approval dates covered the period 1979-89. The loans covered about 52% of the costs of the projects supported and around 6% of the estimated overall investments in the electricity sector over the period.

In Morocco, the total ADB loans to the study projects were UA59.6 million and their approval dates covered the period 1973-89. The loans covered about 36% of the total costs of the projects supported and about 5% of overall investments in the electricity sector over the period.

1.4 Operations and Achievements

In general, the projects were implemented satisfactorily, in most cases within time and budget. Although some of the earlier projects have now been superseded, the evidence available to the mission was that all the major projects have functioned as intended.

1.5 Institutional Aspects

The implementing institution in each country was the national power utility. In all cases, the projects formed part of the sector-development plans of the utilities and in most cases were prioritised and designed by the utilities themselves or consultants working in close collaboration with them. No significant institutional problems appear to have occurred in relation to the implementation and subsequent operation of the projects. Imposition of lending conditions relating to tariff levels and payment of overdue accounts were recommended in a high proportion of the ADB project appraisal reports seen by the mission. In a significant number of cases, these conditions were not observed by the borrowers but failure to fulfil these loan conditions does not appear to have resulted in any sanctions or to have affected the granting of subsequent ADB loans.

1.6 Impact of Operations

The ADB funding was spread over a long time span and formed only a small part of the total investments made in the electricity sector in each country. No regional or inter-state impacts appear to be intended by the projects and none were identified by the mission. At the individual project level, the precise target groups were not generally identified and no baseline studies defining such groups and specifying the relevant parameters by which project impacts on them could be assessed were found by the mission.

In the case of the Egyptian power generation projects, however, the electricity generated can be used as a proxy impact indicator. The mission estimates show that the avoided economic losses as a result of the output of the major stations supported by ADB loans are sufficient to cover the total investment costs of these stations in one to three years.

In Tunisia, the absence of base-line studies prevents any quantitative assessment of the impacts of the rural and urban electrification projects. The available data, however, allow the numbers of new consumers to be quantified. Spot surveys showed significant benefits to new consumers and these can reasonably be taken to apply to the majority of those newly connected.

In Morocco, no precise socio-economic impact can be attributed to any of the ADB-supported transmission line projects though all have clearly contributed to the development of the present effectively-running transmission system.

1.7 Environmental Aspects

Since the early 1980s, the Egyptian Government has required an environmental impact assessment of all new power generation projects. The standards used are comparable with those of the World Bank, USAID and other major organisations. The evidence available to the mission suggests that these standards are being observed. The rural and urban electrification projects in Tunisia have no significant negative or positive environmental impact. The same is true of the transmission line projects in Morocco.

1.8 Sustainability

The sustainability of the projects depends on the national power utilities in the three countries. All are competently managed. Although the financial affairs of the three utilities do not have the degree of transparency and separation from government presently seen as desirable, there is no question about their ability to continue to function effectively for an indefinite future. The sustainability of all the projects for the duration of their working life therefore appears assured.

1.9 Conclusions

The projects, in general, have been effectively implemented and have functioned as intended. In all cases, they appear to have had positive impacts, although the general lack of pre-project baseline studies does not permit these to be quantified with any precision.

1.10 Feedback

Based on the evidence of the projects in the study, the ADB mechanisms for the selection of suitable projects for funding in the three countries appear to have functioned effectively.

If the ADB wishes to exert institutional influence through its loan conditions on future projects, these conditions will need to be rigorously enforced through effective sanctions on loan disbursements and refusals to grant subsequent loans when conditions imposed in previous projects are not fulfilled. If impact assessments are to be carried out, provision needs to be built in from the beginning of the project cycle. It is essential that the target groups are identified at the appraisal stage, that the key parameters by which the project impact will be assessed are specified, and that proper baseline studies are carried out before projects are implemented.

2. BACKGROUND

2.1 Introduction

The Energy Impact Study covered the sixteen projects listed in the Basic Project Data section of this report. The time period covered by them was twenty-four years; loan approval for the earliest project falling within the scope of the mission was granted in 1973 and the completion report for the last was produced in 1997.

The object of the study was to assess the socio-economic impact of these ADB interventions on the target end-user groups in the three countries. The impact indicators suggested in the TOR include the energy balance of the country; the management of the national power utility, taking into account its economic and financial position; and the electrification coverage in the country. Other suggested indicators include deforestation as a result of firewood use, the creation of small and medium size enterprises, improvement in the quality of life, reduction of poverty, improved health and sanitation, and the effects on women.

2.2 Sector and country economic context

The economic context and the characteristics of the electricity sector vary significantly between the three countries.

2.2.1 Egypt

The Arab Republic of Egypt had a population, in 1994, of about 58 million people of whom about 50 % live in the urban areas. GDP in the same year was US\$720 per head. Commercial energy consumption per head grew from 371 kgoe in 1980 to 608 kgoe in 1994. During the 1960s and early 1970s, Egypt was a centrally planned and relatively closed economy. An open-door economic policy was introduced in 1974 to encourage foreign investment and stimulate the economy. This resulted in an economic growth rate of about 9 % per year between 1974 and 1981. Severe economic problems were, however, experienced during the middle 1980s and the need for a range of fiscal tightening and other measures became increasingly evident.

Since 1991, the Government has been implementing a major structural adjustment programme which has included price deregulation, reduction of subsidies, and privatisation. As a result, the budget deficit has been reduced, the rate of inflation has fallen and the balance of payments has moved into surplus.

During the time Egypt was a centrally-planned economy, the main policy objective of energy policy was to ensure that industry had reliable low-cost electricity supplies. A new energy sector policy was introduced by the Government within the framework of the 1992-97 National Five-Year Plan. The energy sector objectives defined in the Plan are to meet national energy needs in a cost-effective manner; to remove major obstacles to improving the efficiency of the energy sector; to maximise energy exports to obtain foreign currency; to increase the role of the private sector in energy sector operations.

The Egyptian Electricity Authority (EEA), is responsible, under the Ministry of Electricity and Energy, for all power generation for public supply in Egypt. The EEA is also responsible for the construction and operation of the national transmission grid which is known as the Unified Power System (UPS).

Electricity demand has grown rapidly during the period covered by the study projects. In 1970, it was 6.9 TWh and by 1980 it had reached 18 TWh. Demand growth has continued to occur and by 1996, the total national consumption had reached 54.5 TWh. The peak demand on the UPS grew from 1,099 MW in 1970 to 7,004 MW in 1990 and was 9,235 MW in 1996. The installed generating capacity has increased from 3,775 MW in 1970 to 13,027 MW in 1996. The

EEA is responsible for 22% of direct sales to consumers, mainly large industrial enterprises, and the remaining 78% goes to the country's eight distribution companies which buy their bulk power from the EEA.

2.2.2 Tunisia

The total population of Tunisia is 9.0 million of whom about 60% live in the urban areas. Tunis, with a population of about 1.5 million people is the capital. The country's GDP per capita was \$1,790 in 1994. The average growth rate in GDP per head over the period 1985-94 was 2.1% per year. Commercial energy consumption per head grew from 483 kgoe in, 1980 to 590 kgoe in 1994.

In the 1970s, the Government became heavily concerned with rural development. 'The Fifth National Five-Year Plan (1977-81) reflected these concerns and placed a major emphasis on the development of agricultural self-sufficiency as a means of reducing imports. Another major intention of the Plan was to reduce regional disparities and move towards a more equitable distribution of the country's rising prosperity. Development plans were drawn up for each region in accordance with their specific needs.

The country experienced serious economic problems in the early 1980s and a major structural adjustment programme was agreed with the World Bank and IMF in 1986. Since 1987, the Government has been engaged in a far-reaching liberalisation programme, opening up the internal market to external competition and attempting to increase exports. The national power utility is the Société Tunisienne de l'Electricité et du Gaz (STEG). It was established in 1956 and it is responsible for the production, transmission, distribution, import and export of electricity. It is also responsible for the transmission and distribution of natural gas. STEG produces approximately 90% of the electricity consumed in Tunisia, with the remainder being produced by a number of large industries for their own consumption. Electricity demand has grown rapidly during the period covered by the study projects. It was 2.01 TWh in 1979; it reached 4.90 TWh in 1990; and in 1996, it was 6.85 TWh. Generating capacity grew from 516 MW in 1979 to 1,727 MW in 1996 and the maximum demand in 1996 was 1,145 MW. The total number of electricity consumers in 1996 was 1.87 million and the national rate of electrification was 100% in the urban areas and 75% in the rural areas. Rural electrification has been a major objective of the Tunisian Government since the mid-1970s when it was made part of the national regional development programme. A national census of electrifiable villages was carried out in 1975 which enabled STEG, in collaboration with the local govemates, to draw up a two-stage rural electrification programme. At that stage, the proportion of the rural population with an electricity supply was just 6 % . The first stage of the rural electrification programme was implemented during the period 1977-81 and the second stage was implemented during the period 1982-86. The subsequent Five-Year National Plans have each included a rural electrification component. Major progress has been made under each plan. By 1985, the proportion of the rural population with a supply had reached 27% and by 1990 it was 42%. Further substantial progress was made in the following decade and coverage had reached 75 % at the end of 1996.

2.2.3 Morocco

The Kingdom of Morocco has a total population of 27 million inhabitants of whom just over 50% are urban dwellers. The GDP in 1995 was \$1,200 per head. Commercial energy consumption per head grew from 254 kgoe in 1980 to 307 kgoe in 1994. The economy was heavily centralised and regulated up to the early 1980s when it began to run into serious economic problems, partly as a result of the heavy expenses of the armed struggle with the Polisario movement. Following an IMF intervention in 1984, there were heavy cuts in government subsidies which resulted in civil unrest and led to a reversal of the cuts. In 1989, following a

settlement of the hostilities with Polisario, a national policy of economic liberalisation was initiated. This has attracted an increasing amount of foreign investment. The economy grew at 4.2 % per year during the 1980s but this fell to 1.7% per year in the period 1990-94.

The objectives of the Government's present energy policy are to satisfy the country's energy needs efficiently; to widen the access of all sectors of the population to modern energy supplies, especially in the rural areas; and to reduce the energy dependency through diversification of sources of supply and the development of indigenous energy resources. In pursuit of these objectives, substantial investments have been made in the development of the country's hydro resources; renewable energy resources, especially wind and solar energy, are being promoted; and exploration for petroleum deposits is being carried out.

The national power utility in Morocco is the Office National de l'Electricité (ONE) which has its headquarters in Casablanca. Up to 1994, ONE was responsible for all the electric power generation in the country, apart from that produced for their own use by certain large users in the chemical and phosphate industries. The status of ONE was significantly altered by the Government in 1994. One of the most important changes was the introduction of legislation which allowed power generation to be opened to private investors. Since then, a number of Independent Power Production projects have been implemented or are at different stages of the planning and implementation processes. ONE, however, still remains wholly responsible for the national electric power transmission system.

There has been a strong and regular growth in electricity demand since the beginning of the 1970s. Total consumption in 1971 was 2.05 TWh. By 1979 it had doubled to 4.0 TWh, an increase of 10% per year over the period. Since then, demand has continued to grow at an average annual rate of just under 6%, reaching 6.2 TWh at the end of 1986 and 11.05 TWh at the end of 1996. The rate of growth in electricity consumption has been about 2.5 % higher than that in the economy as a whole during the 1980s and early 1990s. The total number of consumers in 1995 was 1.1 million and the rural electrification coverage was 27 % .

Generating capacity in Morocco has also grown greatly over the period covered by the study projects. At the end of 1971, the total installed capacity in the national grid system was 762 MW. This had grown to 3,455 MW at the end of 1995 when the maximum demand on the system 2,048 MW.

2.3 History of Operations and Assistance

The history of ADB operations and assistance to the electricity sector differs substantially between the three countries.

2.3.1 Egypt

The Arab Republic of Egypt is among the major recipients of loans from the ADB. The first loan to the electricity sector was granted in 1974. Since then, a total of fourteen loans with a total value of UA825 million have been granted to the electricity sector. Eight of these fell within the scope of the study.

All of these projects were directly or indirectly concerned with increasing generation capacity and were implemented by the Egyptian Electricity Authority (EEA). They can be divided into two groups. The first group of projects consists of relatively small isolated power stations and associated distribution system which were approved in the middle to late 1970s. Projects in the second group are all concerned with large power stations connected to the UPS.

2.3.2 Tunisia

Four projects fell within the scope of the mission in Tunisia. The earliest of these was approved in 1978 while the latest was approved in 1989. Three of these projects were concerned with rural electrification and one with urban electrification. Two of the rural electrification projects were implemented in the south of the country and the third consisted of a series of widely distributed components in different parts of the centre and north of the country. The urban electrification project consisted of additions to the distribution system and consumer connections in a total of 150 municipalities throughout the country.

2.3.3 Morocco

A total of four projects fell within the scope of the mission. All were concerned with strengthening or extending the national transmission system in various parts of the country.

2.4 Sector/Country Strategy Objectives at Appraisal

The ADB published an Energy Sector Policy in June 1994. This outlines the key energy issues affecting its member countries and its own approach to these issues through its lending policies for the energy sector.

In brief, the ADB's loans to the electricity sector are intended to assist institutional development through the formulation of energy master plans, the definition of national priorities and the use of least-cost planning as well as intersectoral and regional coordination. The policy requires the ADB to become actively involved in the assessment and strengthening of energy sector institutions, focusing on human resource development and the creation of regulatory frameworks for the energy sector which address energy efficiency and the environment and allow clear, unambiguous definition of the responsibilities assigned to the various energy sector institutions.

The sector policy aims to support the privatisation of publicly-owned energy sector companies where this is the best solution at a given time. It also supports the adoption of the long run marginal cost of production and distribution. The sector policy also commits the ADB to supporting efforts to develop and promote demand-side management strategies and to move towards a point where energy efficiency becomes an integral part of development strategies in all major energy-consuming activities in member countries. The policy aims to encourage member countries to adopt means and measures that will facilitate a transition to environmentally sustainable energy production and consumption patterns and adoption of environmentally sound energy systems. It also requires the ADB to pay special attention to energy sector activities that take women's needs into account in terms of providing energy technologies that are appropriate to their needs and circumstances and enhancing their role in the energy sector.

The policy also commits the ADB to the development of energy sector guidelines for the various teams of energy experts in the Country Programme and Project Department on the incorporation of the overall energy sector development within the ADB lending programme, formulation and implementation of energy sector projects and programmes.

The publication of this document is subsequent to the date of approval of the latest loan within the scope of the mission and hence no explicit reference to it would be expected, or was found, in any of the project documents seen by the mission. Some, though by no means all, of the issues highlighted in the Sector Policy were, nevertheless, noted as matters of concern in the Appraisal Reports and other project documents seen by the mission.

2.4.1 Egypt

Appraisal Reports for the first five projects were available to the mission. Apart from the specification of the precise outputs of the projects, there was little, if any, discussion of overall sector objectives in anything except the most general terms in these appraisal reports. The 1980 project for the provision of the emergency power generator at the Shoubra El-Kheima in addition to contributing to helping the EEA to meet the forecast electricity demand also had the explicit objective of reinforcing the management capacities of the EEA but did not discuss the means in detail. The 1983 project to connect the Shoubra El-Kheima project to the UPS was intended to improve the quality and reliability of the electricity supply.

2.4.2 Tunisia

Appraisal reports were available for the four projects supported in Tunisia. There was little discussion of overall sector objectives. The 1979 and 1981 rural electrification project stated that their objectives were to extend the distribution network to new consumers in order to provide domestic lighting and to supply industrial users and electric water pumps for irrigation. The 1989 rural electrification project had the objectives of improving the standard of living of the population, the improvement of agricultural production and the development of irrigation.

2.4.3 Morocco

Appraisal Reports were available for three of the transmission line projects in Morocco. Sector objectives were not discussed as such. The objectives of the 1973 project was specified purely in terms of the physical outputs. The 1981 project for the strengthening of the 225 kV transmission system had the objective of contributing to the industrial, agricultural and tourist development of the four regions in which it was implemented. The 1981 project, which, in addition to the 225 kV elements also had a 60 kV component, had the objective of promoting industrial, agricultural and tourist developments in the areas to be served by the 60 kV line but no details of how this would be achieved were provided.

2.5 Financing arrangements

2.5.1 Egypt

Lending arrangements and conditions, and the proportion of costs covered, varied greatly between projects and over time. The 1974 loan for the construction of a new 5 MW power station in Port Said, for example, was for UA5.0 million. It covered 45 % of the foreign exchange cost equivalent to 36% of the total project cost. The interest rate was 6% per year with statutory commission of 1% per year. The repayment period was 14 years with a grace period of four years. The 1980 loan for the emergency generator at the Shoubra El Kheima power station project was for UA10 million. The interest rate was 7 % with a 1% per statutory commission on amounts disbursed but not yet repaid. The repayment period was 20 years with a five year grace period. The loan covered 53 % of the project component cost but only 1.5 % of the total power station cost. The loan for the Cairo West Power Station extension, by contrast, was for a total of UA252.1 million. It covered 85% of the project total cost. The interest rate was 9% and the repayment period was 20 years with a 5-year grace period. In all the projects reviewed, no significant exceptions to the ADB lending practices and conditions of the day were identified by the mission. Loans were made to the Egyptian Government which on-lent to the EEA with the Government acting as guarantor. Other donors, including the World Bank, USAID and others were involved in a number of the projects but no details of any discussions between the donor agencies and the ADB were made available to the mission.

2.5.2 Tunisia

The financing arrangements were broadly similar in Tunisia and varied in accordance with the prevailing interest rates and procedures of the ADB. The project support provided by the ADB ranged from 48 % to 63 % of the total project costs. In the rural electrification projects, a fixed sum per consumer connection, based on an agreement between the Government and STEG, was contributed by STEG, and the Government contributed the remainder of the project costs. No other donors were involved in any of the four projects.

2.5.3 Morocco

The financing arrangements in Morocco were broadly similar to those in the other two countries and varied in accordance with the prevailing interest rates and procedures of the ADB. The project support provided by the ADB varied from 23 % to just under 50% with ONE contributing the remainder. No other donors were involved in any of the four projects.

2.6 Evaluation methodology and approach

A project “impact” is conventionally defined as a result or outcome of an intervention and which can be directly traced to the intervention. The intended impacts of a project should be clearly defined at the project preparation stage and this is frequently done through the preparation of a Logical Framework Analysis in which the project inputs, intended outputs, objectives, goals, objectively verifiable indicators, sources of data and assessment of critical assumptions and risks are all clearly specified. A clear and unambiguous line of causality between the input and the intended effect also needs to be traced.

The availability of bench mark data for measuring impact is a necessary condition for measuring the development impact of a project. It is important that the target groups are clearly defined, that key parameters by which impacts can be assessed are identified and the necessary base line data are collected during feasibility studies, that they are incorporated into appraisal reports and that follow-up data collection is carried out during implementation and at the time the project completion report is being prepared.

In general, the data required for a detailed assessment of the impacts of the projects within its scope were not available to the mission. The only project for which a Logical Framework Analysis was carried out was Morocco Energy VII.

In order to carry out its task of assessing the impacts of the various projects within its TOR, it the mission therefore used proxy indicators or relied on broad qualitative assessments. The approach necessarily varied in accordance with the type of project and this is discussed under the separate headings below.

2.6.1 Power station projects

In the case of power station projects, the intended project impact is usually an increase in the generating capacity of the supply utility. This was generally the case with the projects supported in Egypt... The social and economic impacts of individual power station projects on specific groups of end users supplied by an integrated grid system obviously cannot be assessed since the electricity used by any particular group of consumers comes from a continually varying mix of power stations depending on minute-to-minute decisions in the national load-despatching centre. The overall electricity output of a power station can, however, be used as a proxy indicator of economic benefit, at the macro-economic level, provided details of power station outputs are available, as they are in Egypt. In a heavily loaded grid, with no obviously redundant capacity, and a continuing growth in demand, it can be assumed that had any particular power station not been built, load-shedding equivalent to its output would become necessary at some stage

in the growth of overall electricity demand. A review of the available studies on the costs of unserved electricity demand¹, reveals a huge range of estimates, depending on the country, the end-user, and the methodology used in the assessment. Minimum values tend to be in the range \$0.25-0.40/kWh of unserved demand, with maximum values in the range \$2.00-3.00 and in one case \$12.00/kWh. A conservative figure of \$0.20/kWh (UA0.14/kWh) has been adopted by the mission for unmet industrial and commercial demand and \$0.05/kWh (UA0.034/kWh) for unmet domestic demand. These figures, of course, represent hypothetical economic losses and in the case of unmet industrial and commercial demands are seven times greater than the actual average selling price of electricity which was UA0.02/kWh in 1995/96.

In the case of power station projects, it is also relevant to ask whether the subsequent build-up of demand and generating capacity in the overall electricity supply system have been in accordance with the assumptions made at the time the projects were being appraised. If, for example, the demand growth turned out to be much lower than anticipated, it could be argued that the projects were not justified by events. In this case, the unnecessary investment costs incurred would have had a negative impact on the supply utility and the wider economy of the country concerned.

2.6.2 Rural and urban electrification projects

The impacts of rural and urban electrification cannot be quantitatively assessed without detailed before-and-after socio-economic studies focused on clearly-defined parameters. In the absence of such studies, as was the case with the study projects in Tunisia, general qualitative impressions can, however, be obtained by site visits and comparison with unelectrified areas.

It is, however, important to bear in mind that broad economic changes occurring after a rural or urban electrification project may not be directly or indirectly caused by it and extreme caution is required in attributing any particular set of benefits to a particular project. The basic reason for this is that electricity demand is derived from, and posterior to, the demand for electricity-using services. Given that a variety of alternative energy sources, such as kerosene, batteries, or small diesel generators are often available, though more expensive, the major impact of rural and urban electrification projects may simply be a reduction in the overall energy costs of newly connected customers.

Detailed before and after information is also required before any relationship can be assumed between deforestation and rural electrification. This is because the causes of deforestation are generally complex and are more likely to be related to agricultural activities than the consumption of fuelwood for domestic cooking; it cannot therefore be assumed automatically that rural electrification will reduce the rate of deforestation in any given location.

2.6.3 Transmission line upgrading and extension projects

It is extremely difficult to identify the impact of projects concerned with the upgrading and extension of the high and medium voltage transmission system and the associated construction of substations unless there is a clearly defined weakness or bottleneck in the transmission system which the intervention is explicitly addressing. Nevertheless, a number of relevant questions can be asked concerning such projects. The first is whether the particular solutions adopted have represented good engineering practice and least cost options. If this is not the case, and they represent less than optimum solutions, then they may have had a significant negative impact on the functioning of the supply system in comparison with the solution which might have been adopted. It is also necessary to assess whether the projects are sustainable and whether they have had a

¹ "Power shortages in developing countries," Arun P. Sanghvi, *Energy Policy*, Vol 19, No 5, June 1991.

negative impact by imposing greater operation and maintenance burdens on the utility than other solutions which might have been applied.

It is also relevant to ask whether the general build-up of demand and generating capacity in the overall electricity supply system have been in accordance with the assumptions made at the time the projects were being appraised. Where the overall development of the national electricity supply system has been justified by rising demand, the impact of individual components in the transmission system can usually be taken as positive.

3. PROGRAMME OPERATIONS AND ACHIEVEMENTS

3.1 Implementation

The types of projects falling within the scope of the mission in each country are briefly listed in the following sections. The titles and dates in brackets are those given in the TOR. The documentation available to the mission in each case is noted.

3.1.1 Egypt

A total of eight projects fell within the scope of the study.

Energy Project I (1974)

This consisted of the installation of four 23.45 MW gas turbine generators in Port Said, Ismailia and Marsa Matrouh. The documentation available to the mission consisted of the Project Appraisal Report dated 20 November 1974.

Electrical Energy Project II (1975)

This consisted of four 66/11kV substations and transmission lines in association with the generation facilities in Energy Project I. The documentation available to the mission consisted of the Project Appraisal Report dated 29 August 1975.

Energy Production Project Phase III (1977)

This consisted of a 5 MW gas turbine generator each at Safaga, Hurghada, and Wadi el Natroun. The documentation available to the mission consisted of the Project Appraisal Report dated 23 December 1977 and the Project Evaluation Report dated October 1987.

Shoubra El-Kheima Electricity Project (1980)

This consisted of the construction of a 25 MW emergency standby turbine with fuel tanks and pumps at the Shoubra El-Kheima power station. The documentation available to the mission consisted of the Project Appraisal Report dated September 1980 and a Project Evaluation Report dated June 1992.

Shoubra El-Kheima Interconnection with Transmission Grid Project (1983)

This consisted of the installation of 500 kV and 220 kV lines and substations to connect the Shoubra El-Kheima Power Station with the UPS. The documentation available to the mission consisted of the Project Appraisal Report dated April 1983 and a project evaluation report dated June 1992.

Shoubra El-Kheima Unit No 4 (1985)

This consisted of the installation of an additional 300 MW steam turbine generator at the power station. The documentation available to the mission consisted of the Project Completion Report dated June 1992.

Damietta Power Station (1986)

This consisted of the construction of a 1,125 MW combined cycle power plant, transmission line to the UPS and gas supply line. The documentation available to the mission consisted of the Project Completion Report which was prepared following an ADB mission to Egypt in November 1994.

Cairo West Power Station Extension (1988)

This consisted of the installation of two new 350 MW dual-fuel gas turbines at the existing power station. The documentation available to the mission consisted of the Project Completion Report dated August 1997. In general, the projects appear to have been implemented satisfactorily although documentation on the exact project output achieved was not available in a number of cases. In the Damietta Power Station project, alterations proposed by the contractor and additional capacity ordered by the Egyptian Government enabled the originally planned output of the station to be virtually doubled at a cost increase of 17.5 % which was covered without recourse to additional ADB funding. The Cairo West Power Station completion was two years later than planned, mainly as a result of delays in start-up, but there was no cost overrun; in fact, the final cost was 14% lower than anticipated at appraisal.

3.1.2 Tunisia

A total of four projects fell within the scope of the mission.

Electricity I (1979)

This was concerned with rural electrification in the Sfax and Gafsa areas of southern Tunisia. The project consisted of medium and low voltage extensions to the distribution network, the installation of transformers and the provision of consumer connections. The documentation available to the mission consisted of the Project Appraisal Report dated February 1979.

Electricity II (1982)

The project consisted of rural electrification in the GabPs, Gafsa, Medenine, Tattaouine, and Tozeur governorates in southern Tunisia. The project consisted of medium and low voltage extensions to the distribution network, the installation of transformers and the provision of consumer connections. The documentation available to the mission consisted of the Project Appraisal Report dated February 1981 and the Project Completion Report dated December 1991.

Electricity III project (1984)

This was a highly dispersed urban electrification project in 150 municipalities in six regions of the country. The project consisted of medium and low voltage extensions to the distribution network, the installation of transformers and the provision of consumer connections. The documentation available to the mission consisted of the Project Appraisal Report dated May 1984 and the Project Completion Report dated December 1991.

Electricity IV (1989)

The project covered rural electrification in a number of areas of central and northern Tunisia. The project consisted of medium and low voltage extensions to the distribution network, the installation of transformers and the provision of consumer connections. The documentation available to the mission consisted of the Project Appraisal Report dated August 1989 and an Abridged Project Evaluation Report dated August 1996. In all cases, the projects were completed satisfactorily. In general, the outputs significantly exceeded those planned at appraisal.

3.1.3 Morocco

A total of four projects fell within the scope of the mission. All formed part of the general programme of expansion of the electricity supply system which was taking place during the period when the projects were approved for ADB funding.

Electricity II (1973)

The project consisted of the construction of lengths of 150 kV and 60 kV transmission lines and associated substations in five provinces. It was divided into six geographically separate components. The documentation available to the mission consisted of the Project Appraisal Report dated January 1973.

Electricity IV (1979)

The project consisted of the construction of a number of 225 kV links and the construction or extension of associated 225 kV substations in a number of parts of the country, including that to handle the output of the new 600 MW Mohammedia power station. The documentation available to the mission consisted of the Project Appraisal Report dated November 1979, the Project Completion Report dated December 1988 and the Project Evaluation Report dated March 1988.

Electricity V (1981)

The project was concerned with the expansion of the high voltage transmission system through the installation of 225 kV transmission lines and the expansion of existing and construction of new 225 kV substations. The documentation available to the mission consisted of the Project Appraisal Report dated October 1981.

Electricity VII (1989)

The project consisted of additions to the transmission system in widely separated areas of the country. It also included the connection to the 60 kV of nine localities relying on isolated diesel generators or inadequate connections to the transmission system. The documentation available to the mission consisted of the Project Completion Report dated March 1997. All the projects appear to have been completed satisfactorily. The Project Completion Report for the Energy IV project stated that there had been a delay of 27 months in the planned date of completion, mainly as a result of legal difficulties over the rights of way for the lines from some of the lines causing an increase in project costs of 17%. The additional costs were covered by the World Bank, the government and ONE and did not require any increase of the ADB loan. The Energy VII project was completed satisfactorily at a cost of 10.45% less than anticipated at appraisal although completion was two years late because of the business failure of some sub-contractors and design changes to the 225 kV towers.

3.2 Operational and Technical

The operational and technical experience in each country depends on the type of project supported.

3.2.1 Egypt

The isolated power stations and the associated distribution system constructed in the Suez Canal functioned as intended. These power stations were superseded by the extension of the UPS into the area in the 1980s. The installations in Safaga and Hurghada on the Red Sea coast have also functioned as intended. The installation at Wadi el Natroun was, however, rendered redundant within three years when the area was connected into the UPS by a 220 kV link built to serve Sadat City. The other five loans provided to the Egyptian electricity sector were concerned directly or indirectly with three major power stations: Shoubra El-Kheima with an overall capacity of 1,200 MW, Damietta with an overall capacity of 1,125 MW, and the Cairo West Extension with a capacity of 700 MW.

In the case of Shoubra El-Kheima, the first three 300 MW units were commissioned in 1985 and the remaining 300 MW unit, supported by ADB funding, was commissioned in 1987. Damietta came on stream in 1992 and the Cairo West Extension 1994. All three stations have functioned satisfactorily and are high in the EEA merit order; Damietta is, in fact, the thermal power station with the highest efficiency in the UPS. In the year 1995-96, the 300 MW unit supported by ADB funding at the Shoubra El-Kheima power station accounted for 3.2 % of the total power generation in the UPS; Damietta contributed 4.7 % ; and Cairo West a further 12.1% . In all, the contribution of the three stations to the 1995-96 electricity generation in the country was almost exactly 20 % .

3.2.2 Tunisia

The rural and urban electrification projects in Tunisia are widely dispersed across the country. In general, they consisted of technically simple, and relatively minor additions to the existing medium and low voltage distribution system. The total number of new connections made under the four projects was 366,000 of whom 215,000 were urban and 151,000 rural. Work carried out under the projects was therefore responsible for approximately 20% of the urban and 20% of the present number of rural consumers. No significant operational or technical problems appear to have emerged in any of the works carried out under the four projects. The distribution system components inspected by the mission appeared to be of high quality and to be in a fully operational condition.

3.2.3 Morocco

Based on the documentation provided to the mission and its own observations and field visits, all the projects appear to have been carried out in accordance with the internationally accepted technical standards prevailing at the time they were implemented. In total, 839 km of 60 kV, 55 km of 150 kV and 13 13 km of 225 kV line were constructed. These account for 11% of the 60 kV, 7.2 % of the 150 kV and 28 % of the 225 kV lines presently existing in the country.

From the documentation available to the mission, discussions with ONE personnel and the various sections of line and substations which the mission inspected, the projects all appear to have functioned as intended and no serious operational problems were identified by the mission.

3.3 Conditions and Covenants

Certain relatively similar conditions appear to be applied to all loans provided by the ADB and are referred to in the appraisal reports available to the mission. These conditions cover such issues as the provision of government guarantees for loans, exemption of project inputs from taxes and duties, assurances about the availability of the balance of funding before drawing upon loans and various other procedural matters. Although these conditions show some variations over time and between projects, they appear to represent relatively standard ADB procedures and are not discussed further in this report.

Many of the appraisal reports, however, recommend that loan approvals should be subject to the imposition of further country-specific conditions. Many of -these are concerned with tariff levels and excessive amounts of accounts receivable which have a negative impact on the liquidity of the utility.

These issues are treated in a document entitled *A Framework for Public Utility Tariff Policy* which was approved by the ADB Board in March 1985. This document covers the setting of tariffs in public utility enterprises (PUEs) in the electric power, telecommunications, water supply and sewerage sectors. The aim of the document was to propose a framework for public utility tariff policy which would provide for a flexible tariff covenant to be applied to PUEs in regional member countries. The document states that the ADB would increasingly insist that PUEs receiving loan support should be operationally efficient and self-sustaining entities that contribute to socio-economic growth. The rate of return on an up-to-date valuation of utility assets is referred to as

one of the key performance indicators and the document states it should approximate the financial rate of return which the assets would earn elsewhere in the economy, making due allowance for business risks. This rate of return should become obligatory on the utility and this should be formalised in a rate of return covenant. At a more detailed level, the document recommends that accounts receivable should preferably not exceed three months sales.

On the question of tariffs, the document suggests that they should recover the average incremental cost of supply, which approximates the long run marginal cost (LRMC) of supply. Incremental costs are defined by applying shadow prices which may differ from the actual prices paid by the PUE and are calculated by examining expansion plans and how the system is to be operated as demand increases.

The approval date of this document was subsequent to the appraisal dates of all but five of the projects reviewed by the mission. No reference to this document was found in any of the project documents made available to the mission. Concerns over inadequate tariff levels and excessive accounts receivable are, however, expressed in a high proportion of the appraisal reports seen by the mission and reflect those expressed in the document. These concerns, as referred to in the appraisal reports, are summarised below.

3.3.1 Egypt

From the beginning of its lending programme in Egypt, the ADB was concerned with the fact that EEA tariffs were far below the LRMC of supply and should be increased. Another regularly recurring concern has been with excessive accounts-receivable mainly from government and public bodies.

The first project appraisal in 1974, for example, noted that the prevailing electricity tariffs were extremely low. It stated that the appraisal mission had discussed this with the Egyptian Authorities who were receptive to its comments and welcomed the idea of carrying out a comprehensive tariff study. Similar observations were made in the Appraisal Report of the 1975 project. The 1977 Project Appraisal recommended:

- that the EEA should engage a consultant to carry out a tariff study;
- that the EEA should take the necessary measures to ensure that the amounts owing to it by the Government and public bodies should be recovered and that in future accounts should be settled in a proper manner.

Fourteen years later, the 1991 Project Appraisal for the Cairo West power station was making almost identical recommendations. These were that the Government of Egypt should:

- within 12 months of loan signature, submit to the ADB for its review and comments the terms of reference for the proposed tariff study review;
- cause EEA to continue its efforts in the collection of accounts receivables with a view to obtaining an average of two and a half months of annual sales;
- not later than 30 September 1990, furnish to the ADB for its review and comments a copy of the updated tariff study and, in consultation with the ADB, adopt the recommendations thereof on a timely basis to ensure the financial viability of the EEA's operations;
- have settled the agreed instalment amount and further facilitated the settlement of outstanding bills of the Government offices and the public sector ensuring future payments are effected on a timely basis so that the present level of outstanding receivables be reduced to 2.5 months or below of sales by 1991 fiscal year.

3.3.2 Tunisia

The Appraisal Report for the Electricity I project in 1979 noted that STEG was being forced to carry a heavy burden in the form of unpaid accounts owed by the Government, public bodies and para-statal corporations. It recommended as one of the loan conditions that the Government

should undertake to help STEG recover its arrears as quickly as possible. The same recommendation was made in the Appraisal Report for the Electricity II project. The 1984 Appraisal Report for Electricity Project III recommended that the conditions imposed on the loan should include the following:

- the necessary measures should be taken to ensure that STEG should earn a minimum rate of return of 10% on its capital;
- measures should be taken to ensure that arrears of payment to STEG should not be greater than 60 days of sales.

The 1989 Appraisal Report for Electricity Project IV recommended that the conditions imposed on the loan should include the following:

- the Government should authorise STEG to apply a tariff structure from 1990 onwards which would cover its operating costs and to provide written proof of having done so to the ADB not later than 31 March 1991;
- to take the necessary measures to ensure that STEG had a return of 5 % on its fixed capital by the end of the project.

3.3.3 Morocco

No special conditions were imposed in the Appraisal Report for Electricity Project II. The 1979 Appraisal Report for Electricity Project IV recommended that the conditions imposed on the loan should include the following:

- the Government will undertake to assist ONE in obtaining payment of its overdue accounts from Government and public bodies.

The Appraisal Report for Electricity Project V, two years later, recommended that:

- the Government should ensure that the arrears of payment due to ONE from public bodies should be cleared in accordance with a precise timetable.

The Appraisal Report for the Electricity VII project, in 1989, included the following:

- the Government would take all the necessary measures to ensure that ONE applied a tariff which guarantees a minimum rate of return of 6% per year on its fixed assets;
- the Government would submit to the ADB a programme under which ONE would gradually recover debts owing from the Government and public bodies so that all arrears at 31 December 1987 were paid off not later than 31 December 1992.

3.4 Financial and Economic

The financial position of the electric power utilities in each of the countries was subjected to analysis in all the appraisal reports available to the mission. In general, the appraisal found grounds for criticism on the basis of tariffs which did not adequately cover operating costs or the LRMC of supply. There were also concerns about liquidity and the high levels of accounts receivable. These are reflected in the conditions applied to loans and noted in Section 3.3 above. The overall financial position of the utility was, however, found to be acceptable to the ADB in each case.

3.4.1 Egypt

All the projects for which details of the appraisals were available to the mission were subject to some degree of financial and economic analyses though this varies greatly between projects and the details of the calculations are not always given or available. All the projects appraised were deemed to be financially and economically justified. In general, economic evaluations appear to have been based on market prices rather than shadow prices. This approach

tends to produce results which are considerably more favourable to projects than the use of shadow prices. At the time of the Shoubra El-Kheima appraisal, for example, the cost of fuel-oil to the EEA was taken at its internal value of \$9 per tonne instead of the international price of \$180 per tonne.

3.4.2 Tunisia

The methods used in the economic and financial assessments of the projects varied considerably. In the Electricity I project, two alternative solutions, the use of 30 kV subtransmission lines or isolated diesel generators, were investigated for the financial analysis. It was found that the cost of the subtransmission line solution was considerably lower. A projection of the revenues from the scheme based on the 30 kV line showed a FIRR of 8%. The Appraisal Report concluded that the project was economically, financially and socially justifiable. The Appraisal Report for the Electricity II project calculated that, when the Government grant was deducted from the project costs, the project had a FIRR of 7.6% which the Appraisal Report deemed satisfactory. The EIRR was calculated to be 9.28% which was also deemed satisfactory.

The Appraisal Report for the Electricity III project calculated that the FIRR for the project as a whole was 32%. This figure was revised downwards to 19.5 % in the Project Completion Report but this was still considered satisfactory. The FIRR calculated in the Appraisal Report for the Electricity IV project, with the Government grant excluded from the total cost, was 8.34%. The economic justification for the project was based on the comparison between the costs incurred by rural families using electricity for lighting, TV and water pumping and those using kerosene lamps, batteries and a diesel water pump. The calculation showed that the costs incurred when electricity was used were considerably lower and that the project had an economic rate of return of 11.4%.

3.4.3 Morocco

The financial analysis carried out in the Appraisal Report for the Energy II project is difficult to interpret as few details are provided. It appears to assume that the projected increases in electricity consumption in the five regions in which the project was to be implemented could be entirely attributed to the project. The revenue from these projected sales is compared with the operating and capital amortisation costs of the project. The analysis showed a growing net annual surplus for the project, eventually stabilising at about 30% of the investment costs, and giving a highly acceptable FIRR of 27 % .

The Appraisal Report for the Energy IV project stated that, because of the nature of the project, it was impossible to determine its precise financial viability. Since it formed part of an interconnected network, the origin, or destination, of the electricity flowing through any given part of the network could not be identified so that any of the particular costs and benefits which might be associated with it could be estimated. The Appraisal Report, nevertheless, stated that the project would have an undeniable impact and would facilitate an increased volume of electricity sales in the country.

The Appraisal Report for the Electricity V project stated that it was technically impossible to provide a financial justification for the project. The origin and route through the system taken by the electricity consumed at any point in an integrated grid, such that in Morocco, could not be precisely identified. In consequence, the Appraisal Report states that it is not possible to impute to the project a particular portion of any increase in total electricity sales taking place after the implementation of the project.

The economic justification of the same project was expressed in broad terms. It would reinforce the supply of electricity to irrigated farming areas and a number of industrial zones. It would encourage the development of tourism and fisheries in the south of the country. It would help redress the regional developmental imbalance in the country. It would encourage the industrialisation of the country, reduce unemployment, foster economic growth, improve the balance of payments, and raise the national standard of living. It is clear, however, that none of these result, if they were to occur, could be uniquely allocated to the project.

In the case of the Electricity VII project, the Project Completion Report stated that the basic documents concerning the economic evaluation of the project were no longer available; it also noted that it found errors in the tables in the Appraisal Report. New calculations, however, showed that “the internal rate of return is thus calculated at 18.6 % over and above the internal rate of return and which illustrated the strong extermalisation of the project’s profits in terms of economic advantages for the community.” It points out, however, that this result cannot be compared with the initial rate because of the errors found in the tables.

The Project Completion Report carried out an evaluation of the same project based on awarding scores under a number of evaluation criteria. Its findings ranked the project with a total score of 82 points out of a possible 100 which is judged to be satisfactory. The Project Completion Report was also satisfied with the social impact of the project and asserted that this will be mainly felt in newly electrified areas where standards of living will be increased. It also states that the project will help limit pressure on natural resources by substituting electricity for firewood and will go a long way in stepping up local security by improved street lighting. No evidence is produced for the assertion about fuelwood.

3.5 Bank Performance

The ADB performance in negotiating and administering the various loans appears to have been generally satisfactory. No adverse comments on its performance were made by any of the officials interviewed by the mission in the three countries. The impression gained by the mission was that the ADB was regarded as sympathetic and responsive to the needs of the three countries.

At the same time, the information available to the mission suggests that there was little involvement by the ADB in the development of the electricity sector strategies, in the prioritisation or selection of the projects for which funding was sought or in the upgrading of management and planning capabilities in the various national power utilities. No references to possible alternative options which might be adopted, either at a strategic or a detailed project level, were found by the mission.

4. IMPACT ASSESSMENT

Although there were broad similarities between the types of projects supported within each country, they differed widely between the countries. The Egyptian projects were primarily concerned with power generation, the upstream end of the national electricity system. The projects in Morocco were primarily concerned with power transmission, the intermediate level of the national electricity supply system. The projects in Tunisia were concerned with the distribution system and consumer connections, the downstream end of the system.

No inter-country or regional references or interactions were detected by the mission in relation to any of the projects falling within its scope. The project impacts are all highly country-specific and are considered within their national contexts below.

4.1 Policy reforms

4.1.1 Egypt

The Appraisal Reports available to the mission, or quoted in other documents, show a consistent concern with the need for policy reform in relation to tariffs and the high amounts of accounts receivable. The majority of the Appraisal Reports for the projects reviewed by the mission recommended that conditions in relation to these two issues should be applied to the loans (see Section 3.3). Substantial increases in tariff levels have been made by the EEA and they now stand at about 95% of the LRMC of supply. This is a satisfactory position but it is impossible to identify the extent to which this can be attributed to the ADB conditionalities. The continual need to repeat virtually the same conditions in successive loans from the mid-1970s up to 1991, shows that they were not taken particularly seriously by the borrower. There may, however, have been a cumulative effect.

Information on the latest accounts receivable position was not made available to the mission. The 1997 Completion Report for the Cairo West Power Station Extension, shows that the arrears at the end of 1993 amounted to 5.9 months of sales compared with 3.6 months at the end of 1981. No positive impact can therefore be attributed to the ADB loan programme in this respect. There appears to be little reference from project to project on whether previous conditionalities have been met and no system by which cut-offs in the flow of loan funding are imposed when conditionalities are not fulfilled appeared to apply to the projects within the scope of the study. This is also noted in the Completion Report for the Damietta Power Plant produced after a mission in late 1994. The report points out that while the periodic supervision and follow-up missions of the ADB have contributed to the successful implementation of projects, "similar success was not achieved in institutional issues as either conditionalities were not monitorable or no sanctions were imposed for non-compliance."

4.1.2 Tunisia

The main policy-reform concerns expressed in the Appraisal Reports were over tariffs, accounts receivable, and rate of return on total capital. In the case of tariffs, the present average is close to the LRMC of supply but the mission was not provided with any exact figures by the Tunisian counterparts. It is not possible to ascertain from the available documentation the extent to which the present satisfactory position is a direct result of the ADB conditions imposed on the 1989 loan for the Electricity IV project.

The accounts receivable situation improved during the period 1986-90 from 48 days of sales to 30 days of sales in 1990. The mission was informed that the position has remained stable and STEG has steadily improved its mechanisms of metering and billing as well as payment procedures.

The 1984 Electricity III Appraisal Report recommends that STEG should achieve a 10% rate of return on capital as a condition of receiving the project loan. In the 1989 Appraisal Report for the Electricity IV project the condition was changed to a 5 % rate of return on assets but no comment was made on whether the previous condition had been met. In neither case, was there any discussion of associated and potentially complex issues such as the need for an up-to-date valuation of assets or the basis on which this might be carried out. None of the other documentation available to the mission followed up on whether either condition had been implemented.

4.1.3 Morocco

The main policy reform concerns of the successive Appraisal Reports were over tariffs and accounts receivable. The evolution of tariffs during the period 1985-95 showed a decrease in real terms. In 1996, the tariff structure was reformed and an increase of 5 % was introduced. The intention was that tariffs would move towards the LRMC, a process which was reinforced and given additional urgency by the introduction of IPP projects into the supply system.

The accounts receivable position of ONE has improved from 9.3 months of sales in 1991 to six months in 1995. This was still twice as high as recommended in *the ADB Framework for Public Utility Tariff Policy*. The main reason was that public bodies were authorised to pay 90 days after billing and some have arrears of more than 12 months.

4.2 Socio-economic Impact and Poverty Alleviation

Assessment of the socio-economic impact on key target groups as a result of the ADB lending to the electricity sector in the three countries is extremely difficult for the following reasons:

- in the majority of projects, the key target groups were not identified at appraisal;
- apart from technical outputs, project objectives were only specified in extremely general terms making it impossible to establish any causal connections;
- baseline studies identifying and quantifying the significant parameters by which programme or project impacts might be monitored were not carried out, or were not available to the mission, for any of the projects considered;
- some types of projects, such as transmission line extensions or substations, or power stations connected into a national grid, have no clearly identifiable or quantifiable impact on any particular group of end-users;
- the necessary follow-up socio-economic studies to identify possible impacts were not possible in relation to any of the projects within the time and budget framework of the study;
- even with large-scale before-and-after studies, it can be difficult to link socio-economic change specifically to electricity projects since electricity demand is a derived variable and variety of other factors and inputs are usually involved in cases where electricity demand is increasing.

The mission was therefore, restricted in the type of assessment it was able to carry out. Because the types of projects were broadly similar within each country, and different from those in the other countries, each is treated separately in the following sections.

4.2.1 Egypt

The first three projects supported by ADB loans provided in the 1970s were primarily intended to restore electricity generating facilities to Port Said and other areas in the Suez Canal Zone and east of the country where virtually the whole physical infrastructure had been destroyed during the 1967-73 period of hostilities. The installation of a 5 MW generator at Wadi el Natroun, which was included in the third project, was intended to replace the existing generating equipment which had reached the end of its useful life and provide a basis for future electricity demand growth in the area.

The general need for electricity generation facilities in the Suez Canal Zone was clear at the time they were appraised. Without electricity, it would have been impossible to restore living conditions to their pre-war levels for the 300,000 returning refugees, let alone contemplate raising their living standards. Reliable electricity supplies were also required for the reconstruction work being carried out in the area and for the restoration and improvement of facilities associated with the reopening of the Suez Canal.

These three projects were implemented as intended and in the Suez Canal Zone were fully justified by events. The areas were restored as planned and are now fully integrated by a series of 220kV links into the UPS. The town of Hurghada has developed into a major holiday resort on the Red Sea coast and is likely to be connected into the UPS in the early years of the next century.

Apart from the installation at Hurghada, the projects implemented under the third loan, however, have been less justified by events. The installation at Wadi el Natroun was rendered redundant within three years when the area was connected into the UPS by a 220 kV link with the UPS. At Safaga, the anticipated demand has not materialised and a smaller generating unit could have been installed.

Although the Suez Canal Zone installations have been superseded by the arrival of high capacity links with the national transmission system, they clearly had their intended impact. They can all be judged as successful contributions to the economic development of the areas in which they were installed. The economic impact of the later power generation projects can be estimated by using the costs of unmet demand referred to in Section 2.6. These were assumed to be UA0.14/kWh for industry and UA0.034/kWh for domestic users. These can be applied to the output of the major power stations supported by ADB loans and for which the necessary data are available.

In the case of the Damietta power station, the total net electricity output of the station during 1996 was 6.7 TWh. It can be assumed that, in accordance with the overall national breakdown by end use, 70% of this was consumed by industry, commerce and productive public services, with the remaining 30% being accounted for by domestic and other public service consumption. The overall economic value to the economy of the electricity produced by the power station, in terms of avoided losses, is thus UA725 million per year - approximately two and a half times the investment cost of the station.

Similar calculations show that the avoided economic loss to the national economy as a result of the output of the ADB-supported generating unit at Shoubra El-Kheima power station in 1996 was UA192 million compared with a total investment cost of UA167.58 million. Using the same method of calculation, the economic loss avoided as a result of the electricity output of the Cairo West Extension in 1996 was UA277 million, almost exactly the investment cost of the station itself.

The total economic impact of the ADB-supported projects, in terms of economic losses avoided, can therefore be estimated at nearly UA1.2 billion per year. This is about 4% of the total GDP². The precise degree of credibility which should be attached to any of these figures is debatable; it can nevertheless be safely said that if the power stations supported by ADB loans had not been built, Egypt would have been subject to chronic and economically damaging power shortages with extremely large economic losses. The mission was unable to locate statistics on the extent to which poverty has been alleviated in Egypt over the twenty-five years of the ADB lending to the projects within the scope of the mission. Even if the data could have been located, it would have been impossible to connect them with the electricity output from the power stations in

² The actual contribution, as opposed to this hypothetical loss, is very much lower at about 0.6% of annual GDP.

question since poverty-alleviation, if it can be achieved, is generally a multi-factorial issue which cannot be linked to single parameter such as electricity consumption.

4.2.2 Tunisia

The four projects supported by ADB loans in Tunisia all exceeded their target number of consumer connections at appraisal. The primary impact of the projects was that some 366,000 new consumers were connected. No baseline study of socio-economic conditions either at a community or a household level in any of the project areas is referred to in any of the project documentation or appears to have been carried out. No reliable assessment of the impact of electricity availability can therefore be made for any of the projects. At a qualitative level, however, it is clear that newly connected consumers enjoy a higher standard of living as a result of the availability of electricity. In areas without an electricity supply, the use of car batteries to provide power for TV is, for example, common. According to field information collected by the mission, the average charging fees amount to about 3 dinars per month and battery amortisation costs a further 5 dinar per month. The cost of the electricity used by a TV set is perhaps 2 dinars per month, providing the family with a saving of up to 6 dinars per month - approximately the total electricity bill of a low income rural or urban consumer.

Other benefits from having an electricity supply include improved domestic lighting, reduced bills for kerosene and dry-cell batteries. The availability of lighting and refrigeration improves the quality of service in health centres. Shopkeepers dealing with perishable goods such as meat and dairy products can use electric refrigerators to improve hygiene and reduce waste. Farmers can reduce the costs of water pumping by changing from diesel to electric pumps. The mission found evidence that such benefits were being obtained by newly connected consumers in some of the areas where projects had been implemented. No specific impact on poverty alleviation can, however, be inferred since those connecting to the electricity supply tend to have already risen above extreme poverty.

4.2.3 Morocco

It is impossible to identify or separate the impacts of individual substations or portions of transmission line in an integrated transmission system such as that of ONE in Morocco. This applies to the electricity supply system as a whole and even more strongly to any particular category or target group of consumers which might be selected. As far as the mission could judge from the documentation provided and from its own observations and field visits, the work carried out has been in accordance with the internationally accepted technical standards prevailing at the time the projects were approved and all the equipment installed has represented a prudent choice of the available technology.

The various components added to the transmission system appear to have functioned as intended. No negative impact, in terms of unnecessary costs or poor quality equipment, appears to have resulted from any of the projects. The load forecasting on which some of ONE's longer range system planning was based appears, at times, to have substantially exaggerated the rate of demand growth. In the case of the Energy V project, for example, which was appraised in 1981, the projected consumption and peak load figures for the year 2000 are likely to be twice those which will actually be achieved - judging by the levels reached in 1996. There has also been a degree of unwarranted technical optimism about the costs and technical practicability of nuclear power and the exploitation of the country's oil shale resources which has not been borne out by events. Fortunately, the justification for the various components in the Energy V project did not lie in such long-range projections. Sound short-to-medium term technical justifications were found for all the major components of the project. No negative impacts as a result of unnecessary investments were therefore incurred as a result of the project.

No relationship can be established between any macro-indicators such as GDP and the projects. Similarly, they have no identifiable direct impact on poverty alleviation. Nevertheless, it is clear that reliable and increasing supplies of electricity are essential if a country such as Morocco is to continue to develop economically and increase the living standards of its people. To the extent that these have been made possible, the implementation of the projects has been successful.

4.2.4 Energy balances

The mission attempted to find a relationship between national energy consumption and GDP in the three countries. As can be seen in the table below, Energy consumption per head in all three countries has significantly increased since 1980. Consumption per head in Egypt, however, is almost twice that in Morocco despite a considerably lower GDP per head.

The difference between Egypt and Tunisia in this respect is even more marked, with Egypt having roughly the same energy consumption but only 40% of the GDP per head. In terms of dollars per kgoe, Morocco and Tunisia appear to have roughly three times the output of Egypt. Although this higher energy intensity of economic output in Egypt may be a result of the country's extremely low energy prices, many other factors could also be involved and no firm conclusions can be drawn without a great deal of further analysis.

Country		1980	1994
EGYPT	Energy consumption (kgoe)	371	608
	GDP per head (US\$)	550	720
TUNISIA	Energy consumption (kgoe)	483	590
	GDP per head (US\$)	1360	1790
MOROCCO	Energy consumption (kgoe)	254	307
	GDP per head (US\$)	740	1140

GDP figures are given in current dollars.

4.3 Institutional

Competent and effective electricity utilities existed in all three countries before the ADB loan programmes were initiated and continued to function as such during the period covered by the study projects.

The managerial and technical competence of the three utilities appears to be high and was consistently reported as being so in the ADB documents viewed by the mission. Project design and implementation was largely carried out by the utilities themselves and in all significant respects appears to have been satisfactory. There does not appear to have been any significant direct involvement by the ADB in project selection, design, or implementation. Nor, on the evidence available to the mission, was there any indication that such inputs from the ADB were necessary or desired. None of the projects reviewed by the mission contained explicit institutional development components and the mission was unable to identify any specific institutional impact from the projects included in the study.

4.4 Environmental

4.4.1 Egypt

The negative environmental impacts of the ADB supported projects appear to be within acceptable levels. The early projects have effectively been superseded; any environmental impacts were relatively small in the first place and have now disappeared. As the 1980s projects were being launched, it became the Egyptian Government policy to require an environmental impact analysis (EIA) for all large power project. This policy has been supported by major international agencies, particularly USAID and the World Bank, which have included the preparation of an EIA as one of their conditionalities for loans. The official environmental Egyptian standards are comparable with those of the World Bank and the US Environmental Protection Agency for sulphur dioxide and nitrogen oxides (NO_x). The dry and dusty climate of Egypt means that the natural background level of particulates is often high and the environmental control measures at major power stations are intended to ensure that their operation causes no significant increase in the ambient level of particulates.

The use of natural gas, which is environmentally a particularly benign fuel, greatly facilitates meeting these environmental standards. At present, the almost exclusive use of natural gas as fuel in the Shoubra El-Kheima, Damietta and Cairo West Power stations means that their impact on air quality is well within internationally accepted limits.

Many of the EEA's large steam power plants use the water of the Nile for their operation. In accordance with government regulations, the temperature of cooling water discharged into the Nile should not be greater than 5°C above the ambient Nile temperature and in no case more than 35°C. EEA power plants are equipped with waste water treatment systems designed to treat the various waste streams. The plants also have modern laboratories with facilities for testing and monitoring compliance with all the national environmental requirements. Noise mitigation measures are enforced by the EEA at gas turbine and combined cycle plants. Sound attenuation measures at the Damietta plant, which was visited by the mission, have enabled noise levels to be kept well within those laid down by the US Environmental Protection Agency.

4.4.2 Tunisia

The projects consisted of relatively small-scale extensions to the existing distribution systems in the urban and rural areas where the projects were implemented. No significant negative environmental impacts would be expected from such projects and none were detected by the mission.

4.4.3 Morocco

The transmission line projects in Morocco were generally concerned with upgrading or extending the existing high voltage transmission system. The mission found no evidence that any of the projects had significant adverse environmental effects.

4.5 Women in Development

None of the projects reviewed by the mission had a specific gender component and no reference to the issues concerning women in development was found in any of the project documentation provided to the mission. The rural and urban electrification programmes in Tunisia, by making electricity available at a household level, almost certainly improved domestic living standards. This is likely to have had a particular significance for women. The urban electrification programme may also have improved working conditions in shops and small enterprises in which women are employed. The absence of any baseline or follow-up studies, however, does not permit any such benefits to be quantified or even identified with any certainty.

Neither the power station projects in Egypt nor the transmission line projects in Morocco can be directly related either positively or negatively to any women in development issues.

5. KEY ISSUES

Regional integration is one of the fundamental aspects of the ADB mandate. Regional cooperation in energy matters is another closely related issue with which the ADB is concerned. The projects under review appear, however, to have been conceived and implemented without any reference to projects or programmes in the electricity sector in the other countries. The mission found no evidence of any attempt to identify a regional component in, any of the projects at appraisal or during implementation. No reference was made to regional cooperation in energy matters in any of the documentation seen by the mission.

In the longer term, however, the ADB-supported power generation and transmission system projects would tend to facilitate regional integration. In Egypt, the availability of adequate generating capacity means it is realistic to consider international links. A 400 kV submarine connection with Jordan was under construction at the time of the mission and was expected to be completed at the end of 1997 and a link with Libya was expected to be commissioned in the summer of 1998. Similarly, in Morocco, the strengthening of the transmission system and, in particular, the development of the 225 kV system facilitates intra-regional transmission of electricity and this is already taking place with Spain and Algeria.

6. SUSTAINABILITY OF OPERATIONS

The sustainability of operations in each of the countries is fundamentally a question of the viability of the national power utility which, in all cases, is the operating agency for the projects reviewed. In all three countries, the power utilities are large, competent and well-functioning organisations. At the technical and administrative levels, there are no realistic concerns about their ability to continue to operate and maintain the projects supported by ADB loans.

Some residual -questions, however, remain over the financial performance of the three utilities. Tariff levels still appear to be somewhat below LRMC costs of supply and thus not in conformity with ADB tariff policy. The amounts of accounts-receivable is also in excess of ADB standards in some instances. Neither is it clear whether the three organisations are achieving the rate of return on assets required by the ADB. Despite these violations of ADB standards, the Governments of the three countries stand firmly behind the respective national power utilities and it is inconceivable that they would be allowed to collapse financially. The sustainability of all the projects is therefore fully assured.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Overall Assessment

In each country there is a strong and competent power utility which has been fully capable of prioritising its requirements, expressing them clearly, and implementing the projects emerging from the analysis of its needs. This has led, in all cases, to satisfactory implementation of the ADB supported projects. Almost without exception, the projects have achieved the outputs intended at appraisal. This is an excellent record which reflects extremely well on the implementing agencies - and the ADB's choice of projects to support. Power station projects, by their nature, have their primary impact at the macro-economic level. Once the electricity demand exists, the economic penalties of not meeting it are huge, as clearly demonstrated by the mission calculations on the potential costs of unmet electricity demand in Egypt. On that basis, the power station projects supported by the ADB have repaid their investment costs many times over.

The same is true of transmission system projects, though in a much less quantifiable fashion. Once the power stations have been built, and the corresponding electricity demand exists, the technical and economic case for providing the necessary transmission system capacity is self-evident. The only questions are whether the projects have been properly designed and implemented and are in the care of a utility which can operate and maintain them effectively. In the case of Morocco, there do not appear to be any doubts on either score. Rural electrification becomes a necessity in the later stages of rural economic development. In itself, rural electrification will not cause economic development since the demand for electricity derives from, rather than causes, the demand for rural goods and services. But once rural development has reached a certain level, the absence of rural electrification is undoubtedly going to act as a bottleneck and constraint on further development. This stage has clearly been reached in Tunisia. The rural and urban development projects supported by the ADB represent a shrewd choice of investments and have undoubtedly contributed substantially to an increase in the living standards of those obtaining an electricity supply. Substantial investments in the national electricity supply system of any particular country, whether these investments are in power stations, transmission systems, or rural electrification, are, in effect, a vote of confidence in the economy and the competence and viability of the national power utility. If this confidence is misplaced, the investments will be wasted. In the case of the three countries, and the utilities concerned with the implementation of the projects reviewed by the mission, the confidence of the ADB appears to have been fully justified by events.

7.2 Feedback and Recommendations

It appears to the mission that the ADB functioned mainly in a reactive manner in relation to the projects reviewed. In these cases, it seems to have been responding to loan applications, rather than becoming proactively involved at an earlier stage in the utility planning process developing strategies, highlighting options and suggesting alternatives. The results of the mission review show, however, that this has not resulted in any adverse consequences in any of the three countries. The three national power utilities involved are, however, highly competent and effectively managed organisations and clearly capable of carrying out their own strategic planning as well as selecting and implementing projects. In countries where utilities do not meet these high professional standards, a more proactive role by the ADB might well be required. This will, however, require a considerably greater investment of ADB staff time and resources. It is beyond the scope and competence of the mission to make any recommendations on how the ADB should assess or balance the various trade-offs involved. The conditions imposed on loans in relation to certain issues, most notably, tariff levels, reduction in the magnitude of accounts receivable, and achieving certain rates of return on capital do not appear to have had the desired impacts on utility policies. In some cases, virtually the same conditions are repeated in successive projects over long periods. If the ADB wishes such conditions to be effective in influencing utility policies, they will have to be realistically related to what is organisationally and politically achievable. They will also need to be backed up by credible sanctions such as an automatic cut-off in loan disbursements and a refusal to consider further loans when conditions are not fulfilled. If assessments of the impacts of future projects are to be carried out, provision for this needs to be built in from the beginning of the project cycle. It is essential that the key target groups are identified at the appraisal stage, that the key parameters by which the project impact will be assessed are specified, and that proper baseline studies are carried out before projects are implemented. It is also essential to ensure that there is a clear cause and effect relationship between the project inputs and the parameters being monitored if reliable and unambiguous results are to be obtained from the impact assessment.

7.3 Follow-up Action

The dates of the loan approvals for the latest projects within the scope of the mission were 1988 in Egypt, 1989 in Tunisia and 1989 in Morocco. A variety of activities about which the mission has no detailed information have been undertaken in the three countries in the intervening eight to ten years. The mission did not therefore possess the information on which relevant recommendations for follow-up actions by the ADB at this stage could be made.

LIST OF ADB PROJECT **DOCUMENTS PROVIDED TO THE MISSION**

EGYPT

Project Appraisal Report (1974) Energy Project I.
Project Appraisal Report (1975) Electricity Project II.
Project Appraisal Report (1977) Energy Production Project Phase III.
Project Appraisal Report (1980) Electricity Project: Shoubra El Kheima Power Station.
Project Appraisal Report (1983) Project for the Interconnection of Shoubrah El Kheima Electrical Transmission System.
Project Completion Report (1986) Damietta Power Plant Project.
Project Completion Report (1989) Interconnection of Electrical Transmission System of Shoubrah El Kheima Power Station
Project Evaluation Report (1992) Electricity Project: Shoubrah El Kheima Power Station.
Project Completion Report (1992) Energy Production Project Phase III.
Project Completion Report (1992) Shoubrah El Kheimah Power Station Unit 4.
Project Completion Report (1997) Egypt: Cairo West Power Station Project

TUNISIA

Project Appraisal Report (1979) Electrification of south Tunisia (Sfax and Gafsa).
Project Appraisal Report (1981) Rural Electrification Project in the Govemates of Medenine, Gabès, Gafsa and Tozeur in Tunisia.
Project Appraisal Report (1984) Urban Electrification Project.
Project Appraisal Report (1989) Rural Electrification Project - Electricity IV.
Project Completion Report (1991) Rural Electrification Project in the Govemates of Gabes, Gafsa, Medenine and Tozeur - Electricity II.
Project Completion Report (1991) Urban Electrification Project - Electricity III.
Project Evaluation Report (Abridged) (1996) Tunisia: Rural Electrification-Electricity IV.

MOROCCO

Project Appraisal Report (1973) Extension of 150 kV and 60 kV Electricity Network in Five Regions.
Project Appraisal Report (1979) Electricity IV: Extension of 225 kV Network.
Project Appraisal Report (1981) Electricity V: Extension of 225 kV Network
Project Completion Report (1984) Electricity IV: Extension of 225 kV Network.
Project Evaluation Report (1988) Electricity IV: Extension of 225 kV Network.
Project Completion Report (1997) Electricity VII: The 225 kV, 60 kV and 22 kV Network Extension Project.

GENERAL

Energy Sector Policy (June 1994)
A Framework for Public Utility Tariff Policy (1985)

