Report No. 4135-MOR

Morocco
Power Subsector Study

March 19, 1984

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CURRENCY EQUIVALENTS

Currency Unit	= Dirham (DH)
DH 1	= 100 Centimes (cDH)
DH 5.50	= US$1 (November 1982)
DH 1	= US $0.18

WEIGHTS AND MEASURES

1 kilometer (km)	= 0.621 mile
1 ton	= 1.102 short ton (sh ton) 0.984 long ton (lg ton)
1 kilowatt (kW)	= 1,000 watts
1 megawatt (MW)	= 1,000 kilowatts (10^3 kW)
1 gigawatt	= 1 million kilowatts (10^6 kW)
1 kilowatt-hour (kWh)	= 1,000 watt-hours (10^3 Wh)
1 megawatt-hour (MWh)	= 1,000 kilowatt-hours (10^3 kWh)
1 gigawatt-hour (GWh)	= 1,000,000 kWh (10^6 kWh)
1 kilovolt (kV)	= 1,000 volts (10^3 V)
1 kilovolt-ampere (kVA)	= 1,000 volts (10^3 V)
1 megavolt-ampere (MVA)	= 1,000 kVA (10^3 kVA)

GLOSSARY OF ABBREVIATIONS

BRPM - Bureau de recherches et participations minières (Bureau of Mineral Exploration and Participation)
FEC - Fonds d'équipement communal (Communal Infrastructure Fund)
FSDR - Fonds spécial pour le développement régional (Special Regional Development Fund)
FDCL - Fonds de développment des collectivités locales (Local Community Development Fund)
HV - High voltage
LRAIC - Long-run average incremental cost
LRMC - Long-run marginal cost
LV - Low voltage
MEM - Ministère de l'énergie et des mines (Ministry of of Energy and Mines)
MI - Ministère de l'intérieur (Ministry of Interior)
MV - Medium voltage
ONE - Office national de l'électricité (National Electricity Authority)

ABSTRACT

This report identifies the major issues in Morocco's power subsector and the options open to the Moroccan authorities for dealing with them. It first reviews briefly the country's energy resources whose development may have an impact on the power subsector and recommends in particular that the Government formulate an optimal plan for the development of river basins and integrate it with the least-cost development program for power. The institutional setting of the subsector and the consequences of the fragmentation of its management are then examined, and the need for streamlining and integrating the subsector's operations is recognized. Measures to improve both demand forecasting and system planning are discussed and include inter alia, the collection of detailed data on current electricity consumption at all voltage levels, better coordination between ONE and the distribution regies in developing demand projections, an evaluation by ONE of alternative generation plans using different hydrological conditions and the corresponding sensitivity analysis, and a re-evaluation of all hydropower projects planned for 1990 and after. A detailed review of the system for electricity pricing indicates that the tariff structure is unnecessarily complicated and that tariffs are based neither on marginal costs derived from a least cost plan nor on financial objectives for the regies and ONE. An updating of the tariff study completed in 1978 is strongly recommended following the formulation of a national least-cost development program for the power subsector based on the integration of such plans for ONE and the regies. Finally, the proposed investment program for the development of the subsector between 1981 and 1985 is evaluated in the light of Morocco's current financial constraints, and recommendations are formulated to improve the efficiency of project implementation, finance the expansion of the distribution network, and reform the present system for financing hydropower projects. The need to investigate more closely the regies's operations and investment plans is highlighted and it is suggested to undertake a study of urban distribution as a follow-up to this report.

March 1984

MORROCCO

POWER SUBSECTOR STUDY

Table of Contents

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Table of Contents (cont'd)

MOROCCO

POWER SUBSECTOR STUDY

Historical Trends in the Consumption and Supply of Electricity

Table of Contents

MOROCCO

POWER SUBSECTOR STUDY

Forecast Consumption and Supply of Electricity

Table of Contents

MOROCCO

POWER SUBSECTOR STUDY

Electricity Pricing

Table of Contents

Attachments

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I. INTRODUCTION

1.01 One of the main objectives of Morocco's 1981-1985 economic plan is the implementation of policies aimed at improving the country's balance of payments position. Energy is expected to play the pivotal role in achieving the objective of the plan. The plan calls for the reduction of energy imports by: (a) rationalizing energy prices to restrain the growth of domestic demand; (b) intervening directly in the industrial processes to reduce energy consumption through retrofitting; and (c) substituting, where possible, relatively cheaper domestic or imported energy for the imported crude and petroleum products.

1.02 The power subsector in Morocco is the largest consumer of petroleum products and coal, accounting for 28% of the total commercial energy consumed (1981). As a result, the strategy for its future development, the policies adopted for pricing its output, the efficiency by which it uses energy, and the conservation by its consumers in their consumption of electricity would have a significant impact on determining whether Government energy policies achieve their objectives.

1.03 This report concentrates on identifying the major issues in the power subsector and the options open to the Moroccan authorities for dealing with them. (These are summarized in Table 1.1 below). Consequently, it should not be viewed as a comprehensive document that covers all aspects of the subsector, but as a policy-oriented document that addresses those issues which, in the view of the Bank mission, deserve immediate attention.

1.04 The report is divided in two parts. The first part provides a brief review of the setting for each issue and the recommendations of the mission compartmentalized under six chapters. The second part includes three annexes which provide more detailed support for the analysis presented in the first part.

1.05 Chapter II deals only with the energy resources whose development would have an impact on the power subsector. Therefore, greater emphasis is given to the hydropower potential, coal reserves, oil shale, and to a much lesser degree, the recent discovery of gas and its likely impact on power generation.

1.06 Chapter III presents the institutional setting of the power subsector and examines the consequences of the fragmentation of its management.

1.07 Chapter IV addresses the past trends in the consumption and supply of electricity. The detailed energy and capacity balances for the subsector and supporting data are presented as a part of Annex 1 which is intended as a more extensive review of the development of the subsector since 1975.

1.08 The forecast of energy and capacity balances for the power subsector is dealt with in Chapter V, and an assessment of the likely constraints to achieving the projected demand/supply balance is discussed.

1.09 Chapter VI considers the pricing of electricity and compares the structure and level of the prevailing tariffs with those dictated by the economic pricing of power.

1.10 Finally, Chapter VII reviews the investment plan for 1978-1980 and identifies the major constraints experienced in implementing the plan. The Chapter concludes with a detailed review of ONE's plan for 1981-1985.

1.11 The main shortcoming of the report is the absence of a section on the régies' plans for 1978-1980 and 1981-1985 due to the difficulty involved in gathering reliable information from a relatively large number of individual utilities and the lack of centralized data at the Ministry of the Interior. In order to fill the corresponding gap in our knowledge of the power subsector, the mission suggests to follow up on this report by a study focussing on urban distribution of electricity exclusively.

Table 1.1

Proposed Strategy for the Development of the Power Subsector

Issues	Objectives	Recommendations	Studies	Priority
I. ENERGY RESOURCES				
A. Hydropower				
A large number of multipurpose dams are being developed without guarantee that their development represents the optimal utilization of water resources in the country and is part of the least-cost program for the expansion of electricity generation (para 2.03).	(a) Ensure against the development of multipurpose schemes whose scale or mix of uses are not justified on economic grounds. (b) ensure against the development of marginal hydropower sites (paras. 2.03-2.04).	The Government should undertake the formulation of an optimal plan for the development of river basins and the integration of the results of this plan with the least-cost development program for the power subsector (para. 2.04).		High
II. ELECTRICITY PRICING				
(a) The level of electricity tariffs is below the economic cost of supply, particularly the capacity charge; and insufficient to ensure the financial viability of the subsector(paras. 6.08-6.11).	(a)(i) Ensure the efficient allocation of resources within the power subsector; (ii) ensure the development of ONE and the régies into financially viable public utilities (para. 6.15);	(a)(i) Formulate a national least-cost development program for the power subsector based on the integration of such programs for ONE and the régies (para. 6.15); (ii) formulate a system for gathering, classifying and integrating the data pertaining to the consumption and production of electricity throughout the country (para. 6.16); (iii) the average tariff for electricity should be gradually moved to achieved parity with LRMC (para. 6.11);	(a) Update the tariff study completed in 1978 (para. 6.16).	High
(b) the structure of electricity tariffs is still unnecessarily complicated, and existing regional differences do not reflect any significant differences in the marginal costs of supply (paras. 6.12-6.14);	(b)(i) ensure that correct price signals are given to final consumers; (ii) maintain equity and simplicity in the tariff design (para. 6.12);	(b) apply a single tariff at each voltage level and for all régies unless large differences in the marginal costs of supply are identified (para. 6.12);		Medium
(c) ONE's financial performance has deteriorated recently because: (i) it has not been allowed to pass on to consumers increases in the prices of fuels (para. 6.02); (ii) its fuel bill has increased substantially because of lower hydrogeneration due to the drought (para 6.03).	(c) restore ONE's level of internally generated cash to 20% at least and allow it to recover the cost of increased fuel prices (paras. 6.02-6.03).	(c)(i) once the restructuring of electricity tariffs is implemented, the fuel adjustment clause should be activated and ONE should be given the authority to automatically pass on to consumers all increases in its fuel bill (para. 6.02); (ii) the tariff structure should be redesigned to allow for the energy charge to be based on fuel consumption in hydrologically bad years, and a fuel fund should be created to be used for smoothing out the increases in the bulk tariffs needed to cover the increases in the operating cost following dry years (para. 6.03).		Low

Table 1.1

Proposed Strategy for the Development of the Power Subsector

Issues	Objectives	Recommendations	Studies	Priority
III. INVESTMENT AND FINANCING				
(a) Numerous restrictions and complex administrative procedures have resulted in slippages and delays in the implementation of projects (para. 7.06);	(a) Provide ONE with greater freedom of decision in operating its system and executing its development program;	(a) The Government should make the funds earmarked for the utility's investment program available in a timely and efficient manner through the establishment of a "development contract" with ONE;		High
(b) the Government's coverage of the entire cost of the hydroelectric components of multipurpose dams is inconsistent with its policy of increasing the financial autonomy of public enterprises and with the principles of efficient resource allocation (para. 7.16);	(b) ONE should be responsible for covering the cost of all equipment and share of common facilities used for the generation, transmission and distribution of electricity;		(b) undertake a study to determine the most efficient and equitable means by which ONE can compensate the Government for service provided by the hydropower components of multipurpose schemes.	Medium
(c)(i) the current system for financing the development of urban distribution discriminates against the urban poor; (ii) the development of the network is dictated by the willingness and ability of consumers to pay the high cost of initial connection and does not necessarily follow a least-cost path (paras. 7.17).	(c) ensure equity and least cost for the extension of the network.	(c) plan the expansion of the distribution network on the basis of properly formulated least-cost programs.		Medium
IV. PLANNING				
A. Demand Forecasting				
(a) ONE's forecasting approach is simply the extrapolation of past trends, modified by knowledge of short-term developments in industrial sectors (paras. 5.06-5.07);	(a) Ensure that forecasts of demand for electricity are consistent with projected social and economic development;	(a) ONE's staff should work even more closely with the Ministry of Planning and ensure that electricity demand forecasts by sector are based on up-to-date detailed and realistic economic projections;		Low
(b) forecasting the demand by LV consumers is hampered by the limited information on the LV sales and number of consumers;	(b) improve electricity demand forecasting, particularly at the low-voltage level.	(b) ONE and the régies should start collecting detailed data on the consumption and numbers of consumers supplied at LV;		
(c) the régies are insufficiently involved in demand forecasting.		(c) ONE should develop its coordinating role by providing a forum to bring all the utilities' projections together and by assisting the régies in improving their forecasting techniques.		Medium

Table 1.1

Proposed Strategy for the Development of the Power Subsector

Issues	Objectives	Recommendations	Studies	Priority
		B. System Planning		
ONE's development program includes a large number of hydroelectric projects which might overload its management capabilities; in addition, there are uncertainties as to whether they are needed to meet demand or justified economically (paras. 5.16-5.17).	Optimize hydroelectric projects.	Revaluate the power projects planned for commissioning in 1990 and after.		High
		V. ORGANIZATIONAL STRUCTURE		
(a) There is a chronic conflict between ONE and the régies on the extension of the latter's distribution perimeters (para. 3.20);	(a) Improve the efficiency of the distribution system;	(a) MEM and MI should clarify the conditions and the territory on which ONE is expected to operate and draw up a network management agreement between ONE and the communes;		Medium
(b) the existing system does not capture the potential for substantial economies of scale in the procurement of new equipment (para. 3.21);	(b) reduce costs of inventories and unify standards;	(b) establish a special committee, with representatives of both ONE and the régies, to formulate unified standards of procurement and examine means by which an inventory common to all utilities could be set up;		Medium
(c) proposals for the reorganization of the sector have not yet been formulated by the Government (para. 3.22).	(c) improve the efficiency by which the sector is managed and developed.	(c) appoint a working group to put forth recommendations on the means by which the operations of the power subsector could be streamlined.		Medium

II. ENERGY RESOURCES

A. Overview

2.01. Morocco's presently known domestic energy resources consist mainly of a large hydropower potential, a single coal deposit, some oil and gas whose reserves are currently being evaluated, large deposits of oil shale and uranium, fuelwood and solar energy. Presently, hydropower, oil and gas, coal and fuelwood are exploited commercially. The Government has recently initiated several pilot and demonstration projects to assess the potential for commercially exploiting the oil shale and solar energy; however, the contribution of these resources to the overall supply of energy in the near future is not expected to be significant. In order to continue its past efforts in accelerating the development of domestic energy resources and reducing the dependence on imported energy, the Government is preparing an overall energy plan that will integrate the development strategies for all the energy subsectors and identify national priorities. A review of energy planning and plan is discussed in more detail in the Energy Assessment Report: Morocco: Issues and Options in the Energy Sector. 1/

B. Hydropower

2.02. Morocco's hydropower potential, estimated at about 4,600 GWh per year under average hydraulic conditions, is located on the rivers Moulouya, Sebou and Oum Er Rbia. Only 40% (1,800 GWh) of that potential has been exploited, and the remaining potential of about 2,800 GWh, will be developed over the next 20 years, in two stages. The first step will involve the construction of 13 hydropower stations to tap about 2,000 GWh and should be carried out over the next 10 years given the advanced stage of the feasibility studies. The second stage will cover the development, between 1991 and 1998, of about 15 sites to harness the remaining potential of about 800 GWh; however, detailed studies need to be undertaken to establish the feasibility of the sites.

2.03. Morocco's hydropower potential would continue to be developed as an integral part of multipurpose dams because of the increasing demand for water for irrigation, water supply and power generation. The competing demands of these sectors dictate the balance of uses at the design stage in order to optimize the net benefit to the economy. However, this is a complex process because of the difficulties involved in allocating the common costs of multipurpose infrastructures between the sectors affected. Accuracy in the allocation of common costs is essential to ensuring that multipurpose schemes with marginal electric power potential are not developed by understating their

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1/ Report 4157-MOR.

share of the costs. In recognizing the difficulties involved in determining the economic mix of uses for multipurpose dams, the Government commissioned a study aimed at the preparation of an integrated plan for the development of each of the river basins. Only the plan for the Oum Er Rbia 2/ has been finalized and its first two stages implemented. Under its 1983 program the Administration de l'hydraulique is to update the plan for the Oum Er Rbia as well as undertake the studies for the development of the Sebou and Bou-Regreg rivers. In addition, a subcommittee for the development of river basins was recently established to determine the economic viability of all future projects.

2.04 If the hydropower potential is to be developed as a part of the least-cost program for the expansion of generation (thermal and hydro combined), and if each of the multipurpose dams is to be optimally developed and utilized, the plans for the development of the river basins should be completed and integrated with the least-cost plan for power. This would ensure that the development of the hydropower potential is dictated by a comprehensive plan that takes into account the optimal uses of water resources and the overall configuration of the power system. Therefore, in order to guard against the development of marginal hydropower sites, it is recommended that the Government undertake the formulation of an optimal plan for the development of river basins and the integration of the results of this plan with the least-cost development program for the power subsector.

C. Coal

2.05 Morocco's proven reserves of coal, estimated at 16 million tons, are located near Jerada. The coal has a relatively high calorific value; ranging between 5,000 kcal/kg and 7,500 kcal/kg. Annual production is estimated at about 750 thousand tons of which 690 thousand tons are used by ONE for power generation, the rest being consumed by the industrial sector. A program to partially mechanize the mine is currently being implemented and would, in a first stage, bring the annual production to 1 million tons. Part of the additional output (about 150,000 tons) would be used by ONE and the rest would go to the production of industrial steam. A target output of 2 million tons would be reached in a second stage and will require the completion of a market study. ONE counts among the potential consumers as new power plants could be adapted to burn this type of coal; they would, however, need to be installed away from Jerada as this site is severely constrained by limited water availability.

D. Oil and Gas

2.06. The known oil fields are presently almost depleted with domestic production falling to 17,500 tons in 1981 compared to 143,000 tons in 1963.

2/ SCET International (France): Plan directeur de l'aménagement de la branche Oum er Rbia, 1975.

In addition, about 78.5 million cubic meters (0.06 million toe) of gas have been produced each year during the period 1975-1981. In 1981, gas was discovered at Meskala, in the Essaouira basin, in what could potentially prove to be a significant reserve with a relatively high proportion of condensates. However, due to the variable and generally poor quality of reservoirs, and the fact that the gas extends over a large area, it is not possible to make an exact estimate of recoverable reserves before 1983 when the assessment of the reserves is completed. If the gas reserves prove to be large, the mix of fuels used in Morocco would be altered significantly, particularly the import of fuel oil and coal. In order to measure the impact of the availability of different quantities of gas on the investment configuration for the power subsector, ONE has already prepared various alternative investment plans which assume different levels of dependence on domestic gas for power generation. The projections indicate that if relatively large quantities of gas were made available to ONE, they would first be used in those power plants which have been designed for dual fire and where gas would advantageously substitute for fuel oil. Given the possibilities for converting both existing units and those under construction, ONE's gas requirements would amount to a maximum annual level of 1.5 million tons by 1990. If additional quantities of gas were made available, they would then be used in the new base load plants planned for commissioning beyond 1990 and where gas would substitute for imported coal.

E. Oil Shale

2.07. Morocco's presently known oil shale reserves are put at over 100 billion tons with an estimated oil content of about 6 billion tons. The reserves at Timahdite are the largest; estimated at about 3.3 billion tons of shale. The shale at Timahdite has already been tested for retorting, both in Morocco and abroad. In an effort to compensate for the decline in the domestic production of oil, the Government initiated an extensive program for testing and evaluating the technical and economic viability of the presently known technologies for extracting oil from the shale by retorting. The program, which is supported technically and financially by the Bank, includes the construction of a station for testing the shale, the evaluation of the various retorting processes, and the formulation of a plan for mining the shale. In parallel, ONE, in cooperation with Russian and German firms, has conducted tests and studies on the direct combustion of the shale which indicated that the Timahdite shale could be burnt in a specially designed power plant. However, because of its current financial difficulties and having set as a priority the implementation of its petroleum exploration program, the Government recently reduced its budgetary contribution to the oil shale program very substantially, resulting in the postponement of that program. In particular, the execution of ONE's plan, which involved the construction in the Timahdite area of a first shale-fired unit of 100 MW by 1985, had to be postponed until the issues of water availability, mining conditions, project feasibility and regional planning could be solved.

2.08 The Government, however, remains anxious to capitalize on the research which has already been carried out in the last few years and seems to have decided in favor of a less ambitious program for using the oil shale in power generation. The possibility of burning the shale in small units of 10-15 MW is currently being explored; the technology selected would be that of fluidized-bed combustion, which has the advantage of being environmentally safer and operationally more efficient than the conventional combustion technology. A detailed evaluation of the presently known technologies is indispensable before proceeding any further with these preliminary plans.

F. Nuclear Fuel Material and Renewable Energy Resources

2.09 Morocco's large reserves of phosphate (about 50 billion tons) are estimated to have a uranium content of 150-200 grams per ton. Extraction would, however, be uneconomic with present technology. No commercially exploitable deposits of primary uranium have so far been discovered in Morocco. Renewable energy resources are relatively abundant, mainly in the form of fuelwood, wind energy and solar radiation. Morocco's large natural forests are being overexploited, while its wind and solar energy resources are significantly underutilized.

III. ORGANIZATIONAL STRUCTURE

3.01 Morocco's power subsector is under the control of the Ministry of Energy and Mines (MEM) and the Ministry of Interior (MI). MEM supervises the operations of the Office national de l'électricité (ONE), a Government-owned utility responsible for the generation and transmission of virtually all the publicly supplied electricity in the country, and its distribution throughout the country with the exception of the main urban centers. MI oversees the operations of the publicly owned utilities entrusted with the distribution of electricity in the main urban areas (régies). In addition, MI is responsible for the formulation of the national rural electrification program whose implementation is entrusted to ONE.

A. Office national de l'électricité (ONE)

3.02 ONE was created in 1963 to take over the generation and transmission of electricity throughout Morocco. In 1981, it accounted for 90% of all the electricity generated in the country. The remaining 10% was produced by the large industrial enterprises for their own use. In addition, ONE distributes electricity at both the medium and low voltage levels in the areas not served by the régies. In 1981, ONE's sales at the medium and low voltage levels accounted for about 40 % of total sales at the distribution level.

3.03 ONE's management is supervised by a Board (Conseil d'Administration) chaired by the Prime Minister 1/. The other Board members are representatives of the Ministries of Interior, Finance, Planning, Equipment, Agriculture and Labor. These members are appointed by Royal Decree for a 3-year term which may be renewed. It normally limits itself to general policy and leaves day-to-day operations to ONE's management. ONE's Director General is assisted by a Deputy Director General to whom he delegates most of the day-to-day business.

3.04 At the end of 1981, ONE had a total of 5,766 employees of which about 1,400 were assigned to 9 regional offices for the operation and maintenance of its distribution network, including the rural distribution system. ONE has an efficient training center at Ain Sebaa (Casablanca) with about 250 places where about 400 employees are trained every year in various skills needed by the utility; trainees at all levels are required to remain a number of years in ONE's employment. This requirement was instituted in order to alleviate the problem which ONE experiences at time in recruiting suitably qualified staff. The difficulties encountered in recruiting manpower stems from two factors: (a) a phenomenon common to many enterprises in Morocco which suffer

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1/ The latter being most of the time represented by the Minister of Energy and Mines.

from the country's general shortage of technicians; and (b) the fact, more specific to ONE, that the compensation package offered to young professionals at the recruitment stage represents about 60% of what is offered in the private sector. Although these relatively low salaries are later adjusted through the allocation of substantial fringe benefits, after a minimum number of years of employment with ONE, the current wage policy hampers the rapid recruitment of well-qualified technicians when needed.

B. The Régies

3.05 The remaining 60% of the electricity sold at the low voltage level is distributed by the régies. According to their mandate, the régies are supposed to be financially and administratively autonomous enterprises, responsible, in most cases, for the distribution of water and electricity within an identified perimeter. In reality, however, the régies are tightly controlled by MI, and their finances are heavily dependent on prepayment for services by new consumers, and to a lesser degree, budgetary allocations and soft loans from the local and central governments (paras. 3.10-3.11). Régies are either communal or intercommunal. 1/ Communal régies serve a single urban center or city, and the intercommunal régies provide service to several small communities surrounding an urban center. Since the creation of the first régie at Casablanca in 1962, the number of régies has increased to reach 16 by the end of 1981. Of these, only 10 régies are involved in the distribution of electricity. The remaining six régies are, at present, only concerned with the distribution of water. 2/

3.06 The relative size of the régies in terms of total sales of electricity varies considerably. The régie of Casablanca is by far the largest; accounting for about 51% (1980) of the régies' total sales, compared to the régie of Rabat, the second largest, which accounted for only 13% of total sales, and the régie of El Jadida, the smallest, with a market share of 1%. The market shares of the régies are summarized in Table 3.1 below.

1/ The communal régies are those of Fes, Marrakech and Meknes; the intercommunal régies are those of Casablanca, Rabat, Kenitra, Tangers, Tetouan, Safi and El Jadida.

2/ These include the régies of Settat, Nador, Beni Mellal, Oujda, Taza and Agadir.

Table 3.1

Electricity Sales by the Régies in 1980
(GWh)

	Low Voltage	Medium Voltage	Total Sales	% Share in the Total Sales by the Régies	Medium Voltage As % of Total Sales
Casablanca	420	670	1,090	51	61
Rabat	164	119	283	13	42
Fes	61	104	165	8	63
Tanger	45	100	142	7	69
Meknes	36	89	125	6	71
Tetouan	35	74	109	5	68
Marrakech	56	38	94	4	40
Kenitra	25	41	65	3	63
Safi	19	21	40	2	53
El Jadida	12	11	23	1	48
Total	872	1,268	2,140	100	59

Moreover, the mix of consumers served by each régie, expressed as the ratio of sales at the medium voltage and total sales, also varies significantly; ranging from 71% for the régie of Meknes to 40% for Marrakech. The variation in the size of the régies and the mix of the customers makes the adherence to the Government's rules governing financial and administrative autonomy difficult to attain.

3.07 The right of the communes to establish their own régies has been decreed by law as part of the Government's program for decentralization (Charte Communale, 1976). The main criterion for the establishment of régies is their ability to maintain financial autonomy by covering their operating costs from the sale of water and electricity, and finance their development program without subsidy or budgetary transfers from the Government. The process of creating a new regie usually involves three steps:

(a) the expression of interest by the community which is represented either by a municipality in case of a communal régie, or by a syndicate of a group of villages and small towns in the case of an intercommunal régie;

(b) the commissioning of a feasibility study carried out by a commission composed of representatives of various ministries (interior, finance, energy and mines, equipment); and

(c) the enactment of the Government decision through a decree signed by all ministries.

The ministries must all concur before a régie is established. In practice, this requirement has not been fulfilled in all instances: the régie of Taza, and most recently that of Agadir, were established without the approval of the Ministry of Energy and Mines which has consistently resisted the creation of new régies. One of the reasons for the Ministry's opposition to the establishment of new régies is the absence of clear and satisfactory terms on which ONE would transfer its existing infrastructure to the régie. At present, ONE is supposed to relinquish to the new régie all the equipment it has installed within the perimeter of the régie, without receiving any financial compensation in return.

3.08 Each régie is managed by a board (conseil d'administration), a managing committee (comité de direction) and a management team headed by the director. Two thirds of the board is composed of representatives elected from the municipal and communal council (or the intercommunal council depending on the type of régie), and the remaining one third, of Government representatives appointed by MI. The latter group usually includes the provincial governor as well as representatives of the Ministers of Interior, Finance and Equipment. 1/ The board is responsible for the formulation of the overall investment and financing plans. The three-member managing committee is an emanation of the board and is responsible for the overall supervision of the régie and the implementation of the decisions made by the board. The régie's management is headed by the director who is appointed by MI. The director manages the daily operations of the régie under the supervision of the board and the managing committee, and is assisted by the chief engineers for the water and power departments and the manager for finance and administration (common to both water and electricity departments).

3.09 The régies rely on three sources for financing their investment programs: (a) internally generated cash; (b) Government contributions and loans; and (c) prepayment of customer connection charges (paras. 7.16-7.17). Little information is available on the contribution of each source to the financing of the régies' investment. This gap in the Bank's knowledge of the finances of the régies would be bridged through the special study on urban electricity distribution proposed in this report.

3.10 Government contributions are allocated either directly from the national budget or indirectly through the budget of the communes. These contributions are essentially local revenues collected by the central government on behalf of the local communities and redistributed back to them. The contributions are not considered as subsidies that compensate for shortfalls in the communes' or the régies' income although an element of subsidy (revenue sharing) may be implied. Direct contributions are disbursed through a special fund for regional development, "Fonds spécial pour le développement régional" (FSDR). FSDR, established in 1973 to provide relatively quick grants for the local development of communities in the least

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1/ The Ministry of Energy and Mines is represented by a non-voting member only.

developed regions, is administered by the State Secretariat for Planning. Although little information is available on the use of FSDR funds, it is estimated that FSDR has benefited the régies to a very limited extent. Subsidies from the local communes' budgets, which are financed by allocations from the national budget through the Local Community Development Fund (Fonds de développement des collectivités locales, FDCL), are also disbursed in a sparse manner because of the chronical shortage of funds available to the local communes in general.

3.11 Régies may secure loans from a communal infrastructure fund, "Fonds d'équipement communal" (FEC), which is an autonomous public corporation whose responsibility is to finance infrastructure projects needed by the communes. The FEC's sources of finance are: loans authorized and guaranteed by the Government, advances from the "Caisse de dépôt et de gestion" (which supervises FEC's operations), budgetary allocations, interest and repayment from outstanding loans, and grants from other sources. FEC lends to the régies at an interest rate of 8.5% and for periods of 8 to 10 years. Access to FEC resources is however reserved because these are regulated by creditworthiness criteria which tend to favor the wealthiest régies. In addition, the low rate of domestic private and public savings which has prevailed in Morocco for the past few years has contributed to restricting FEC sources of finance. The Government is now encouraging those régies which are financially viable to seek financing from other sources, especially by borrowing from abroad, and securing funds through supplier's credits. However, the commercial interest rates would be significantly higher than the concessionary rates that were paid by the régies in the past, and consequently, unless the Government de-controls the tariffs at the low voltage and allows tariffs to be based on a general level of self-financing for the sector, ONE is likely to end up absorbing the incremental cost to the régies of borrowing commercially (para. 6.14).

C. Isolated Systems and Autoproducers

3.12 In addition to the power generated by ONE, electricity is made available in limited quantities by isolated systems and a few autoproducers. Isolated systems, consisting of small diesel generators and rudimentary distribution networks, are installed in about 190 remote villages to provide lighting for streets and a few buildings. These installations are owned by MI and financed from its budget for municipal equipment. Daily operation is ensured by the local municipalities, while maintenance is entrusted to ONE. The quality of electricity supply in the isolated systems is poor and generally unreliable. The small diesel generators are often in poor condition, overloaded or deteriorating fast. About 30 of these isolated villages will be connected to the national grid as part of the ongoing national program for village electrification (paras. 3.15-3.16).

3.13 About 10% of the power generated in Morocco is produced by industrial enterprises which have their own generating facilities for standby reasons (mines and oil refineries) or because of specific steam generation

requirements (sugar refineries and paper mills). Their installed capacity is estimated at about 192 MW (11% of total installed capacity in Morocco) and their production amounted to nearly 500 GWh in 1980. Most of these facilities are connected to the national grid for interchange of energy; however, there is a growing tendency for those enterprises to rely on the central grid because of the continued improvement in ONE's operations.

3.14 A recent study undertaken by a Bank consultant on the potential for energy conservation in the industrial sector identified the possibility for several industrial plants to expand their autogeneration and sell their surplus production to ONE. The case was made in particular for the sugar refining industry where bagasse could be used to generate electricity. It is recommended therefore that the Government initiate a detailed study to examine possibilities for expanding cogeneration in the industrial sector, and integrate it with the preliminary load research and management study undertaken by ONE (para. 5.12). Such a study would formulate a strategy for improving the overall energy efficiency in meeting the future demand for electricity.

D. Rural Electrification

3.15 Management of the rural electrification program is the responsibility of the Infrastructural Planning Division of MI, and of ONE's distribution department, under the auspices of the Interministerial Committee for Rural Electricification (Commission interministérielle de l'électrification rurale, CIER), chaired by the Minister of Energy and Mines. Before the 15-year national rural electrification program was established in 1978, MI used to draw a list of the villages to be electrified, and the estimate of the cost of implementation was then requested of ONE. Upon receiving these costs from ONE, the MI drew a list of priority villages whose size depended on the budgetary allocation for the program and where the ranking was dictated by the socioeconomic objectives of the Government.

3.16 The overall management of the program continues to be weak because of the short-term nature of its planning cycle, the division of responsibilities between entities involved and serious shortage of staff to manage the program. These weaknesses are still prevailing despite efforts undertaken by the Government, with the Bank's assistance, in formulating a long-term program and strengthening MI's planning capabilities. The first phase of the 15-year national rural electrification program is currently being implemented, with the objective of extending electricity supply to 254 villages and with ONE acting as the executing agency. However, the project is about one year behind schedule, mainly because of delays in the disbursement of funds by the Government. In addition, the list of villages included in the first phase was established in its definite form only after a lengthy review process between ONE, the local communities, the consultant and the various ministries concerned. Therefore, in order to complete the first stage of the rural electrification program on time, it is recommended that the Government disburse funds in a timely and efficient manner. It is further recommended that, before the Government undertake the second phase of the program, the

list of villages to be electrified be carefully reviewed to ensure that it is the most economic option.

E. Administration de l'hydraulique

3.17 ONE works closely with the Administration de l'hydraulique of the Ministry of Equipment in planning the expansion of its hydrogeneration capacity. The Administration is entrusted with the responsibility for the development of river basins in Morocco and the construction of dams to meet the increasing demand for water for irrigation, water supply and power generation. The Ministry of Equipment is well aware of the need for planning the development of water resources in Morocco and recently reorganized the Administration de l'hydraulique in order to strengthen its project preparation and evaluation capabilities. Two new divisions were set up within the administration, responsible respectively for the preparation of the integrated plans for the development of river basins and for the implementation of large hydro projects. The new institutions will be in charge of establishing the economic viability of multi-purpose hydro projects. Moreover, a subcommittee for the development of river basins was created in December 1982 with representatives from ONE, the Office national de l'eau potable (ONEP), the Ministry of Agriculture and the Administration de l'hydraulique. The subcommittee, whose creation should contribute to better coordination among all entities concerned, is entrusted with the responsibility for determining the feasibility of multipurpose projects on a both technical and economic basis.

F. Intra-Sectorial Coordination

3.18 The current institutional setting of the sector, characterized by the fragmentation of responsibilities for its supervision and management, requires close coordination between the various entities involved: between MEM and MI at the policy level, and between ONE and the régies at the implementation level. Coordination is particularly essential in the areas of investment planning and load forecasting, standardization of equipment and network management. At present, however, cooperation between ONE and the régies and between the respective ministries of control is very weak. Lack of coordination results in substantial inefficiencies in the overall management of the sector.

3.19 Investment plans in ONE and the régies are drawn up independently from one another and little information seems to flow between the various entities prior to the formulation of these plans. The régies are required by ONE to provide data on projected demand in their respective areas of distribution; however, the quality of the data furnished varies widely from one régie to another, and in general does not reach the level of reliability which would allow ONE and the régies themselves to plan their investments in an optimal fashion. Moreover, investments by ONE and the régies are not

systematically matched in time, nor in terms of individual projects so that duplication or delays in their execution may occur at times. In addition, there is no guarantee that the overall investment program for the distribution of electricity is least cost (para. 6.14).

3.20 Management of the network also suffers from the present sectorial organization. Complaints are regularly voiced by the régies about ONE's lack of cooperation in meeting the régies' allegedly unforeseeable increase in demand for ONE's electricity and the technical impossibility for ONE to meet it. This is actually the result of the régies' reluctance to participate in the financing of investments required to meet growing demand and in the execution of the related projects. Thus, in addition to the issue of establishing new régies (para. 3.07), there is a chronic conflict between ONE and the existing régies on the extension of the latter's distribution perimeters. A similar problem keeps on reoccurring between ONE and the communes where generator sets are managed in a more or less adequate fashion by the commune staff and maintained by ONE. It is recommended therefore that MEM and MI clarify the terms on which ONE is expected to operate and draw up a network management agreement between ONE and the communes, in order to enhance the efficiency of the distribution system.

3.21 Another area where the absence of intrasectorial coordination is leading to substantial diseconomies of scale is the procurement of new equipment. At present, the purchase of equipment for the extension of the distribution network is done separately by each institution (ONE and each of the 10 régies) and there is no standardization in the equipment purchased. Consequently, each utility carries its own inventories with the corresponding financial burden that this entails. It is recommended therefore that a special committee, with representatives of both ONE and each régie, be established, in order to formulate unified standards of procurement and examine means by which an inventory common to all utilities could be set up.

3.22 All these problems have been recognized by the Bank as early as 1976 (Loan IBRD 1299-MOR) and the Government was requested to undertake a study for the reorganization of the sector. The study was completed by EDF (France); however, its recommendations were not accepted by the Government because it emphasized the need for centralizing responsibilities for the distribution of electricity under the authority of ONE. In 1978, the Government appointed an interministerial committee to review in detail the recommendations of EDF's study and bring them in line with the institutional setting of Morocco. No report has yet been submitted to the Government by the committee. Since the reorganization of the sector would involve MI and MEM as well as the communes and the central government, it is expected that it would take a relatively long time to reach consensus among all those concerned, on the committee's possible recommendations. In the interim, however, there is an urgent need for the Government to take some measures which would improve the efficiency by which the sector is managed and developed. These measures would cover the formulation of least-cost development plans and the financing of investments. It is therefore recommended that the Government appoint a working group that would put forth recommendations on the means by which the operations of the power subsector could be streamlined and better coordinated. Simultaneously,

the Bank which so far has not been successful in tackling the sectorial organization issue could assist the Government in dealing with specific measures to improve the subsector's organization through its lending operations.

IV. HISTORICAL TRENDS IN THE CONSUMPTION AND SUPPLY OF ELECTRICITY

A. Past Trends in Electricity Consumption

Overall Consumption of Electricity

4.01 Electricity consumption increased during the period 1970-1980, at an average annual rate of 9.6% while maximum demand increased at an average annual rate of about 8.8%. Table 4.1 below summarizes the changes since 1970 in the consumption of electricity, maximum demand and the average load factor. Rapid growth of industrial electricity consumption, and stagnation or decline in access of households to supply explains other trends which occurred in the demand for electricity. On a per capita basis, gross national electricity consumption grew from 138 kWh in 1970 to 262 kWh in 1980, corresponding to an average rate of 6.6% per year. Despite the high proportion sold to industry, per capita consumption of electricity remains relatively low in comparison to other countries in the region. This reflects, to a large extent, the very low degree of electrification in rural areas, where only 6% of the population has access to public electricity supply.

Table 4.1

Growth in Electricity Demand, 1965-1980

	1970	1975	1980	Annual Rate of Growth (%) 1970-1975	1975-1980
Electricity Consumption (GWh)	2,108	3,269	5,247	9.2	9.9
Interconnected System					
Gross Generation (GWh)/1	1,957	3,038	4,762	9.2	9.4
Maximum Demand (MW)	384	596	910	9.2	8.8
Load Factor (%)	48.3	58.7	61.6		

/1 Including production by Electras Morroquies and purchases.

4.02 Electricity consumption per dollar of GDP 1/ increased at an average annual rate of about 4%; from 525 kWh/US$1,000 in 1970 to 783 kWh in 1980. The increase in the intensity of electricity consumption is primarily attributed to the expansion of the industrial, agricultural and service sectors. This was responsible for the fairly high elasticity of electricity consumption with respect to GDP which averaged 1.8 for the period 1970-1980.

1/ Measured in 1970 prices.

Electricity Consumption by Economic Sector

4.03 The sectoral consumption of the publicly supplied electricity is shown in Table 4.2 1/ below. Among the major sectors of the Moroccan economy, public administration had the highest rate of growth, followed by services, industry, and agriculture. There was a decline in the share of transport and mining, from 22% of total electricity sold in 1970, to 16% in 1980. The extension of irrigated areas, in addition to the 1980-1981 drought which increased irrigation requirements, resulted in the consumption of electricity by agriculture growing at an average annual rate of about 12.8%.

Table 4.2

Sectoral Consumption of Electricity
(Public Supply System)

	1970		1980		Annual Rate of Growth (%) 1970-1980
	GWh	%	GWh	%	
Agriculture	49.0	3.0	163.6	4.1	12.8
Mining	252.1	15.7	482.0	12.2	6.7
Industry	529.1	32.9	1,439.8	36.4	10.5
Services	60.7	3.8	203.4	5.1	12.9
Transport	104.0	6.5	160.0	4.0	4.4
Public Administration	38.1	2.4	187.8	4.7	17.3
Residential & Commercial	402.5	25.1	983.5	24.9	9.4
Others /1	170.0	10.6	334.9	8.5	7.0
TOTAL	1,605.5	100.0	3,955.0	100.0	9.4

/1 Includes public lighting, energy, and water distribution.

4.04 The overall sectoral consumption of electricity presented in Table 4.2 does not take account of autogeneration in the industrial, mining, and agricultural sectors. Net consumption by autoproducers 2/ is estimated to have increased from 134 GWh in 1970 to 463 GWh in 1980; representing an average annual rate of increase of about 13.2%. Thus, the consumption of electricity generated by the autoproducers grew at a slightly higher rate than the consumption of publicly supplied electricity by the industrial and mining sectors. As a result, the proportion of all industrial electricity supplied by autoproducers rose from 20% in 1970 to 22% in 1980. By contrast, the growth of consumption by the agricultural sector of publicly supplied

1/ Excluding autoproducers, isolated systems run by the Ministry of Interior, and others for which no sectoral breakdown is available.
2/ Excluding station use and sales to ONE.

electricity was higher than the rate of growth of electricity produced by the isolated systems, reflecting mainly the preference of consumers for electricity provided at subsidized tariffs to autogenerated electricity using diesel oil whose price has been brought in line with its border price since 1976.

4.05 Detailed data on the consumption by industry of publicly supplied electricity shows considerable variation in the consumption pattern of the various industrial subsectors (Annex 1, para. 5). The changes in the rates of growth over the period 1970-1980 is a clear indication of Morocco's industrial strategy over the 10-year period, and the emphasis on electricity-intensive industries. Chemicals, construction materials, cement and engineering equipment had the highest rates of growth in electricity consumption over the last five years of the decade; ranging from 31% for chemicals to 12.7% for engineering equipment. The increased consumption of electricity by the transport sector, particularly rail, since 1975 reflects the substitution in the public transport system of electricity for high-value petroleum products in response to higher oil prices.

4.06 Consumption by the residential and commercial sector remained at about 25% of total electricity consumption (Annex 1, para. 6). Although no breakdown between households and commerce is available, it appears that access to supply did not improve much during the second half of the 1970s and may actually have decreased. This decline, or at best, lack of improvement in access to public supply of electricity has been a consequence of the policies for financing the extensions of the distribution networks (para. 7.17). Initial consumers are responsible for financing in part, facilities that are subsequently used by others.

Distribution of Final Electricity Sales between ONE and the Regies

4.07 ONE has been able to continuously increase its share of the market relative to the share of the régies (Annex 1, para. 10). The increase in ONE's share is primarily due to the direct service extended to the growing industrial sector; the decline in the rate at which the régies connect new low-voltage consumers relative to the pace maintained by ONE in extending its service; and the extension of ONE's distribution network in the rural areas. ONE's direct sales to final consumers now account for 46% of total electricity sales in Morocco, compared to 44% in 1970.

B. Past Trends in the Supply of Electricity

Generation

4.08 ONE's generating capacity has increased substantially over the past ten years, from 532 MW in 1970 to 1,560 MW in 1981; representing an average annual rate of increase of about 10.3%. Since 1970, the bulk (71%) of the new capacity was provided by the installation of new thermal generating facilities, mainly oil-fired steam power plants. The greatest increases in oil-fired capacity occurred between 1975 and 1979. As a result, by the end of

1981, ONE's installed capacity consisted of 613 MW of hydroelectric capacity located for the most part on the Oum Er R'bia river and 947 MW of thermal units, including 735 MW of steam power plants and 120 MW of gas turbines. Details are provided in Annex 1, Attachments 1 and 2.

4.09 The available capacity fluctuated considerably during the period 1975-1981 because of the variations in hydrological conditions and their impact on the production potential of the hydro power plants (Annex 1, Attachment 4). 1/ Average capacity available at peak during 1975-1981 was 73% of installed capacity for hydro and 80% for thermal plant. Since peak demand has increased steadily since 1970 from 380 MW to 960 MW in 1981, the effective reserve margin has ranged between 56 MW and 204 MW equivalent to 6% and 23% of maximum demand respectively. However, the absolute margin of installed capacity to demand has been much higher, ranging from a minimum 30% in 1976-1977 to a maximum of 63% in 1981 (Annex 1, para. 12).

4.10 Total generation by ONE reached 5,099.6 GWh in 1981, compared to 1,908 GWh in 1970, which represents an average growth of 9.3% per year. The share of thermally generated electricity has increased substantially during the last 15 years reflecting the steady shift by ONE toward increased dependence on thermal capacities for electricity supply (Annex 1, para. 13). Thermal facilities produced about 79% of total electricity generated by ONE in 1980, compared to only 11% in 1965. Hydro production fell as low as 20% in 1981 because of the drought. Production by autoproducers was mainly from thermal plants and represented about 10% of total electricity generation for the country.

4.11 ONE power station use in 1980 amounted to 1.8% of gross generation for the hydro plants and 8.6% for the thermal plants. Losses in transmission, amounted to 7% of energy delivered to the network. These losses are relatively high, reflecting the slippages in ONE's program for the reinforcement and expansion of the national transmission network (para. 7.05). Distribution losses were 2.8% for the ONE system and 6% for the régies, which seem low. Nationally, it is estimated that about 16% of electricity generated was either used by the power stations for their own needs, or lost in transmission and distribution. The level of losses at each of the stages involving the production, transport and delivery of electricity cannot be determined accurately because of inadequate data on the areas served by the régies. Reduction of losses is one of the main means for abating the increase in the cost of electricity. It is recommended therefore that a study be undertaken for determining losses at each voltage level in the public system and to propose a set of actions for reducing them.

1/ Actual hydro generation may vary within a 30% margin around the average, depending on the year's rainfall.

4.12 As seen from Table 4.3, since 1970, the growth in the share of oil-fired thermal power stations in ONE's generating system has resulted in an increased dependence on fuel oil which is either imported directly or produced locally from imported crude oil. (Details are provided in Annex 1, para. 16.)

Table 4.3

Distribution of Power Generation by Primary Energy Source
(ONE)

	1970		1980		1981	
	GWh	% Share in Total	GWh	% Share in Total	GWh	% Share in Total
Coal	557.4	29	980.0	21	1,190.1	24
Fuel Oil	--	--	2,180.8	47	2,863.9	56
Gas Oil/Diesel	34.2	2	5.7	--	21.7	--
Hydroelectricity	1,316.4	69	1,514.6	32	1,023.9	20
TOTAL	1,908.0	100	4,733.1	100	5,099.6	100

NOTE

-- = Negligible (less than half a percentage point).

While practically all the electricity generated in 1970 was produced using domestic resources (coal or hydropower), this share has dropped to about 50% in 1980 and because of the drought, to an even lower level in 1981. The balance was met by generating power in steam plants burning fuel oil.

Transmission

4.13 The transmission network has been extended and improved in line with the expansion of system generating capacity. The 225-kV grid is progressively replacing the former 150-kV system. A 60-kV subtransmission network transports energy to the distribution system at 22 kV. A plan for interconnecting the Moroccan system to the Algerian one has been contemplated for several years now. This interconnection would contribute to a more economic utilization of generation facilities in both countries and therefore, the Government should give serious consideration to initiating the link since it would make possible the reduction of the stand-by capacities in the two systems.

V. FORECAST CONSUMPTION AND SUPPLY OF ELECTRICITY

A. Growth of the Economy

5.01 Morocco's economy experienced a relatively slow rate of economic growth over the period 1978-1980 as a result of strict fiscal and monetary policies implemented by the Government to stabilize the economy. During this period, GDP increased in real terms at an average annual rate of 3.8%. According to Bank staff projections, GDP would grow at an average rate of about 4.5% for the period 1981-1985 and accelerate slightly to 5% for the period 1985-1990. Value added in agriculture is expected to grow at 5.5% per year from 1981 to 1985, and at 2.5% thereafter, as recovery from the 1981 drought would spread over several years. The growth of the industrial sector is projected to be low in 1982, but to rise afterwards, so that it could reach, in real terms, an average annual rate of about 4.7% for the period 1981-1985, and 5.5% for 1985-1990. The higher growth rate of industry in 1981-1985, compared to the one achieved in 1977-1980 (2.3%), is expected because of the size of planned industrial investments. If the gas reserves currently being assessed prove as large as expected, gas production in the middle 1980's would stimulate further the growth of the industrial sector. In the case of the service sector, value added in transport, commerce and services is expected to follow the increased demand arising from agriculture and industry. However, the projected reduction in Government consumption should induce a slowdown in the overall growth rate of the service sector to 4.2% per year from 1981-1985, compared to 5.2% for 1977-1980. The historical and projected growth rates of the main sectors of Morocco's economy are presented in Table 5.1 below:

Table 5.1

Historical and Projected Real Growth Rates for the Main Sectors of Morocco's Economy /1
(%)

	Actual	Projected	
	1977-1980	1981-1985	1985-1990
Agriculture	7.2	5.5	2.5
Industry	2.3	4.7	5.5
Services	5.2	4.2	5.5
GDP	3.8	4.5	5.1

/1 World Bank projections.

B. Future Electricity Demand

5.02 The future demand for electricity was examined using income and price elasticities for the main categories of consumers, estimated from historical observations. The long-run elasticity of domestic electricity consumption per consumer with respect to real per capita expenditure was estimated to be about 1.2, while the long-run price elasticity was -0.1. This indicates that demand is more influenced by changes in real per capita expenditures than by changes in real electricity prices. Since real electricity prices did not rise during the period over which the elasticities were estimated, the actual response of consumers in Morocco to higher electricity tariffs should therefore be higher than estimated. Studies in other countries indicate that price elasticities may be higher when prices are rising than when they are falling. Nevertheless, in the short to medium term, increases in electricity prices to LV consumers to align them with marginal costs, are unlikely to lead to large losses in the potential income of utilities.

5.03 Analysis for the mining and services sectors where consumption was related to real GDP for the sector and real electricity prices produced the following elasticities:

	Mining	Services
Income elasticity - short run	0.50	1.30
- long run	1.60	1.70
Price elasticity - short run	-0.09	-0.06
- long run	-0.30	-0.08
Coefficient of determination (R^2)	0.97	0.98

These results indicate that net output has had the dominant effect on demand. Services respond to changes in net output or electricity prices faster than mining, which is to be expected, given the lumpy capital stock of the mining industry.

5.04 Lack of adequate data and its aggregated nature made it difficult to accurately estimate the elasticities for industry. Preliminary results indicate a long-run GDP elasticity for industry of about 1.7. This analysis of the relationship between electricity consumption and the factors which influence it has produced promising results. However, there is a need to acquire better data on electricity consumption, and to estimate a wider range of models. The results to date indicate that demand is relatively insensitive to price, and that incomes or output tend to dominate demand.

5.05 The demand forecast derived from the analysis presented above projected a global electricity demand consistent with the demand forecast prepared by ONE in 1981 for the entire subsector. According to ONE's projections, maximum demand and gross generation are projected to grow at an annual average rate of 9% until 1990, which represents a slight decline in the rate of growth in the 1980's, compared to the 1970's.

Table 5.2

Forecast Consumption of Electricity by Economic Sector, 1980-1990

	1980 (Actual)		1985		1990		Annual Rate of Growth (%)	
	(GWh)	(%)	(GWh)	(%)	(GWh)	(%)	1980-1985	1985-1990
Agriculture and fishing	163.5	3	295	4	520	5	12.5	12.0
Mining	482.0	10	620	8	785	7	5.2	4.8
Food processing	247.5	5	380	5	570	5	9.0	8.5
Textiles	273.6	6	365	5	480	4	5.9	5.5
Chemicals	215.5	5	335	5	515	5	9.2	8.4
Cement and construction materials	442.7	9	820	11	1,480	13	13.1	13.0
Other manufacturing	314.0	7	440	6	610	5	7.0	7.0
Water supply	188.0	4	290	4	440	4	9.1	9.0
Trade, hotels, and services	203.4	4	440	6	940	8	16.7	16.5
Railways	106.6	2	130	2	155	1	3.6	3.5
Radio, TV, Army, and Government	187.8	4	310	4	495	4	10.7	10.0
LV sales /1	1,130.4	24	1,635	22	2,385	21	7.7	7.9
Total sales	3,955.0	83	6,060	83	9,375	83	8.9	9.1
Losses & station use	807	17	1,265	17	1,890	17	9.4	8.4
Gross generation	4,762	100	7,325	100	11,265	100	9.0	9.0
Maximum demand (MW)	855		1300		2,000		8.7	9.0

/1 LV consumers are mainly residential, but also include small consumers in other categories, e.g. shops, offices, schools, post offices, etc.

The forecast of sales by consumer group presented in Table 5.2 (details are provided in Annex 2, Attachment 1) shows that private and public services, cement and agriculture are expected to have the highest rates of growth. Railways, textiles and mining are forecast to have the slowest growth rates. The proportion of electricity sold at LV is expected to decrease slightly from 24% to 21% of gross generation. Station use and transmission and distribution losses are expected to remain constant at 17%.

5.06 Improvements to Electricity Demand Forecasting: Assuming the projected rates of growth for the major sectors of the economy, ONE's forecast

of overall electricity sales seems reasonable. However, substantial improvements could be made to the methodology used. The approach adopted by ONE is essentially the extrapolation of past trends, modified by knowledge of short-term developments in industrial sectors. It would however be necessary to check that medium-term electricity demand forecasts are consistent with projected economic development in each subsector and to obtain a rational basis for projecting longer-term demand. Forecasting the demand by LV consumers is hampered by the limited information available on the LV sales and the number of consumers (Annex 2, para. 10). Moreover, in forecasting demand by household consumers, no explicit account is taken of the relationships between the number of domestic electricity consumers and population growth, household formation and access to supply (Annex 2, para. 11). Nor is the effect of household income, energy prices, and weather conditions on the consumption of electricity in a household taken into consideration (Annex 2, para. 12).

5.07 In order to improve electricity demand forecasting and ensure that forecasts are consistent with projected social and economic development, it is recommended that: (a) ONE's staff work even more closely with the Ministry of Planning to ensure that electricity demand forecasts by sector are based on up-to-date detailed and consistent economic projections; (b) ONE and the régies start collecting detailed data on the consumption and numbers of consumers of households and various service, industrial and other subsectors supplied at low voltage; and (c) ONE develop its coordinating role by providing a forum to bring all the utilities' projections together and by assisting the régies in improving their forecasting techniques.

C. Future Electricity Supply

5.08 ONE is responsible for all generation and transmission planning. It is also responsible for distribution planning in the areas it serves. Ultimately, ONE requires the approval of MEM for its investment program. The régies are responsible for most of the distribution planning in Morocco. Little information is available at the Bank on their investment plans. However, it is known that régies tend to prepare investment budgets for the year ahead and that at least one régie prepares a five-year plan of capital expenditures. This chapter covers generation planning only, because of the lack of information on distribution plans.

Future Generating Capacity

5.09 ONE does not plan to commission any new plant on the interconnected system until 1984-1985 when two additional 150-MW units will be completed at the Mohammedia steam station. Unlike the existing 2x150-MW units at Mohammedia which burn fuel oil, the new units will burn imported coal. No further thermal plant is planned except for a 4x250-MW steam station burning imported coal to be commissioned in 1993. Annex 2, Attachment 2 shows projected thermal capacity until 1990.

5.10 ONE is planning an ambitious program of hydro development. Four stations are planned for commissioning in the 1980s with a total capacity of 451 MW (Annex 2, para. 17). Another 16 hydroelectric stations, with a total capacity of 1,215 MW, are planned for 1990-1994. Four more stations are proposed for 1995-1996 which will add a further 169 MW to the system (Annex 2, Attachments 3 and 4). Almost all of Morocco's surveyed hydro potential will be exhausted after the planned development program has been completed. ONE then proposes to commission a 600-MW nuclear power station towards the late 1990's to meet base load demand and has initiated contacts with the International Atomic Energy Agency (IAEA) for assistance in the preparation of its nuclear program. In addition, an agreement was recently signed with Sofratome (France) to carry out a study on the feasibility and the location of the first nuclear plant. Many of the proposed hydro projects are part of multipurpose schemes which are primarily intended for irrigation, water supply, or flood control. Most of the projects are small, and their energy (GWh) output would be small in relation to their capacity. In a mean hydrological year, only 7 out of the proposed 25 projects will have a load factor greater than 15%. This raises an issue as to the role of hydro in future system development and the optimization of station size (paras. 5.14-5.17).

5.11 As seen from Table 5.3 below which summarizes the balance of demand and capacity, the hydro program described above will result in hydro capacity increasing from nearly 40% of total installed capacity at present to almost 54% in 1990. The proportion of thermal plant will continue to increase to 68% in 1985 and then decline. The gross reserve margin, is forecast to fall from its highest for many years of 43% in 1981, to 31% in 1985 and 23% in 1990.

Table 5.3

Planned Generating Capacity
(ONE Interconnected System)

	--Actual---		--------Planned--------			
	1981		1985		1990	
	(MW)	(%)	(MW)	(%)	(MW)	(%)
Hydro	604.2	39	616	32	1,286	50
Thermal	949.4	61	1,305	68	1,305	50
of which: Steam	784.0	50	1,185	62	1,185	46
Gas Turbine and Diesel	165.4	9	120	6	120	4
TOTAL	1,553.6	100	1,921	100	2,591	100
Maximum Demand	880		1,330		2,000	
Gross Reserve Margin	43%		31%		23%	

5.12 No information is available on any planned increases in the capacity of autoproducers. ONE plans its system on the basis of no import from autoproducers since the sale of surplus energy by autoproducers is not guaranteed. However, there may be scope for increasing the level of imports, particularly if industrial peak demands occur at a different time to the interconnected system peak. Further savings could be made by using purchases to reduce gas turbine generation. Given that autoproducers have almost 200 MW of plant capacity, ONE should review its existing contractual arrangements with autoproducers with the view to integrating them further into the interconnected system. ONE should examine particularly the methods of charging for purchases and sales to ensure that both parties are given the correct marginal cost signals and incentives to supply each other at both peak and off peak times. In April 1983 ONE undertook a sectorial survey with the purpose of collecting data on the structure of electricity consumption by the industrial sector. The survey should contribute to determining the opportunities for some industries to shift their unessential demand from peak to off-peak periods and thus for ONE to defer new capacity. It is recommended, however, to ensure that this preleminary load research and management study be accompanied by a review of ONE's contractual arrangements and, in particular, of its tariffs to industrial consumers.

5.13 The forecast of electricity consumption which serves as a basis for planning the expansion of ONE's generating capacity assumes that station use, and transmission and distribution losses would remain at their present level of 17% (para. 5.05). The data collection exercise to be undertaken for the proposed tariff study (para. 6.16) should permit to determine more accurately the sources of the high losses in the public systems and identify ways by which these losses could be reduced. Capacity cost savings could in turn be achieved by deferring the need to install new capacity. A rough calculation shows that a reduction in losses from their present level of 17% to about 12% in 1990 would save about 140 MW of additional capacity.

Future Production of Electricity

5.14 In its generation planning studies, ONE formulates its investment plans under the assumption that the most adverse hydrological conditions would persist over the entire planning horizon. This analysis is undertaken to ensure that sufficient supply of energy will be available under the worst possible case for hydropower generation. In addition, ONE also determines the outputs of generating units and their cost of operation under mean hydrological conditions (Annex 2, para. 21). According to ONE's forecast of generation, the share of hydrogeneration during years of average hydrology will rise to 27% of total energy available in 1985, and to 31% in 1990, as a large number of hydropower sites are developed. Thermal generation will fall to about 73% of available supply in 1985, and to 69% in 1990. Towards the end of the 1980's, about one third of total electricity generation by ONE will be supplied by hydropower plants, another third by coal-fired steam stations, and the last third by oil-fired steam stations. The contribution of gas turbines and small diesel plants will be minimal.

5.15 Under poor hydrological conditions, however, where hydrogeneration could be reduced by as much as 40%, the shortfall of energy available would be mainly supplied by oil-fired steam plants and by gas turbines. The margin of spare energy available in a dry year above the projected demand for energy will amount to about 33% in 1985, which suggests that there will be no problem in supplying energy; meeting peak demand will thus be the most important constraint. Thereafter, the margin will fall to 0% in 1990. However, the margin of available energy does not include support from autoproducers or bringing back plant from cold storage, which could raise the 1990 margin to over 5%.

Optimization of Hydro Projects

5.16 Most hydro schemes in Morocco are multipurpose, and have been appraised in the past by taking the decision to build the dam as given and regarding the incremental power plant costs as an input to the least cost power development plan. This approach would be correct if the decision to construct a multipurpose project to a stated design on a particular site was in fact independent of the power aspects of the project. In practice though, the power requirements will influence the choice of site, dam height, etc. (Annex 2, para. 25). There may be some hydro projects worth undertaking for the power benefits alone. For these projects, it is necessary to firstly identify the sites and secondly to rank them in terms of economic attractiveness. It is recommended, therefore, that the Administration de l'hydraulique, in collaboration with ONE, establish an inventory of potential hydro sites based on a methodology for determining their optimal use (Annex 2, para. 26). These projects should then be ranked and integrated with thermal power projects in a least cost generation development plan.

5.17 ONE plans to commission 25 hydroelectric stations during the ten years 1986-1996. Even though many of these projects are small, their manpower requirements will be similar to a much larger station with the same number of generating units. A large training program will be required to man these stations adequately. At present such a program does not exist. Furthermore, constructing this number of projects will be likely to overload the management resources involved in design, procurement, and construction. For these reasons, as well as the uncertainty as to whether the hydro plant is needed to meet demand, or justified economically, it is recommended that ONE revaluate, in a more detailed fashion, the power projects planned for commissioning in 1990 and after, to ensure that the longer term development plan is the least-cost solution.

VI. ELECTRICITY PRICING

A. Historical Review

6.01 As seen from Table 6.1 below, the average tariff paid by ONE's high and medium voltage consumers increased, in nominal terms, at an average annual rate of about 11.5% during the period 1972-1981. In real terms, however, the increase was substantially lower averaging only about 4%. By contrast, the tariff paid by the low voltage consumers increased, in nominal terms, at an average annual rate of about 7.3%, but remained unchanged in real terms. The failure of the low voltage tariff to reflect the real increase in the bulk supply tariffs resulted in the erosion of ONE's level of internally generated revenue, and in turn, the level of its contribution to the overall cost of its development program (para. 6.02).

Table 6.1

Average Electricity Tariffs (ONE), 1972-1981
(cDH/kWh)

	Low Voltage Tariff				High, Medium Voltage Tariff				Index for the General Price Level /1
	Current	1972 Prices			Current	1972 Prices			
Year	Prices	cDH/kWh	Index	/1	Prices	cDH/kWh	Index	/1	
1972	31.1	31.1	100		11.0	11.0	100		100
1973	32.5	31.3	101		11.0	10.6	96		104
1974	33.3	31.1	100		11.7	10.9	99		107
1975	34.2	31.1	100		11.9	10.8	98		110
1976	39.1	31.0	100		14.1	11.2	102		126
1977	45.9	31.0	100		17.2	11.6	106		148
1978	49.5	31.1	100		19.7	12.4	113		159
1979	51.1	31.2	100		23.0	14.0	127		164
1980	55.5	31.2	100		25.3	14.2	129		178
1981	58.8	31.6	102		29.2	15.7	143		186

/1 1972 = 100

6.02 During the period 1972-1979, ONE's financial performance fluctuated between extremes; that is, for some years ONE managed to cover all of its operating costs and contribute from internal sources between 25% and 30% of the overall cost of its development program, and for the other years, its internal cash contribution dropped to less than 5%. This fluctuation has been primarily attributed to the delays by the Government in adjusting the tariffs for higher fuel prices, and the fact that a large proportion of ONE's

electricity supply depends on hydroelectric plants, and in turn, on the level of rainfall (para. 6.03). Since 1979, ONE's financial position has been steadily deteriorating because of the substantial increases in its fuel bill and the delays by the Government in reflecting these increases in the tariffs. As seen from Table 6.2 below, over the three-year period, the fuel cost per kWh increased by about 167% and non-fuel cost by about 27%, while the average revenue increased by only 32%.

Table 6.2

ONE's Average Operating Cost and Revenue
(cDH/kWh)

	1979	1980	1981	Percentage of Change (1979-1981)
Average Operating Cost				
Fuel	8.1	11.3	21.6	167
Others	8.2	8.6	10.2	24
Depreciation	6.5	6.4	5.2	-20
Total	22.8	26.3	37.0	62
Average Revenue	24.4	27.0	32.1	32

Moreover, despite the fact that 1980 was a dry year and 1981 was exceptionally dry, which increased ONE's dependence on thermally generated electricity, increases in the bulk tariffs were less than needed to cover the rise in its cost of operation. As a result, ONE's net operating income decreased from about DH 112 million in 1979 to DH 87 million in 1980, and a loss of about DH 129 million in 1981, and its internal cash contribution decreased from 21% in 1979 to only 9% in 1981. The Government had earlier agreed to the inclusion of a fuel adjustment clause in ONE tariff structure; however, as seen from the discussion above, ONE has been prevented from putting it into operation. 1/ In order for ONE to recover the cost of higher fuel prices and maintain the level of its internally generated cash unaltered, it is recommended that, once the program for the restructuring of electricity tariffs (para. 6.15) is implemented, the fuel adjustment clause be activated and that ONE be given the authority to automatically pass on to consumers all increases in its fuel bill.

6.03 The large contribution of the hydropower plants to ONE's total electricity production increases the vulnerability of its financial position to changes in the hydrological conditions. In years with above average rainfall, the utility manages to reduce its operating costs by decreasing

1/ The introduction of a fuel adjustment clause is a covenant under IBRD Loan 1299-MOR.

thermal generation, and in turn, its fuel bill. In dry years, however, fuel consumption increases, and if the financial position is to remain intact, upward adjustment in the tariffs are needed to cover the unexpected increase in the fuel bill. At times, these adjustments could be fairly high, and frequently, socially and politically impractical to apply; particularly if several dry years occur in sequence. Deficits in internal cash generation in dry years may be difficult to finance, or upset the financing of new investment. A possible approach to offsetting the financial risks of a dry year would be to base the energy component of the tariffs (price/kWh) on the level of fuel consumption that would prevail under adverse rather than mean hydrological conditions. 1/ This would avoid the need for frequent and disproportionately large increases in tariffs, and would allow for the creation of a fuel fund which would be replenished during the years of good or average hydrological conditions, and used to smooth out the adverse impact on ONE's finances during the hydrologically poor years. Therefore, it is recommended that the Government and ONE consider the redesign of the tariff structure to allow for the energy charge to be based on the fuel consumption in hydrologically bad years, and the creation of a fuel fund to be used for smoothing out the increases in the bulk tariffs needed to cover the increases in the operating cost and maintain the utility's internal cash contribution at a relatively stable level following hydrologically bad years.

B. Institutional Responsibilty for Tariffs

6.04 ONE is responsible for proposing global tariff adjustments to compensate for increases in its operating costs due to higher fuel prices and to ensure, to the extent possible, a minimum cash generation ratio. However, the actual rate of increase and its distribution among various consumers are decided upon by the Prime Minister upon ONE's proposal. Tariffs are then set for each voltage level, each consumer category, and each distribution régie. It is worth mentioning that tariffs applied to the régies, both for purchases and sales of electricity, are set so as to leave the financial position of the régies unaltered, i.e., to maintain the net operating income of the régies at the level that prevailed prior to the tariff adjustment.

6.05 The practice for setting tariffs results in differences in the rates paid by the régies for electricity supplied by ONE. These differences are dictated by the financial position of the régies, and since large and well established régies, such as Casablanca, Rabat, etc., are usually in a relatively better financial position than the smaller or new régies, such as El Jadida and Safi, the large régies cover part of the difference between the rate requested by ONE and the rate finally paid by the subsidized régies. The rest of the difference is covered by ONE. Moreover, by ensuring that the financial positions of the régies remain unaffected by the increases in the bulk and retail tariffs, the régies are not induced to improve their operating efficiencies or their internal cash generation (para. 7.16).

1/ A detailed review of the principle is presented in Annex 3, paragraph 4.

6.06 These practices result in serious departure from the principles of economic pricing of electricity. Economic pricing dictates that tariffs be set at levels that convey to consumers the real cost to the economy of the resources used in meeting their demand for electricity. Adopting these principles would result in the elimination of the current practices for setting bulk tariffs primarily on the basis of the financial targets of the régies and indirect cross-subsidization among them. They should be replaced by a system where tariffs are based on the average incremental cost of supply derived from a unified national least-cost program (generation, transmission, and distribution for both ONE and the régies). This is discussed in greater detail in para. 6.15.

C. Level of Existing Tariffs

6.07 The present level of tariffs is compared here to the marginal cost of electricity supply as estimated by the World Bank for different voltage levels. These estimates are based on ONE's medium-term investment program (1983-1990) as it was submitted to the Bank in February 1982; assumptions used to calculate marginal costs are presented in detail in Annex 3, attachment 3. The results obtained by the Bank are somewhat different from the figures estimated by ONE, particularly for the capacity costs. ONE's estimates, however, are based on a study carried out in 1979 and updated for fuel price adjustments only. The marginal cost estimates thus obtained do not reflect changes in ONE's long-term development program. It is, therefore, recommended that ONE carry out a complete update of this study.

Bulk Supply Tariffs

6.08 Energy components in the bulk supply tariffs covering the sale of electricity by ONE to the régies and large industrial consumers are, on the average, equal to, and in some cases higher than, the marginal cost for energy (Annex 3, para. 14). On the other hand, the capacity component is set substantially lower than the average incremental cost of the resources used. Table 6.3 below compares the bulk supply tariffs and the economic cost of supply (energy and capicity charges) for selected régies and industries.

Table 6.3

Comparison Between Bulk Supply Tariffs and Economic Costs
(prevailing charges as a % of economic costs)

Tariff	Max Demand (DH/kVA/Year)	Energy (cDH/kWh) Day	Night
Economic Cost	844/739 /1	37.5	32.1
Casablanca	60	43.1	34.5
(largest régie)	(7)	(115)	(108)
Meknès	62	44.6	35.7
(highest bulk tariff)	(7)	(119)	(111)
El Jadida	52	37.0	29.6
(lowest bulk tariff)	(6)	(99)	(92)
Industry	173	40.2	32.2
(main MV system)	(23)	(107)	(100)

/1 Régies/industry assuming a power factor of 0.8 and coincidence factors of 0.9 for régies and 0.7 for industry.

Retail Tariffs

6.09 Medium Voltage. At the medium voltage level, the relationship between the two components of tariff (energy and capacity charges) and their economic costs is similar to that of the bulk supply tariffs. As indicated by Table 6.4 below, capacity charges are in the order of 9% of the economic cost, while energy charges are about 30% to 40% above the marginal cost of energy.

Table 6.4

Comparison Between MV Tariffs and Economic Costs
(prevailing charges as a % of economic costs)

Region	Max Demand (DH/kVA/Year)	Energy (cDH/kWh) Day	Night	Total /2 (cDH/kWh)
a. Economic cost	1,295 /1	39.1	33.4	83.9
b. Tariff	110	55	44.0	56.2
	(9)	(141)	(132)	(67)

/1 Based on a 0.8 power factor and a coincidence factor of 0.75.
/2 Assuming a 40% load factor and day/night kWh 75%/25%.

6.10 Low Voltage. It is difficult to compare the LV tariffs to economic costs because of the lack of data on consumer load characteristics.

Residential and commercial consumers in Casablanca, as well as small industrial consumers, pay an average tariff that is slightly higher than half of the economic cost. LV consumers in some of the areas served by ONE pay as much as 70% of the economic cost. On the average, however, LV tariffs are well below the economic costs of supply. The Government control over the increases in the low voltage tariff since 1972 has maintained the real price of electricity to the households and small commercial consumers virtually unchanged while allowing the tariffs for bulk sales to increase in real terms by about 43% (para. 6.01). This has had the effect of lowering the internal cash generation of the subsector, mainly ONE, and increasing the dependence of the subsector on budgetary allocations to finance the development programs of the régies and ONE. The budgetary contribution by the Government represents a compensation to the subsector for subsidies that are passed on to consumers. In particular, the Government subsidizes the LV consumers to maintain households' expenditures on energy at a reasonable level relative to their income; particularly for the low income groups. However, the extension of subsidy for electricity to all the LV consumers is unjustified on both economic and social grounds. The subsidy for the large LV consumers (households and commercial consumers) lowers the average price of electricity which encourages their uneconomic use of electricity and denies the Government the resources which could otherwise be mobilized, if the LV tariffs reflected the economic cost of supply. Subsidy for the electricity consumption of the low income consumers could be accommodated by introducing a system involving a two-tier tariff for electricity: a subsidized tariff for a minimum level of consumption needed to meet the electric energy needs for basic lighting and household needs; and a tariff that is at or above the economic cost for consumption above the minimum level.

6.11 Economic pricing is essential for the efficient use of electricity, particularly in view of the recent efforts by the Government in bringing the domestic prices for petroleum products in line with their cost to the economy. Maintaining tariffs below economic cost distorts the price of electricity relative to the competing fuels and results in their use in a sub-optimal mix. Therefore, in order to maintain the price of electricity, relative to the competing fuels, at a level that would ensure their efficient use, and given the potential resources that could be mobilized by pricing electricity on the basis of economic cost, it is recommended that the Government gradually move the average tariff for electricity to achieve parity with the LRMC. The optimal strategy for moving the tariffs upwards would be dealt with in the tariff study proposed below (para. 6.16).

D. Structure of Existing Tariffs

Bulk Supply Tariffs

6.12 Although some features of the bulk supply tariff structure are consistent with the principles of economic pricing of electricity, the regional differences in ONE's bulk supply tariffs do not reflect differences in the cost of supply. Unless there is strong evidence of substantial

differences in transmission costs, each régie should face the same tariff for supply at the same voltage. Differences in the costs of connecting a régie to the main system, which are unique to that régie, could be levied as annual fixed charges. This could also serve as the vehicle for any cross-subsidization to achieve regional equity. Fixed charges could be calculated to make up any difference between income derived from a bulk supply tariff set equal to marginal cost and ONE's financial requirements. As this would effectively be a tax on the régie, régies in established areas could pay higher fixed charges in relation to their size than régies expanding their networks. Alternatively, if the income from a marginal cost based bulk supply tariff exceeds ONE's financial requirements, tariffs should continue to be set equal to economic cost to ensure efficiency, and a mechanism established for transferring the surplus accruing to ONE to a fund that would finance the development programs of the régies; for example, the FEC would be ideal for managing such a fund. It is therefore recommended that a single tariff for bulk supply be applied for all régies, unless large differences in the marginal costs of supply are identified, in order to ensure that correct price signals are given to final consumers, and that principles of equity and simplicity are included in the tariff design.

Retail Tariffs

6.13 Medium Voltage: The structure of MV tariffs charged by the régies is consistent with the marginal costs of supply. In addition, the structure of ONE's MV tariffs is also largely consistent with the structure dictated by LRMC.

6.14 Low Voltage: The existence in the tariff schedule of five consumer classifications for LV tariffs for each régie and ONE does not appear unreasonable, although the definition of some consumer groups should be examined in the proposed tariff study (para. 6.15). There is scope for a considerable reduction in the number of tariffs by grouping together consumers with similar cost structures. Different tariffs should apply at a particular voltage level only where differences in marginal cost can be identified. The optimal number of consumer categories and the definition of each with respect to the cost of supply would be addressed in the tariff study. Moreover, the block sizes in the present domestic tariff are defined according to the number of rooms in the household. Although electricity consumption is highly correlated with the number of rooms, their contribution to the system peak will depend also on the number of lights switched on and their ratings. Other appliances, the ownership and use of which is likely to be related only remotely to the number of rooms, will also contribute to peak demand. This definition of kWh block size distorts the marginal cost message given to consumers. It also leads to administrative problems in changing tariffs when consumers add rooms to their home. The proposed tariff study should define the consumption blocks on the basis of kWhs consumed rather than the number of rooms in the consumers' households (para. 6.10). Finally, differences in the LV tariffs among régies are justified if tariffs are to reflect the cost of supply and the financial target of each régie. However, the large number of regional variations in ONE LV tariffs has been substantially reduced after the last tariff increase of December 1982 for the purpose of greater efficiency and equity.

E. Strategy for New Electricity Tariffs

6.15 Although many aspects of the tariff structure are consistent with marginal costs, the present tariffs are based on financial rather than economic criteria. On economic grounds, tariffs should be based on a properly formulated least-cost development plan and financial targets that would ensure the development of the régies and ONE into self-financing public utilities. To achieve this objective, ONE and each régie should first formulate least-cost development programs from which the economic cost of electricity could be determined. Then, long-term financial targets should be set for ONE and the régies in order to ultimately evolve towards a satisfactory level of self-financing for the power subsector. However, in view of the difference in the financial positions of the régies and the recent deterioration in ONE's self-financing capabilities, a strategy should be set for gradually achieving the long-term financial objective over a relatively long period of time, to avoid the need for unrealistically high increases in tariff over the next 2 to 3 years. The time horizon for achieving self-financing could be adjusted for each régie to accommodate the need for a longer time horizon for newly created utilities to achieve the targeted level of internal cash generation. Therefore, in order to ensure the economic and efficient use of electricity and provide sufficient funds needed for the development of the subsector from the internal sources of the utilities, it is recommended that the government formulate a national least-cost development program for the sector based on the integration of such programs for ONE and the régies, and set tariffs at levels that would reflect the economic cost of supply while ensuring the gradual move of the power subsector towards self-financing.

6.16 Under Loan 1299-MOR, the Government undertook a study of the energy sector which included, among other things, a tariff study based on marginal cost pricing. The study set the principles on which all subsequent tariff adjustments have been based and have contributed to bringing about the much needed reforms and simplifications in the tariff structure. However, in view of the changes that have taken place since the tariff study was completed in 1978, and given the fact that the study concentrated its analysis on ONE's development program rather than an integrated program for the entire power subsector, the Government should update the tariff study. A major problem in updating the study is expected to be the lack of data that is detailed enough to allow for an accurate estimate of the economic cost of supply. Most, if not all, régies suffer from poor quality data on their consumers' patterns of electricity consumption. A consistent system for gathering and classifying data from all the utilities in the power subsector is urgently needed. This system could be in place in a relatively short period of time because some of the data covering the régies are presently available at the régies' data center in Cassablanca. The new data would serve as a basis for the formulation of a least-cost development plan for the power subsector, and in turn, the estimation of the long-term average incremental costs (LRAIC) and electricity tariffs. Therefore it is recommended that the Government consider the formulation of a system for gathering, classifying and integrating the data pertaining to the consumption and production of electricity throughout the country, and the use of this data for updating the tariff study completed in 1978. Annex 4 (para. 26) lists the areas to be covered in the proposed data collection exercise.

VII. INVESTMENT AND FINANCING

7.01 As discussed in Chapter III, the major weakness of the subsector is the fragmentation of its management between ministries and entities between which coordination is, in most cases, minimal. The weakness in coordination between ONE and the régies is reflected in the absence of a national least-cost development program that identifies investment priorities and serves as a means for mobilizing financial resources for its implementation. ONE provided the mission with an accurate account of its investment plans. The mission was unable to gather similar information for the régies. Consequently, this section of the report is limited to the review of ONE's investment planning. The absence of similar coverage for the régies is but another example of the gap in the Bank's knowledge of the urban distribution. Bridging this gap will be given high priority and would be undertaken through a specific study on urban electricity distribution.

A. ONE's Investments During the 1978-1980 Development Plan

General Program

7.02 Total planned investments by ONE under its general program (programme général) for the period 1978-1980 amounted to about DH 2,280 million (US$ 550 million). The development of generation was expected to account for about 75% of the total investment, transmission another 18%, distribution 3%, and the rest was to cover the cost of buildings and technical equipment for the offices, laboratories and workshops. However, by the end of 1980, DH 2,041 million was disbursed; representing about 90% of the planned investment. In addition, there was marked departure from the originally planned allocation with the share of generation increasing from 75% of total planned investment to 82% of the actual. The increase in the share of generation was at the expense of transmission which decreased from 18% of planned investment to 14% of the actual. Table 7.1 below compares ONE's planned and actual investment for the period 1978-1980.

Table 7.1

ONE's Investment Program for 1978-1980
(DH million)

	Planned		Actual		Actual/Planned
	Amount	% of Total	Amount	% of Total	(%)
Hydro generation	419	18	396	19	94.3
Thermal generation	1,305	57	1,288	63	98.7
Total Generation	1,724	75	1,684	82	97.6
Transmission	402	18	277	14	68.9
Distribution	60	3	38	2	63.0
Others	93	4	42	2	45.0
TOTAL	2,280	100	2,041	100	90.0

Generation has had the highest rate of success with 98% of the planned expenditures disbursed, followed by transmission with 69%, distribution with 63%, and finally, the category covering all other aspects of the development program with actual outlays amounting only to 45% of their planned figure. In addition to investments included in the general program undertaken and partly self-financed by ONE to meet increases in future demand, a number of other programs are implemented by ONE which acts as an executing agency and for which it does not contribute financially. These investments amounted to about DH 302 million for the 1978-1980 period and were distributed as follows:

	DH Million
- Special Fund	36
- Rural Electrification	27
- Customer Connections	239

7.03 ONE's investments under its general program were financed by the Government, loans and supplier's credits, and the utility itself. The sources of financing for the program are summarized in Table 7.2 below.

Table 7.2

Sources of Financing for ONE's 1978-1980
Investment Program
(DH million)

Source	Amount	% of Total
Government	566	28
Loans & supplier's credits	1,135	55
ONE	340	17
	2,041	100

ONE's contribution-to-expansion ratio, as computed according to a Bank loan covenant (IBRD Loan 1299-MOR) dropped to about 9% in 1980 from 22% in 1979 and 24% in 1978. This significant drop was caused by: the substantial increase in the utility's fuel bill brought about by the Government's decision to bring the domestic prices of petroleum products and coal in line with their opportunity cost to the economy; and the unexpected increase in the overall fuel bill, resulting from the fact that 1980 was a relatively dry year which reduced the contribution of ONE's hydroelectric plants to the overall supply of electricity and forced the utility to increase its dependence on thermal power plants. However, the reluctance of the Government to allow ONE to pass on all increases in its fuel bill to its customers was the main reason for the erosion in ONE's level of self-financing.

7.04 The contribution of the Government to the overall cost of ONE's investment program, amounting to DH 566 million, represents about DH 0.050/kWh or a 20% increase in the average tariff for the 3-year period. This would have been in addition to the increases needed to compensate ONE for the increased cost of fuel. The analysis shows that complete financial independence of ONE (financial autonomy) could have been achieved between 1978 and 1980 with a relatively modest yearly increase in the utility's average tariff. This would ensure the financial autonomy of ONE and mobilize resources from the consumers, and release a sizeable amount of the national budget for the non-revenue earning sectors.

7.05 In spite of the fact that 90% of the overall planned expenditures were disbursed, the projects included in the 1978-1980 plan had, in most cases, slipped, and their date of completion and the financing of their cost overruns are now included in the plan for 1981-1985. The dependence of ONE on Government funds for implementing its development program and the delays in the disbursement of these funds have been primarily responsible for both the slippages in implementing the investment program, and most of the resulting cost overruns experienced. The delays in the disbursement were particularly severe for the multipurpose projects which involved several ministries and entities, each with its own budgetary constraints and priorities. Details of project implementation under the 1978-1980 plan is summarized below:

Generation: The expansion of ONE's generating capacity included the completion of three hydroelectric projects (Idriss I, Al Massira, and Oued El Makhazine), the expansion of an existing hydro power plant (Lalla Takerkoust), the installation of four gas turbines, and the construction of the 4x75-MW steam power station at Kenitra and of the 4x150-MW fuel-fired plant at Mohammedia. Delays were incurred in the execution of the hydropower projects (Al Massira, Lalla Takerkoust), and in the construction of the Mohammedia plant. These resulted in some significant cost overruns; ranging between 5% and 25% (Lalla Takerkoust 25%, Al Massira 11.2%, etc.).

Transmission and Distribution: The program for the expansion of the transmission network was significantly curtailed, with less than 70% of the planned expenditures actually disbursed; primarily because of a shortage of funds. The reduction was even greater in the case of the distribution program financed by ONE (63%) and the category

covering buildings and specialized equipment (45%). This has actually been a recurring trend in the implementation of ONE's investment programs. Contrary to initial plans, most of the scarce funds actually made available go to the expansion of ONE's generating capacity, leaving insufficient resources for the reinforcement and extension of the rest of the power facilities.

7.06 The review of ONE's investment program for 1978-1980 made possible the identification of the main constraints or bottlenecks to the timely and efficient implementation of the development program. These are:

(a) Erosion in ONE's Level of Internal Cash Generation: The Government's control of tariffs and the continued increase in the cost of fuel used for power generation, coupled with the hydrologically dry years, resulted in a significant deterioration in ONE's ability to maintain a healthy level of internal cash generation. As a result, a relatively efficient revenue-earning utility has moved from an adequate level of self-financing of more than 20% in 1978 and 1979 to 9% in 1980. This increased its competition with the non-revenue earning public entities for the scarce revenues of the Government. This bottleneck could be resolved by allowing ONE to activate the fuel adjustment clause in its tariff structure and allow the utility to pass on to its consumers all increases in the cost of fuel. In addition, the elimination of control over tariffs and indirect subsidies to the régies at the expense of ONE's finances, and the creation of a fuel cost stabilization fund would go a long way in smoothing the increases needed by ONE to cover unexpected increases in its cost of operation and providing the funds needed for the implementation of its development program;

(b) Organizational Control of ONE: According to its mandate, ONE is supposed to be a financially and administratively autonomous enterprise. In reality, however, the utility is beset by administrative regulations and controls which affects the efficiency of its operations. Procurement laws restrict ONE's acquisition of material and services to a maximum of DH 50,000 (US$9,000) and DH 500,000 (US$90,000) respectively. Otherwise, permission of the Ministry of Finance is required which is usually granted after considerable delays. Disbursement by the Government of funds for projects undertaken by ONE in cooperation with other ministries and institutions, involves in most cases, concurrence by the Ministry of Finance and all ministries involved. These concurrences are usually marked with delays because of the complexity of the administrative procedure. If the plan for 1981-1985 is to be implemented efficiently and cost overruns to be avoided, the Government should take all the necessary steps to ensure that the administrative autonomy of ONE is guaranteed and that the funds allocated from the national budget for its development program are provided at the beginning of each fiscal year and placed under the full disposal of the utility.

As stated earlier (para. 6.02), ONE's financial autonomy should be ensured by removing the control over tariffs, the activation of the fuel adjustment clause, the creation of a fuel fund, the elimination of indirect subsidies to the régies and gradually moving the utility towards an acceptable level of self-financing. These are long-term measures whose implementation would take time. In the interim, however, it is recommended that the Government reduce the administrative restrictions and complex procedures to provide ONE greater freedom of decision in operating its system and executing its development program, and make the funds earmarked for the utility's investment program available in a timely and efficient manner to ensure against slippages and delays in the implementation of projects. Such measures, which would implicitly lead to a radical change in Morocco's system of public enterprises' financial control, could be introduced more smoothly through the establishment of a special "development contract" with ONE in the same manner as is being implemented with Royal Air Maroc (RAM) which aims at substituting a system of management by objectives for the present strict a priori Government financial control.

B. Planned Investment in the Power Subsector, 1981-1985

7.07 ONE's planned investment for 1981-1985, included in its general program, amounts to about DH 3,932 million (US$710 million), 1/ of which about 50% (DH 2130 million, or US$385 million) will be in direct foreign exchange cost. Relative to the overall investment program planned for the energy sector as a whole, it represents the largest investment, or about 55% of the total. The allocation of ONE's planned investment is summarized in Table 7.3 below.

Table 7.3

ONE's Investments, 1978-1980 and 1981-1985
(DH Million)

	1978-1980		1981-1985	
	Amount /1	% Share in Total	Amount /2	% Share in Total
Generation	1,684	82	2,877	73
Transmission	277	14	620	16
Distribution	38	2	160	4
Others	42	2	275	7
Total	2,041	100	3,932	100

/1 In current terms.
/2 In 1981 prices.

1/ In 1981 prices.

About 73% of these investments will be allocated to the expansion of the generating capacity, which represents a slight decrease in its share of total investment as compared to the previous plan period (82%). This is offset by an increase in the relative share of transmission which will rise from less than 14% during 1978-1980 to 16% between 1981 and 1985, of distribution (from 2 to 4%) and of other investments (from 2 to 7%).

7.08. The investment program presented in Table 7.3 excludes: (a) the sector's contribution to the joint costs of multi-purpose hydroprojects (according to Morocco's five-year plan, the construction of dams is classified under the Ministry of Equipment's investment program); and (b) investments undertaken by the régies to develop their urban distribution networks. Very limited information is available on the régies' investment programs which, in most cases, are established on a short-term basis, contrary to ONE's programs. Further investigation into each régie's planning is necessary to obtain an estimate of their yearly investment in electricity distribution facilities, covering both the reinforcement and extension of their respective supply networks, and to determine how they fit into ONE's expansion program, and whether they represent a least-cost development program. Most of the data could be collected under the electricity tariff study proposed in Chapter VI. Moreover, the investment program presented in this chapter for the 1981-1985 period does not take account of the changes currently under way as a result of Morocco's financial difficulties.

Generation

7.09 The program for the expansion of the generating capacity consists of:

(a) The development of 6 hydroelectric sites, 5 of which are multipurpose projects (para. 5.10). Total expenditures during 1981-1985 will amount to about DH 713 million, equivalent to 25% of the proposed investment in generation; this amount might, however, be reduced due to the postponement by 6 months to 2 years of three of the 6 projects;

(b) The completion of the 4x150-MW steam power plant at Mohammedia, including the conversion to dual-fired operations of the last two units coming on stream in 1985. Total outlays will reach DH 1,124 million, of which DH 890 million corresponds to the cost of the coal conversion;

(c) The initiation of an oil shale direct combustion program with the construction of a 100-MW pilot power station at Timahdite with a total cost of about DH 2,300 million, of which DH 1,000 million would be disbursed between 1981 and 1985. However, given the recent Government decision to substantially reduce its budgetary contribution to the financing of the oil shale program, it is most likely that ONE will defer its investment expenditures beyond 1985.

Transmission

7.10 Investment outlays for the extension of the transmission network are expected to reach about DH 620 million (US$115 million) between 1981 and

1985. Beside the connection of Mohammedia to the national grid, the main thrust of the investment program is the reinforcement and extension of the 225-kV network through the addition of 1,052 km of lines which will mainly be used to transport electricity from Mohammedia to the load centers in the south. The 60-kV transmission system will also be expanded through the installation of 1,540 km of new lines, part of which will come from the downgrading of 150-kV lines.

Distribution

7.11 Investments included in the general program for distribution amount to about DH 160 million (US$ 29 million) between 1981 and 1985. Most of the budget will cover the reinforcement and extension of the 22-kV distribution network.

7.12 In addition, ONE plans to invest about DH 1,023 million under its other programs. About DH 330 million is expected to cover the cost of connecting new customers to ONE's supply system. ONE's objective is to reach a 75% urban electrification ratio by 1990 with the connection of 250,000 additional customers to public electricity supply. The rest will be devoted to rural electrification through the implementation of three programs:

(a) ONE's special fund program (DH 138 million) which consists essentially of the much needed maintenance, reinforcement and extension of its distribution network in the rural areas in order to improve the quality of service to its customers;

(b) The program for the electrification of the Saharan provinces which is executed by ONE on behalf of the Government. This program is expected to cost about DH 105 million over a three-year period starting in 1982; and

(c) The national program for rural electrification which, under its first phase, is expected to connect 254 villages to the national grid at an estimated cost of DH 450 million. Initiated in 1977 by MI which requested Bank assistance for its formulation and financing (IBRD Loan 1695-MOR), it is currently being implemented, with ONE acting as the executing agency. The program is however about 1 year behind schedule, mainly because of the slow space of disbursement of Government funds and of the delays incurred in establishing the list of villages to connect.

Overall, ONE plans to double the number of its LV consumers before the end of 1990 with the connection of 700,000 new customers in both urban and rural areas.

Buildings and Technical Equipment

7.13 About DH 275 million (US$50 million) are budgeted for additional works to be undertaken by ONE, of which the construction of a dispatching center constitutes the largest investment.

C. Financing Plan for the 1981-1985 Program

7.14 It is estimated that about 37% of the overall investment program will be financed out of the national budget, 39% from external borrowings and 20% from domestic borrowings. ONE would contribute about 4% from its internally generated cash, and the balance of about 12% would be covered by customers' contributions. Table 7.4 below summarizes the share of each financial source in the planned investment program.

Table 7.4

Financing Plan for the 1981-1985 Investment Program /1
(DH million)

	Amount	% Share in Total
Government	1,455	37
External Borrowings	1,533	39
Domestic Borrowings	786	20
ONE	157	4
TOTAL	3,932	100

/1 In 1981 prices.

7.15 The Government plans to continue its coverage of the cost of the hydroelectric components of the multipurpose dams from budgetary allocations extended through the Ministry of Equipment. Although this approach to financing some of ONE's new hydroelectric plants has a favorable impact on the utility's financial position, it is inconsistent with the Government's recent policy of increasing the financial autonomy of public enterprises to reduce their burden on the national budget. It also adds further to the complex financial environment in which ONE operates with controlled tariffs, indirect subsidies to the régies at the expense of ONE and the large régies, and equity transfers to ONE at the expense of the already overstrained budget. On the pricing side, ONE should be entrusted with the determination of its own tariffs to cover its operating costs and provide the desired level of internal cash generation. On the cost side, ONE should be responsible for covering the cost of all equipment and share of common facilities used for the generation, transmission and distribution of electricity. However, this responsibility should only cover the cost of facilities which are a part of ONE's least-cost program. It is, therefore, recommended that the Government undertake a study for determining the most efficient and equitable means by which ONE can compensate the Government for the service provided by the hydropower components of multipurpose schemes. The study should allow for the formulation of a gradual strategy for ONE's achievement of financial autonomy which could, however, be implemented only after ONE's financial viability has been restored and electricity tariffs have been sufficiently increased.

7.16 A large proportion, even higher than that provided to ONE, of the development programs of the régies is covered by the Government through two channels: budgetary allocations disbursed through MI; and concessionary loans from the Fonds d'Equipment Communal (FEC) (para. 3.10). As in the case of ONE, the Government is foregoing a substantial amount of resources to provide funds for the development programs, which are not necessarily least cost from the national point of view, and whose finance could be secured by capturing some of the surplus accruing to the low and medium voltage consumers. The prevailing law, which ensures the neutrality of the effects of new tariffs on the financial positions of the régies, is inconsistent with the Government's policy for fiscal austerity because it does not provide the incentives to the régies to achieve a greater level of self-financing or improve the efficiency of their operations. Although the régies are supposed to be financially autonomous utilities, their financial objectives are not clear (no set targets for self-financing), and the concept of autonomy is not associated with a fixed level of internal cash generation. Consequently, the level of self-financing for the régies fluctuates from one year to the next; depending on the number of new consumers connected, the success of the management of each régie in securing soft loans from the FEC, and the Government. Moreover, the régies are not induced to improve their efficiency because the law ensuring the financial neutrality of changes in tariffs, reduces the régies to being transmitters of changes initiated by ONE to the ultimate consumers; almost as would exist in a system where electric service is provided on a cost plus basis. Therefore, if the régies are to improve their technical and operating efficiencies, and move towards financial autonomy, it is recommended that the Government start by requiring each regie to formulate a least-cost investment program, and integrate these programs and that of ONE into a national development program for power, then eliminate the indirect subsidies to the small régies, and finally set financial targets that would gradually be adjusted upwards to ensure that all utilities are financially viable.

7.17 Customer contributions constitute an important element in the financial resources of both ONE and the régies. Customer contributions are in essence a prepayment for equipment and material used to connect new consumers. The rules governing the payment by new consumers require that they cover the total cost of the facilities needed for their supply of public electricity. All new customers are required to pay connection charges before service is provided. In the case of a small consumer (domestic), the entire charge must be paid before work begins in extending the service. In the case of a large consumer (industrial), the connection charge can be paid in four or less installments (depending upon the utility and the nature of the new consumer). In both cases, the customer is expected to prepay for all costs (equipment, lines, additions to transformer capacity, etc.) that will be incurred by the utility in providing the service. Prepayment for the domestic consumer is required and at least 60% (depending upon the régie) of the domestic customers living in a development to be provided with power must ask for the service and prepay before work to service the development begins. If a large consumer requires the expansion of facilities for his exclusive use, the total cost incurred by the utility must be prepaid by that customer. Later on, if the facilities are used by other customers during a qualifying period (five years for the medium voltage and ten years for the low voltage),

the customer is reimbursed a segment of his connection charge proportional to the ratio of the magnitude of the service to be received by the new customers and the maximum potential service paid for by the first customer. This process continues until the facilities are fully utilized. The consumer loses the right to any reimbursement, if within the qualifying period the facilities are not used by additional customers. This system for financing the development of urban distribution has two main shortcomings. The first is that it discriminates against the urban poor who usually settle around the perimeters of the urban centers. The consumers are usually unable to afford the initial payment for distribution facilities, and as a result, unable to gain access to public supply of electricity. This is reflected by the fact that the percentage of urban population with access to electricity has been steadily declining over the past 10 years. The second shortcoming of depending on consumer contributions for financing distribution is that the development of the network does not follow a least-cost path, but instead, is dictated by the willingness and ability of consumers to pay the high cost of the initial investments. If the distribution network is to be developed in accordance with a least-cost plan, and considering the adverse impact the prevailing system has from the point of view of equity within a consumer category (low voltage urban), it is recommended that the Government consider the expansion of the distribution network on the basis of properly formulated least-cost programs. Recommendations for a reform of the connection charge system could only be formulated once a detailed investigation of the urban distribution of electricity is carried out, as proposed in this report.

March 19, 1984
(0781P)

MOROCCO

POWER SUBSECTOR STUDY

Historical Trends in the Consumption and Supply of Electricity

A. Past Trends in Electricity Consumption

Overall Consumption

1. Electricity consumption increased during the period 1970-1980, at an average annual rate of 9.6% while maximum demand increased at an average annual rate of about 8.8%. Table 1 below summarizes the changes since 1970 in the consumption of electricity, maximum demand and the average load factor. Rapid growth of industrial electricity consumption, and stagnation or decline in access of households to supply explains other trends which occurred in the demand for electricity. On a per capita basis, gross national electricity consumption grew from 138 kWh in 1970 to 262 kWh in 1980, corresponding to an average rate of 6.6% per year. Despite the high proportion sold to industry, per capita consumption of electricity remains relatively low in comparison to other countries in the region (Algeria: 307, Tunisia: 364, Jordan: 445, Egypt: 455 kWh). This reflects, to a large extent, the very low degree of electrification in rural areas, where only 6% of the population has access to public electricity supply.

Table 1

Growth in Electricity Demand, 1965-1980

	1970	1975	1980	Annual Rate of Growth (%) 1970-1975	1975-1980
Electricity Consumption (GWh)	2,108	3,269	5,247	9.2	9.9
Interconnected System					
Gross Generation (GWh) /1	1,957	3,038	4,762	9.2	9.4
Maximum Demand (MW)	384	596	880	9.2	8.8
Load Factor (%)	48.3	58.7	61.6		

/1 Including production by Electras Marroquies and purchases.

2. Electricity consumption per dollar of GDP 1/ increased at an average annual rate of about 4%; from 525 kWh/US$1,000 in 1970 to 783 kWh in 1980. The increase in the intensity of electricity consumption is primarily attributed to the expansion of the industrial, agricultural and service sectors. This was responsible for the fairly high elasticity of electricity consumption with respect to GDP which averaged 1.8 for the period 1970-1980.

Electricity Consumption by Economic Sector

3. The sectoral consumption of the publicly supplied electricity is shown in Table 2 2/ below. Among the major sectors of the Moroccan economy, public administration had the highest rate of growth, followed by services, industry, and agriculture. There was a decline in the share of transport and mining, from 22% of total electricity sold in 1970, to 16% in 1980. The extension of irrigated areas, in addition to the 1980-1981 drought which increased irrigation requirements, resulted in the consumption of electricity by agriculture growing at an average annual rate of about 12.8%. In 1981 which was an extremely dry year, the electricity consumption of the agricultural sector increased by 55%, most of which was for irrigation pumping.

Table 2

Sectoral Consumption of Electricity
(Public Supply System)

	1970		1980		Annual Rate of Growth (%)
	GWh	%	GWh	%	1970-1980
Agriculture	49.0	3.0	163.6	4.1	12.8
Mining	252.1	15.7	482.0	12.2	6.7
Industry	529.1	32.9	1,439.8	36.4	10.5
Services	60.7	3.8	203.4	5.1	12.9
Transport	104.0	6.5	160.0	4.0	4.4
Public Administration	38.1	2.4	187.8	4.7	17.3
Residential & Commercial	402.5	25.1	983.5	24.9	9.4
Others /1	170.0	10.6	334.9	8.5	7.0
TOTAL	1,605.5	100.0	3,955.0	100.0	9.4

/1 Includes public lighting, energy, and water distribution.

4. The overall sectoral consumption of electricity presented in Table 2 is understated because it does not take account of autogeneration in the

1/ Measured in 1970 prices.
2/ Excluding autoproducers, isolated systems run by the Ministry of Interior, and others for which no sectoral breakdown is available.

industrial, mining, and agricultural sectors. Net consumption by autoproducers /1 is estimated to have increased from 134 GWh in 1970 to 463 GWh in 1980; representing an average annual rate of increase of about 13.2%. As seen from Table 2 above, the consumption of electricity generated by the autoproducers grew at a slightly higher rate than the consumption of publicly supplied electricity by the industrial and mining sectors. As a result, the proportion of all industrial electricity supplied by autoproducers rose from 20% in 1970 to 22% in 1980. By contrast, the growth of consumption by the agricultural sector of publicly supplied electricity was higher than the rate of growth of electricity produced by the isolated systems, reflecting mainly the preference of consumers for electricity provided at subsidized tariffs to autogenerated electricity using diesel oil whose price has been brought in line with its border price since 1976.

5. Detailed data on the consumption by industry of publicly supplied electricity shows considerable variations in the consumption pattern of the various industrial subsectors. Table 3 provides a summary of the consumption by type of industry. Details are presented in Attachment 7.

Table 3

Consumption of Electricity by Economic Subsector (GWh)
(Public Supply System)

Subsector	1970	1975	1980	Annual Rate of Growth (%) 1970-1975	1975-1980
Mining	252.1	414.6	482.0	10.5	3.1
Phosphates	142.9	225.4	298.5	9.5	5.8
Coal	31.9	41.7	46.8	5.5	2.3
Other	77.3	147.5	136.7	13.8	-1.5
Industry	578.1	828.4	1,507.2	7.5	12.7
Engineering	19.7	34.2	78.4	11.7	18.0
Cement	110.7	162.0	339.5	7.9	15.9
Chemicals	40.3	55.9	215.5	6.8	31.0
Food Processing	126.1	168.0	247.5	5.9	8.1
Textiles	123.5	183.1	273.6	8.2	8.4
Construction and Construction Materials	31.4	39.2	103.2	4.5	21.4
Others /2	126.4	186.0	249.5	8.0	6.1
Transport	104.0	113.0	160.0	1.7	7.2
Rail	73.3	74.9	106.6	0.4	7.3
Other	30.7	38.1	53.4	4.4	7.0

/1 Excluding station use and sales to ONE.
/2 Others include glass and ceramics, leather, wood, paper, plastics, and industries supplied at low voltage.

The changes in the rates of growth over the period 1970-1980 is a clear indication of Morocco's industrial strategy over the 10-year period, and the emphasis on electricity-intensive industries. Chemicals, construction materials, cement and engineering equipment had the highest rates of growth in electricity consumption over the last five years of the decade; ranging from 31% for chemicals to 12.7% for engineering equipment. The increased consumption of electricity by the transport sector, particularly rail, since 1975 reflects the substitution in the public transport system of electricity for high-value petroleum products in response to higher oil prices.

Electricity Consumption by Households

6. Little reliable information is available on the consumption of electricity by households and their access to supply. Electricity sales to households is divided between the régies and ONE. As the régies report to a different ministry, the responsibility for gathering data to cover the entire subsector is lacking. Estimated numbers of household consumers and their consumption are shown for ONE and three régies in Table 4. Since 1975, the annual rate of growth in the number of household consumers has averaged between 4.0% and 4.8%, depending on the utility. This is compared to an average annual growth for the population over the same period of about 3% and 5% for the urban population. Based on the limited information available, it appears that access to supply did not improve much during the second half of the 1970s and may actually have decreased. A Bank study carried out in 1977 estimated that the population with access to supply in the predominately urban areas supplied by the régies fell from 63% in 1972 to 57% in 1977. 1/ This decline, or at best, lack of improvement in access to public supply of electricity has been a consequence of the policies for financing the extensions of the distribution networks. Initial consumers are responsible for financing in part, facilities that are subsequently used by others.

1/ Yellow Cover report on Urban Electricity Distribution in Morocco, June 29, 1978.

Table 4

Household Electricity Consumption /1

	1970	1975	1980	Annual Rate of Growth (%) 1970-1975	1975-1980
Number of Consumers					
ONE Supplied Areas	177,231	249,043	305,475	7.0	4.2
Casablanca /2	--	240,924 /3	286,712	--	4.4
Fès	36,488	45,525	55,365	4.5	4.0
Rabat	66,249	81,627	103,051	4.3	4.8
Consumption (GWh)					
ONE Supplied Areas	55.3	103.7	161.7	13.4	9.3
Casablanca /2	--	317.1 /3	419.6	--	7.3
Fès	21.1	30.3	50.9	7.5	10.9
Rabat	57.6	85.7	129.5	8.3	8.6
Specific Consumption (kWh/Consumer)					
ONE Supplied Areas	312	417	529	6.0	4.9
Casablance /2	--	1,316 /3	1,464	--	2.7
Fès	580	666	919	2.8	6.7
Rabat	869	1,050	1,257	3.9	3.7

/1 Data are for the following tariffs: éclairage privé, tarif mixte, and tarif triple.
/2 Casablance data are for all LV sales.
/3 Data for 1976.

7. Table 4 also shows how the average consumption per consumer has changed between 1970 and 1980. In 1980, households taking supply from ONE consumed about 530 kWh compared to nearly 1,260 kWh in Rabat. These levels of consumption are similar in other countries in the region. The differences in average household electricity consumption among the utilities arise from rural consumers having lower consumption. This also accounts for the differences in growth rates in average consumption per consumer.

Consumption by Voltage Level

8. Consumption increased most rapidly at the medium and high voltage levels at an average rate of about 9.8% per year for the period 1970-1980; reflecting the high proportion of electricity consumed by industry. Low voltage consumption increased at an average rate of 8.6% per year (Attachment 9).

Regional Electricity Consumption

9. Electricity consumption in Morocco is heavily concentrated in the central region of the country where most of the population and the largest industries are located. As can be seen from Table 5 below, Casablanca, Rabat, and their surroundings account for two-thirds of total consumption. Details are given in Attachment 8. Demand from the south has been growing fast as a result of economic and military developments in this area.

Table 5

Regional Consumption of Electricity

Province	1970 GWh	1970 %	1980 GWh	1980 %	Annual Rate of Growth (%) 1970-80
Centre	775.8	48.3	1,691.8	42.8	8.1
Northwest	321.5	20.0	907.3	22.9	10.9
Tensift	127.3	7.9	378.9	9.6	11.5
East	115.1	7.2	283.8	7.2	9.4
South	65.1	4.0	251.8	6.4	14.5
Center-South	115.1	7.2	226.5	5.7	7.0
Center-North	86.6	5.4	214.9	5.4	9.5
TOTAL	1,606.5	100.0	3,955.0	100.0	

Distribution of Final Electricity Sales Between ONE and the Régies

10. ONE has been able to continuously increase its share of the market relative to the share of the régies. The increase in ONE's share is primarily due to the direct service extended to the growing industrial sector; the decline in the rate at which the régies connect new low-voltage consumers relative to the pace maintained by ONE in extending its service; and the extension of ONE's distribution network in the rural areas. ONE's direct sales to final consumers now account for 46% of total electricity sales in Morocco, compared to 44% in 1970. ONE's and the régies' comparative market share has evolved as shown in Table 6 (Attachment 9).

Table 6

ONE's and the Régies' Comparative Market Share

	1970		1980		Annual Rate of Growth (%) 1970-1980
	GWh	%	GWh	%	
Low Voltage Sales					
ONE	92.0	18	256.8	23	10.8
Régies	403.5	82	872.6	77	8.0
TOTAL (1)	495.5	100	1,129.4	100	8.6
Medium and High Voltage Sales					
ONE	551.0	50	1,557.4	55	10.9
Régies	560.0	50	1,268	45	8.5
TOTAL (2)	1,111.0	100	2,825.6	100	9.8
All Voltage Sales					
ONE	643.0	40	1,814.2	46	10.9
Régies	963.6	60	2,140.8	54	8.3
TOTAL (1)+(2)	1,606.5	100	3,955.0	100	9.4

B. Past Trends in the Supply of Electricity

Generating Capacity

11. ONE's generating capacity has increased substantially over the past ten years, from 532 MW in 1970 to 1,560 MW in 1981; representing an average annual rate of increase of about 10.3%. Since 1970, the bulk (71%) of the new capacity was provided by the installation of new thermal generating facilities, mainly oil-fired steam power plants. The greatest increases in oil-fired capacity occurred between 1975 and 1979. As a result, by the end of 1981, ONE's installed capacity consisted of 613 MW of hydroelectric capacity located for the most part on the Oum Er R'bia river and 947 MW of thermal units, including 735 MW of steam power plants and 120 MW of gas turbines. In addition, 49 MW of dual coal/oil-fired steam plant and 15.5 MW of gas turbines had been placed in cold storage. Table 7 summarizes ONE's installed capacity from 1965 to 1981. Further details are given in Attachments 1 and 2.

Table 7

ONE's Installed Capacity
(MW)

		1965	1970	1975	1981
Hydro		332	362	397	613
Thermal					
- Steam:	Coal	--	--	165	165
	Fuel Oil	--	--	60	510
	Coal/Fuel Oil /1	57	117	109	109
- Gas Turbines:	Fuel Oil	--	--	60	120
	Gas Oil	--	16	16	16
- Diesel		22	33	24	20
- Isolated Systems		3	4	3	8
Total Installed Capacity		414	532	833	1,560

/1 Dual-fired plants.

12. The available capacity fluctuated considerably during the period 1975-1981 because of the variation of the hydrological conditions and their impact on the production potential of the hydro power plants (Attachment 4). 1/ Average capacity available at peak during 1975-1981 was 73% of installed capacity for hydro and 80% for thermal plant. Hydro availability ranged from 59% to 90%. As a result, the system's effective reserve margin fluctuated substantially from one year to another, in addition to the usual variations arising from the commissioning of new units. Since peak demand has increased steadily since 1970 from 384 MW to 960 MW in 1981, the effective reserve margin has ranged between 56 MW and 204 MW equivalent to 6% and 23% of maximum demand respectively. Because of severe hydrological conditions in 1980 and 1981, the effective reserve margin in 1981 amounted to only 60 MW, which represented 6% of the year's peak demand. However, the absolute margin of installed capacity to demand has been much higher, ranging from a minimum 30% in 1976-1977 to a maximum of 63% in 1981. There is no significant seasonal variation in monthly peak demand. It varies by about 5-7% above the average in winter and the same amount below in summer. However, the effective reserve margin will vary by more than this because of seasonal variation in hydro output.

1/ Actual hydro generation may vary within a 30% margin around the average, depending on the year's rainfall.

Electricity Generation

13. Total generation by ONE reached 5,099.6 GWh in 1981, compared to 1,908 GWh in 1970, which represents an average growth of 9.3% per year. As summarized in Table 8 below (see Attachment 4 for details), the share of thermally generated electricity has increased substantially during the last 15 years reflecting the steady shift by ONE toward increased dependence on thermal capacities for electricity supply. Thermal facilities produced about 80% of total electricity generated by ONE in 1980, compared to only 11% in 1965. Hydro production fell as low as 20% in 1981 because of the drought.

Table 8

Pattern of ONE's Electricity Production, 1965-1981
(% of Total Production)

	1965	1970	1975	1980	1981
Hydro Power Stations	89	69	34	32	20
Thermal Power Stations	11	31	66	68	80
- Steam Power Plants	10	29	61	67	79
- Combustion Turbines /1	1	2	5	1	1
TOTAL	100	100	100	100	100

/1 Including isolated and autonomous diesel generators.

14. Production by autoproducers has been mainly from thermal plants. During the period 1975-1980, hydro production by autoproducers accounted for less than 5% of total generation by this group of producers. Although little reliable information is available on electricity production outside the public supply system, an estimate was made of the overall balance of electricity production and consumption for 1980 (Attachment 5). It shows that 90% of all electricity generated nationally was produced by thermal plants with ONE accounting for 90% of all electricity generated. In 1980, autoproducers sold 6% of their output to ONE, but their sales to ONE had been as high as 11% in 1977. Of the total electricity used by final consumers, 41% was sold by ONE, 49% by the régies, 9% was produced by autoproducers for their own use and the remainder was supplied by MI to the isolated villages whose public services are being managed by the Ministry.

Station Use and Losses

15. ONE power station use in 1980 amounted to 1.8% of gross generation for the hydro plants and 8.6% for the thermal plants. Losses in transmission, i.e., before sales to bulk consumers, amounted to 7% of energy delivered to the network. These losses are relatively high, reflecting the slippages in ONE's program for the reinforcement and expansion of the national transmission

network. Distribution losses were 2.8% for the ONE system and 6% for the régies, which seem low. Attachment 5 shows that nationally, about 16% of electricity generated was either used by the power stations for their own needs, or lost in transmission and distribution. The level of losses at each of the stages involving the production, transport and delivery of electricity cannot be determined accurately because of inadequate data on the areas served by the régies. Reduction of losses is one of the main means for abating the increase in the cost of electricity. It is recommended that a study be undertaken to determine losses at each voltage level in the public systems and to propose a set of actions for reducing them.

Fuel consumption for Power Generation

16. The growing predominance of oil-fired thermal power stations in ONE's generating system has resulted in a large increase in its fuel oil consumption since 1970, as summarized in Table 9 below (Attachment 6).

Table 9

Fuel Consumption for Electricity Generation, 1970-1981
(ONE)

	1970		1980		1981	
	GWh Produced	'000 Tons Consumed	GWh Produced	'000 Tons Consumed	GWh Produced	'000 Tons Consumed
Coal	557.4	254	1,032.1	595	1,167.2	690
Fuel Oil	--	--	2,180.8	570	2,886.8	745
Gas Oil/Diesel	34.2	5	5.7	3	21.7	3

Average thermal efficiency was about 27%, until the commissioning of the Kénitra oil-fired station in 1978 raised it to its present level of about 30%. The efficiency of all fuel oil-fired units is about 35%, whereas the coal-fired units have an efficiency of around 25%.

17. The increasing trend in fuel consumption has been exacerbated by the drought that has affected Morocco in the past two years which reduced ONE's hydrogeneration. The adverse effect of rising fuel consumption has been compounded by successive increases in the prices of fuel. Fuel price increases have been enforced following the Government's determination to progressively eliminate subsidies for petroleum products. ONE has not been allowed to raise its electricity tariffs systematically to compensate for higher fuel costs, so that it has been unable to meet its financial targets in 1980 and 1981 (para. 6.02). This highlights the need for ONE both to adjust its tariffs upward and to reduce its dependence on petroleum fuels. Taken globally, this dependence has risen dramatically during the last decade. Table 10 presents the distribution of ONE's electricity generation by primary energy source (including hydroelectricity).

Table 10

Distribution of Power Generation by Primary Energy Source
(ONE)

	1970		1980		1981	
	GWh	% Share in Total	GWh	% Share in Total	GWh	% Share in Total
Coal	557.4	29	980.0	21	1,190.1	24
Fuel Oil	--	--	2,232.8	46	2,863.9	56
Gas Oil/Diesel	34.2	2	5.7	--	21.7	--
Hydroelectricity	1,316.4	69	1,514.6	32	1,023.9	20
TOTAL	1,908.0	100	4,733.2	100	5,099.6	100

Note

-- = Negligible (less than half a percentage point).

While practically all the electricity generated in 1970 was produced using domestic resources (coal or hydropower), this share has dropped to about 50% in 1980 and because of the drought, to an even lower level in 1981. The power subsector has thus contributed significantly to the increase in Morocco's dependence on imported energy, especially petroleum products. 1/

Transmission

18. The transmission network has been extended and improved in line with the expansion of system generating capacity. The 225-kV grid is progressively replacing the former 150-kV system. A 60-kV subtransmission network transports energy to the distribution system at 22 kV. A plan for interconnecting the Moroccan system to the Algerian one has been contemplated for several years now. This interconnection would contribute to a more economic utilization of generation facilities in both countries and therefore, the Government should give serious consideration to initiating the link since it would make possible the reduction of the stand-by capacities in the two systems.

1/ If power generation by autoproducers is taken into account, the dependence of the power subsector on imported fuels would be even greater.

MOROCCO

POWER SUBSECTOR STUDY

Installed Capacity of Thermal Plants, 1965-1981
(MW)

Plant	1965	1970	1975	1976	1977	1978	1979	1980	1981
Jerada	-	-	165	165	165	165	165	165	165
Roches Noires									
Unit 1	32	32	32	32	32	32	32	32	32
Unit 2	-	60	60	60	60	60	60	60	60
Unit 3	-	-	60	60	60	60	60	60	60
Kenitra	-	-	-	-	-	75	300	300	300
Oujda	24.5	24.5	17	17	17	17	17	17	17
Mohammedia	-	-	-	-	-	-	-	-	150
Total Steam Plants	56.5	116.5	334	334	334	409	634	634	784
Sidi Kacem	-	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
Agadir	-	-	20	20	40	40	40	40	40
Tangier	-	-	20	20	40	40	40	40	40
Tetouan	-	-	20	20	40	40	40	40	40
Total Combustion Turbines	-	15.5	75.5	75.5	135.5	135.5	135.5	135.5	135.5
Tangier	10	10	10	10	6.4	6.4	6.4	6.4	6.4
Sidi Kacem	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Other diesel engines	4.7	15.9	6.7	4.5	5.3	6.4	6.4	6.4	6.4
Total Diesel Plants	21.9	33.1	23.9	21.7	18.9	20.0	20.0	20.0	20.0
Standby plants	3.3	4.4	3.0	5.0	5.1	5.3	6.2	7.6	7.6
Total Thermal Plants	81.7	169.5	436.4	436.2	493.5	569.8	795.7	797.1	947.1
Non-interconnected plant	-	-	1.8	4.8	5.3	6.4	6.4	6.3	-
Autoproducers	-	104.3	120.7	127.0	154.0	154.7	192.0	192.0	192.0
NATIONAL TOTAL	81.7	273.8	559.0	568.0	653.0	731.0	994.0	995.0	1,139.0

(0436P)

MOROCCO

POWER SUBSECTOR STUDY

Installed Capacity of Hydro Plants, 1965-1980 /1
(MW)

Plant	1965	1970	1975	1976	1977	1978	1979	1980	1981
Commissioned before 1965	345.4	345.4	345.4	345.4	345.4	345.4	345.4	345.4	345.4
Mohammed El Khamis	-	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2
Bou Areg	-	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Moulay Youssef	-	-	24	24	24	24	24	24	24
Mansour Ed Dhabi	-	-	10	10	10	10	10	10	10
Idriss 1st	-	-	-	-	-	40	40	40	40
Oued Makhazine	-	-	-	-	-	-	36	36	36
Al Massira	-	-	-	-	-	-	-	128	128
Total Hydro Plants	345.4	375.0	409.0	409.0	409.0	449.0	485.0	613.0	613.0

/1 At end of year.

(0436P)

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POWER SUBSECTOR STUDY

Supply of Electricity by Power Station and Fuel, 1965-1981
(GWh)

	1965	1970	1975	1976	1977	1978	1979	1980	1981
Hydro	1,168	1,316	1,016	998	1,365	1,416	1,582	1,515	1,024
Thermal									
Coal-fired steam									
Jerada	-	-	1,138	1,175	1,188	1,218	865	864	1,167
Roches-Noires 2	-	557 /1	-	-	-	-	-	93	23
Oujda				67	27	31	15	23	-
Total Coal-Fired Steam	-	557	1,138	1,242	1,215	1,249	880	980	1,190
Oil-fired steam									
Roches-Noires 1,2 & 3	129	-	726	930	856	845	741	613	669
Kenitra 1-4	-	-	-	-	-	122	1,012	1,566	1,809
Mohammedia 1 & 2	-	-	-	-	-	-	-	-	121
Total Oil-Fired Steam	129	-	726	930	856	967	1,753	2,179	2,599
Gas turbines	-	10	95	132	190	329	110	54	277
Diesel & purchases	15	28	60	37	44	37	47	34	57
Total Available	1,312	1,911	3,035	3,339	3,670	3,998	4,372	4,762	5,147

/1 Includes generation from Roches Noires 1.

(0436P)

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POWER SUBSECTOR STUDY

Balance of Demand and Capacity, 1965-1981
(Interconnected System, MW)

	1965	1970	1975	1976	1977	1978	1979	1980	1981
Maximum demand (1)	267	380	590	640	695	750	815	880	960
Installed Capacity									
Hydro (2)	332	362	397	397	409	449	485	613	613
Thermal (3)	82	170	436	436	494	570	796	797	947
Total (4)	414	532	833	833	903	1,019	1,281	1,410	1,560
Capacity Available at Peak									
Hydro (5)	308	312	298	359	350	305	382	407	360
Thermal (6)	82	128	349	418	450	522	489	677	660
Total (7)	390	440	647	777	800	827	871	1,084	1,020
Reserve Margin (%)									
Total capacity (4)/(1)	55	40	41	30	30	36	57	60	63
Available capacity (7)/(1)	46	16	10	21	15	10	7	23	6
Average Plant Availability (%)									
Hydro (5)/(2)	93	86	75	90	86	68	79	66	59
Thermal (6)/(3)	100	75	80	96	91	92	61	85	70
Total (7)/(4)	94	83	78	93	89	81	68	77	65

(0436P)

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POWER SUBSECTOR STUDY

National Electric Power Balance, 1980
(GWh)

	ONE	Regies	Ministry of Interior	Auto-Producers	Others /3	TOTAL
Gross Generation						
Hydro (1)	1,514.6	—	—	13.3	—	1,527.9
Thermal (2)	3,218.5	—	15.6	456.5	(28.9)	3,719.5
Total (1)+(2) = (3)	4,733.1	—	15.6	469.8	28.9	5,247.4
Power Station Use						
Hydro (4)	-27.9	—		(-0.3)		-28.2
Thermal (5)	-276.4	—	-0.7	(-27.9)	(-1.4)	-306.4
Total (4)+(5) = (6)	-304.3	—	-0.7	-28.2	-1.4	-334.6
Net Generation (3)+(6) = (7)	4,428.8	—	14.9	441.6	27.5	4,912.8
Transmission Losses (8)	-312.3	—	—	—	—	-312.3
Available for Bulk Supply (7)-(8) = (9)	4,116.5	—	14.9	441.6	27.5	4,600.5
Purchases (+) by Producers						
ONE (10)	+28.9	—	—	-28.9	—	—
Regies (11)	-2,288.9	+2,288.9	—	—	—	—
Autoproducers (12)	/2	/2	—	—	—	—
				—	—	—
Total Purchased (10)+(11)+(12) = (13)	-2,260.0	2,288.9	—	- 28.9	—	—
Available for Final Consumption (9)+(13) = (14)	1,856.5	2,288.9	14.9	412.7	27.5	4,600.5
Distribution Losses (15)	- 51.6	-138.8	(-1.5)	—	(-2.8)	-194.7
Final Consumption (14)-(15)	1,804.9	2,150.1	13.4	412.7	24.7	4,405.8
of which:						
Agriculture	163.5		—	—	—	163.5
Industry	2,177.3		—	412.7	—	2,590.0
Services	630.8		—	—	—	630.8
Households & Commerce	983.5		(13.4)	—	(24.7)	10,021.6

/1 Figures in brackets () are Bank estimates.
/2 Any purchase by autoproducers from public system is included in final consumption.
/3 "Others" includes statistical discrepancy.

(0436P)

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POWER SUBSECTOR STUDY

Fuel Consumption for Electricity Generation, 1970-1981

	1970	1975	1976	1977	1978	1979	1980	1981
Thermal Electricity Generation by Fuel Source (GWh)								
Coal	557.4	1,138.4	1,175.2	1,187.8	1,218.5	865.5	980.0	1,190.1
Fuel oil	-	794.8	1,094.7	1,070.8	1,319.0	1,873.6	2,232.8	2,863.9
Gas oil	34.2	82.7	63.8	10.1	17.1	9.2	5.7	21.7
Total	591.6	2,015.9	2,333.7	2,268.7	2,554.6	2,748.3	3,218.5	4,075.7
Thermal Electricity Generation by Fuel Source (% of total thermal generation)								
Coal	94	57	50	52.5	48	31.5	27	28.5
Fuel oil	-	39	47	47	51	68	73	71
Gas oil	6	4	3	0.5	1	0.5	..	0.5
Total	100	100	100	100	100	100	100	100
Fossil Fuel Consumption for Electricity Generation ('000 tons)								
Coal	254	645	686	691	711	524	595	690
Fuel oil	-	222	286	312	396	492	570	745
Gas oil	5	44	41	7	9	6	3	3
Average Thermal Efficiency (%) /1								
TOTAL	33.2	27.0	27.0	27.0	26.9	29.5	30.2	30.6

/1 Thermal efficiency calculated using following calorific values: Coal 5,835 Kcal/kg, fuel oil 9,950 Kcal/kg, gas oil 10,375 Kcal/kg, and electricity 1 GWh = 8.60×10^8 Kcal.

(0436P)

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POWER SUBSECTOR STUDY

Electricity Consumption by Sector (GWh)

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Residential	337.1	381.9	402.5	451.2	492.8	544.3	569.7	616.5	695.2	740.5	823.0	887.7	983.5
Public Lighting	38.1	42.4	44.4	48.2	49.0	51.3	55.1	60.8	64.9	75.1	72.5	76.6	79.6
Motive Power	42.4	48.9	48.6	51.9	55.7	55.8	56.6	58.3	61.0	64.8	65.7	65.7	67.3
Total Low Voltage	417.6	473.2	495.5	551.3	597.5	651.4	681.4	735.6	821.1	880.4	961.2	1,030.0	1,130.4
Agriculture	38.4	40.5	49.0	49.5	56.4	68.2	67.3	98.2	101.1	112.0	120.7	129.7	163.6
Mining	260.3	256.0	252.1	272.1	311.5	373.5	422.8	414.6	407.8	463.5	454.9	473.4	482.0
of which: Phosphates	128.6	138.1	142.9	165.2	193.8	218.3	246.9	225.4	227.6	262.2	285.5	301.3	298.5
Coal	26.8	29.6	31.9	33.0	34.9	37.6	38.9	41.7	42.0	45.7	47.0	44.3	46.8
Industry	467.5	534.5	607.1	632.0	694.6	785.1	818.5	903.1	1,012.7	1,108.5	1,254.9	1,496.0	1,627.8
of which: Cement	80.4	92.2	110.7	114.5	117.0	123.7	145.4	162.1	179.9	209.8	223.8	322.1	339.5
Machine Tools	17.7	18.5	19.7	21.6	23.1	26.9	27.8	34.2	60.8	62.2	66.7	70.9	78.4
Chemicals	38.9	42.3	50.4	50.2	52.5	65.1	68.4	71.7	85.8	92.2	142.2	200.8	215.5
Textiles	106.0	121.1	123.5	129.4	157.7	171.9	174.3	183.1	204.1	205.7	224.3	244.0	273.6
Construction & Public Works /1	21.8	21.9	31.3	36.6	34.4	34.3	30.7	39.2	57.3	71.8	73.3	89.3	103.2
Food Processing	91.3	108.0	126.1	126.0	132.1	149.5	156.6	168.0	183.8	203.5	221.2	238.0	247.5
Services	41.3	54.0	60.7	70.4	82.6	91.9	97.1	99.5	114.5	147.1	178.4	175.3	203.4
Transportation	95.8	97.2	104.0	106.8	110.0	118.0	127.5	113.0	134.3	149.0	152.9	148.3	160.0
of which: Rail Transport	70.0	69.2	73.3	75.5	79.8	85.3	88.5	75.0	90.1	100.4	103.2	87.6	106.6
Public Administration	26.7	30.8	38.1	45.6	53.8	72.5	72.0	89.8	142.9	145.4	154.1	173.2	187.8
Total Medium and High Voltage	930.0	1,012.0	1,111.0	1,176.4	1,308.9	1,509.2	1,605.2	1,718.2	1,913.3	2,125.6	2,315.9	2,596.0	2,824.6
Total Consumption	1,347.6	1,485.2	1,606.5	1,727.7	1,906.4	2,160.6	2,286.6	2,453.8	2,734.4	3,006.0	3,277.1	3,626.0	3,955.0

Source: ONE - Planning department

/1 Excluding cement.

September 1982
(0436P)

MOROCCO

POWER SUBSECTOR STUDY

Regional Consumption of Electricity (GWh)

Region	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Center	667.3	732.3	775.8	833.0	908.6	1,024.7	1,074.5	1,116.6	1,199.9	1,337.5	1,506.0	1,588.6	1,691.8
of which: Casablanca /1	479.8	518.1	540.9	592.0	629.2	712.7	735.5	795.9	871.4	963.5	1,091.3	1,161.7	1,250.8
Northwest	240.0	285.1	321.5	340.7	385.8	442.6	468.5	532.2	621.5	679.7	729.6	819.1	907.3
of which: Rabat /1	97.2	109.8	119.2	142.7	160.8	179.2	196.3	213.3	238.0	267.9	293.3	336.3	384.4
Tensift	109.5	119.8	127.3	136.7	148.9	169.2	179.3	193.8	243.6	263.0	295.7	356.4	378.9
East	134.0	125.0	115.1	118.4	118.9	143.5	161.5	181.3	184.0	206.9	175.6	249.0	283.8
South	43.6	51.0	65.1	80.0	83.2	95.6	102.6	135.9	154.7	168.8	190.1	213.2	251.8
Center-South	81.5	92.7	115.1	118.5	139.3	156.6	167.5	165.6	173.0	185.0	193.0	204.2	226.5
Center-North	71.7	81.6	86.6	99.7	121.6	128.5	132.2	128.8	157.7	165.1	187.1	194.8	214.9
TOTAL	1,347.6	1,487,5	1,606.5	1,727.0	1,906.3	2,160.7	2,286.1	2,453.8	2,734.4	3,006.0	3,277.1	3,625.3	3,955.0

/1 Prefectures

Source: ONE - Distribution Department

July 1982
(0436P)

MOROCCO

POWER SUBSECTOR STUDY

ONE's and the Regies' Comparative Market Share (GWh)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Low voltage sales											
ONE	92.0	104.3	115.8	123.7	138.3	150.9	175.8	195.9	214.3	226.8	256.8
Regies	403.5	447.0	481.8	527.4	543.1	584.8	645.7	684.5	747.1	803.2	872.6
Total low voltage sales	495.5	551.3	597.6	651.1	681.4	735.7	821.5	880.4	961.4	1,030.0	1,129.4
Medium and High voltage sales											
ONE	551.0	587.6	654.9	771.4	826.8	874.1	965.4	1,095.4	1,214.2	1,418.9	1,557.4
Regies	560.0	588.8	654.0	738.1	778.4	844.0	947.5	1,030.2	1,101.5	1,177.1	1,268.2
Total Medium and High Voltage Sales	1,111.0	1,176.4	1,308.9	1,509.5	1,605.2	1,718.1	1,912.9	2,125.6	2,315.7	2,596.0	2,825.6
All voltage Sales											
ONE	643.0	691.9	770.7	895.1	965.1	1,025.0	1,141.2	1,291.3	1,428.5	1,645.7	1,814.2
Regies	963.5	1,035.8	1,135.8	1,265.5	1,321.5	1,428.8	1,593.2	1,714.7	1,848.6	1,980.3	2,140.8
Total Sales	1,606.5	1,727.7	1,906.5	2,160.6	2,286.6	2,453.8	2,734.4	3,006.0	3,277.1	3,626.0	3,955.0

July 1982
(0436P)

MOROCCO

POWER SUBSECTOR STUDY

Forecast Consumption and Supply of Electricity

A. Growth of the Economy

1. Morocco's economy experienced a relatively slow rate of economic growth over the period 1978-1980 as a result of strict fiscal and monetary policies implemented by the Government to stabilize the economy. Thus, GDP increased in real terms at an average annual rate of 3.8%. According to Bank staff projections, GDP would grow at an average rate of about 4.5% for the period 1981-1985 and accelerate slightly to 5% for the period 1985-1990. Value added in agriculture is expected to grow at 5.5% per year from 1981 to 1985, and at 2.5% thereafter, as recovery from the 1981 drought would spread over several years. The growth of the industrial sector is projected to be low in 1982, but to rise afterwards, so that it could reach, in real terms, an average annual rate of about 4.7% for the period 1981-1985, and 5.5% for 1985-1990. The higher growth rate of industry in 1981-1985, compared to the one achieved in 1977-1980 (2.3%), is due first of all to planned investment and strong external demand for phosphoric acid and manufactured products. Production of natural gas could grow rapidly after 1983 and stimulate further the overall growth rate. In the case of the service sector, value added in transport, commerce and services is expected to follow the increased demand arising from agriculture and industry. However, the projected reduction in Government consumption should induce a slowdown in the overall growth rate of the service sector to 4.2% per year from 1981 to 1985, compared to 5.2% for 1977-1980. The historical and projected growth rates of the main sectors of Morocco's economy are presented in Table 1 below:

Table 1

Historical and Projected Real Growth Rates for the Main Sectors of Morocco's Economy /1
(%)

	Actual	Projected	
	1977-1980	1981-1985	1985-1990
Agriculture	7.2	5.5	2.5
Industry	2.3	4.7	5.5
Services	5.2	4.2	5.5
GDP	3.8	4.5	5.1

/1 World Bank projections.

B. Future Electricity Demand

2. The future demand for electricity was examined using income and price elasticities for the main categories of consumers, estimated from historical observations. The elasticity of domestic electricity consumption per consumer with respect to real per capita expenditure was estimated to be about 1.2, while the long-run price elasticity was -0.1. This indicates that demand is influenced more by changes in real per capita expenditures, than by changes in real electricity prices. However, real electricity prices did not rise during the period over which the elasticities were estimated. Studies in other countries indicate that price elasticities may be higher when prices are rising than when they are falling. Nevertheless, in the short to medium term, increases in electricity prices to LV consumers in order to align them with marginal costs, are unlikely to lead to large losses in the potential income of utilities.

3. Analysis for the mining and services sectors where consumption was related to real GDP for the sector and real electricity prices produced the following elasticities:

	Mining	Services
Income elasticity - short run	0.50	1.30
- long run	1.60	1.70
Price elasticity - short run	-0.09	-0.06
- long run	-0.30	-0.08
Coefficient of determination (R^2)	0.97	0.98

These results indicate that net output has had the dominant effect on demand. Services respond to changes in net output or electricity prices faster than mining, which is to be expected, given the lumpy capital stock of the mining industry.

4. Lack of adequate data and its aggregated nature made it difficult to accurately estimate the elasticities for industry. Preliminary results indicate a long-run GDP elasticity for industry of about 1.7. This analysis of the relationship between electricity consumption and the factors which influence it has produced promising results. However, there is a need to acquire better data on electricity consumption, and to estimate a wider range of models. The results to date indicate that demand is relatively insensitive to price, and that incomes or output tend to dominate demand.

5. The demand forecast derived from the analysis presented above projected a global electricity demand consistent with the demand forecast prepared by ONE in 1981 for the entire subsector. According to ONE's projections, maximum demand and gross generation are projected to grow at an annual average rate of 9% until 1990. As summarized in Table 2 below, the forecast represents a slight decline in the rate of growth in the 1980's, compared to the 1970's.

Table 2

Electricity Demand Forecast

Year	Gross Generation (GWh)	Maximum Demand (MW)	Load Factor %
	---------- Actual ----------		
1970	1,912	384	56.8
1975	3,034	600	57.7
1980	4,762	855	63.5
1981	5,147	920	63.9
	----------Forecast----------		
1982	5,657	1,015	63.6
1983	6,165	1,100	64.0
1984	6,720	1,200	63.9
1985	7,325	1,300	64.3
1986	7,985	1,420	64.2
1987	8,703	1,545	64.3
1988	9,487	1,680	64.5
1989	10,340	1,830	64.5
1990	11,271	2,000	64.3
Growth rates (% p.a.)			
1970-1975	9.7	9.3	
1975-1980	9.4	7.3	
1980-1985	9.0	8.7	
1985-1990	9.0	9.0	

6. The forecast of sales by consumer group presented in Table 3 (details are provided in Attachment 1) shows that private and public services, cement and agriculture are expected to have the highest rates of growth. Railways, textiles and mining are forecast to have the slowest growth rates. The proportion of electricity sold at LV is expected to decrease slightly from 24% to 21% of gross generation. Station use and T&D losses are expected to remain constant at 17%.

Table 3

Forecast Consumption of Electricity by Economic Sector, 1980-1990

	1980 (Actual)		1985		1990		Annual Rate of Growth (%)	
	(GWh)	(%)	(GWh)	(%)	(GWh)	(%)	1980-1985	1985-1990
Agriculture and fishing	163.5	3	295	4	520	5	12.5	12.0
Mining	482.0	10	620	8	785	7	5.2	4.8
Food processing	247.5	5	380	5	570	5	9.0	8.5
Textiles	273.6	6	365	5	480	4	5.9	5.5
Chemicals	215.5	5	335	5	515	5	9.2	8.4
Cement and construction materials	442.7	9	820	11	1,480	13	13.1	13.0
Other manufacturing	314.0	7	440	6	610	5	7.0	7.0
Water supply	188.0	4	290	4	440	4	9.1	9.0
Trade, hotels, and services	203.4	4	440	6	940	8	16.7	16.5
Railways	106.6	2	130	2	155	1	3.6	3.5
Radio, TV, Army, and Government	187.8	4	310	4	495	4	10.7	10.0
LV sales /1	1,130.4	24	1,635	22	2,385	21	7.7	7.9
Total sales	3,955.0	83	6,060	83	9,375	83	8.9	9.1
Losses & station use	807	17	1,265	17	1,890	17	9.4	8.4
Gross generation	4,762	100	7,325	100	11,265	100	9.0	9.0

/1 LV consumers are mainly residential, but also include small consumers in other categories, e.g. shops, offices, schools, post offices, etc.

7. Intensity of Electricity Use: Table 4 below shows the intensity of electricity use by sector, as well as the kWh consumed by households per DH 1,000 of private consumption expenditure. LV consumption was allocated among households, industry, and services in the same proportions observed in 1980 because detailed breakdown at the distribution level is not available. The growth forecasts of the value added by sector were prepared by the Bank in mid-1982.

Table 4

Intensity of Electricity Use
(kWh per DH 1,000 of value added, 1969 prices)

Sector	Actual 1970	Actual 1975	Actual 1980	Projected 1985	Projected 1990	Annual Rate of Growth (%) 1970-75	1975-80	1980-85	1985-90
Agriculture	13	28	38	65	101	16.6	6.3	11.3	9.2
Industry	176	183	229	296	339	1.2	4.6	5.3	2.9
Services	26	30	38	50	68	2.9	4.8	5.6	6.3
TOTAL	83	100	122	161	195	3.8	4.1	5.7	3.9
Households /1	28	36	46	57	57	5.2	5.0	4.4	-

/1 Electricity consumption (kWh) per DH 1,000 of private consumption expenditure

8. The intensity of electricity use in agriculture increased at an accelerated rate for the period 1970-1975 because of a structural shift towards the use of electricity for irrigation pumping. This increase tapered down significantly for the period 1975-1980 as the irrigation pumping market become more saturated. The intensity of electricity use in agriculture is projected to grow at a rate lower than that recorded in 1970-1975. However, the electricity used per unit of agricultural value added is projected to more than double between 1980 and 1990. Intensity in industry is forecast to accelerate during 1980-1985, and taper down thereafter as a result of projected investments in energy conservation. For services, intensity is expected to continue increasing at about 6% per year during the 1980s. The household electricity consumption per DH 1,000 of private consumption expenditure is forecast to rise up until 1985 and to remain at its 1985 level thereafter.

9. Improvements to Electricity Demand Forecasting: Assuming the projected rates of growth for the major sectors of the economy, ONE's forecast of overall electricity sales seems reasonable. However, substantial improvements could be made to the methodology used. The approach adopted by ONE is essentially the extrapolation of past trends, modified by knowledge of short-term developments in industrial sectors. This is a useful approach for sectors where large projects are planned. However, information on new

projects is usually available for less than five years ahead, a short period in relation to the lead time of power projects. It is therefore necessary to check that medium-term electricity demand forecasts are consistent with projected economic development in each subsector and to obtain a rational basis for projecting longer term demand. This could be achieved by quantifying the relationships between electricity demand and economic activity in each subsector. Electricity demand projections should then be calculated on the basis of the projections of economic growth for each subsector. This would require ONE staff to work even more closely with the Ministry of Planning so that electricity demand forecasts are based on up-to-date detailed and consistent economic forecasts.

10. Improvements could also be made to forecasting the demand by LV consumers which accounts for almost 30% of electricity sold. ONE has prepared good data on the consumption of electricity by industrial subsectors at medium and high voltage. However, little information is available on the breakdown of LV sales and the number of LV consumers. Most of this data is collected by the régies, but no consistent analysis has been undertaken to establish the consumption and numbers of consumers of households and various service, industrial and other subsectors supplied at LV. Because most LV consumers are residential, it should be reasonably straightforward to categorize the remaining non-household consumers. A classification of consumers by economic activity that is consistent with other national statistics should be adopted. Non-household LV demand should be projected along with MV demand for each subsector.

11. Part of the past growth in the demand for electricity by households has been caused by connecting new households in areas already with supply and extending distribution networks to areas without supply. In the future the growth of population is expected to fall from an annual average rate of 3.2% at present to 2.8% during 1990-1995. This will ultimately lead to a slowdown in the growth of new households. The number of those with access to supply will depend on specific rural and urban distribution plans. Ultimately, the proportion of households with electricity supply will approach saturation. The relationships between the number of domestic electricity consumers and population growth, household formation and access to supply need to be considered explicitly in the demand forecast.

12. The consumption of electricity in a household depends on the household's stock of appliances and their utilization. These in turn depend, inter alia, on household income, energy prices, and weather conditions. Ownership of particular appliances, e.g., irons, tends to approach saturation and eventually ceases to contribute to the growth in electricity demand. The extent to which these processes can be modelled depends on the data available. It is recommended that ONE and the régies start to collect this data, e.g., on numbers of consumers by district, and forecast household electricity demand taking the factors which influence it into explicit account.

13. There is also some scope for the régies to intensify their involvement in overall demand forecasting. Each régie requires its own demand forecast for financial analysis and to prepare its least-cost development plan. Régies are in a position to acquire information on local developments that affect electricity demand, e.g., applications for supply, information on proposed projects, implications of land use planning, etc. They are, therefore, ideally placed to prepare market survey type forecasts for, say, up to five years ahead. However, an individual régie alone is unlikely to be able to ensure that its forecast, when added to the forecasts of the other utilities, is consistent with overall economic development. It is recommended, therefore, that ONE develop its coordinating role by providing a forum to bring all the utilities' projections together and by assisting the régies in improving their forecasting techniques, to ensure that electricity demand forecasts are consistent with economic and social development.

C. Future Electricity Supply

14. ONE is responsible for all generation and transmission planning. It is also responsible for distribution planning in the areas it serves. Ultimately, ONE requires the approval of MFM for its investment program. The régies are responsible for most of the distribution planning in Morocco. Little information is available at the Bank on their investment plans. However, it is known that régies tend to prepare investment budgets for the year ahead and that at least one régie prepares a five-year plan of capital expenditures. This section of the annex covers generation planning only, because of the lack of information on distribution plans.

15. ONE has an obligation to provide an adequate supply of electricity at the lowest cost. In the case of Morocco where hydrogeneration plays a major role, security of supply requires that there be sufficient reserve thermal capacity to maintain supplies during a hydrologically dry year. This section examines first how maximum demand (MW) will be met in the future, then considers the plan to ensure sufficient energy (GWh), and finally reviews whether ONE's power system planning practices result in a least-cost generation plan.

Future Generating Capacity

16. ONE does not plan to commission any new plant on the interconnected system until 1984-1985 when two additional 150-MW units will be completed at the Mohammedia steam station. Unlike the existing 2x150-MW units at Mohammedia which burn fuel oil, the new units will burn imported coal. No further thermal plant is planned except for a 4x250-MW steam station burning imported coal is commissioned in 1993. With the exceptions of Roches Noires Unit 1 and Oujda which are being placed into cold storage, all existing steam plants will be refurbished when necessary so as to remain in service at the end of the century. The three existing gas turbines at Agadir, Tangier,

and Tétouan are to be retired in 1994. All diesel plants on the interconnected system are planned to be retired in 1982. Attachment 2 shows projected thermal capacity until 1990.

17. ONE is planning an ambitious program of hydro development. Stations planned for commissioning in the 1980s are:

Amougguez	67 MW	1987
Dchar el Oued	92 MW	1988
M'dez	52 MW	1988
M'jara	240 MW	1989
	451 MW	

Another 16 hydroelectric stations, with a total capacity of 1,215 MW, are planned for 1990-1994. Four more stations are proposed for 1995-1996 which will add a further 169 MW to the system. Attachment 4 lists the 25 proposed projects, which will have a total installed capacity of 1,845 MW and would ultimately be capable of producing an additional 2,832 GWh in a mean hydrological year. Attachment 3 shows the buildup of hydro capacity. Almost all of Morocco's surveyed hydro potential will be exhausted after the planned development program has been completed. ONE then proposes to commission a 600-MW nuclear power station in 2000-01 to meet base load demand, and has already initiated contacts with the International Atomic Energy Agency (IAEA) to seek assistance in the preparation of its program.

18. Many of the proposed hydro projects are part of multipurpose schemes which are primarily intended for irrigation, water supply, or flood control. Most of the projects are small; 16 of them will have an installed capacity less than or equal to 60 MW. Furthermore, the energy (GWh) output of most of the schemes is small in relation to their capacity. In a mean hydrological year, only 7 out of the proposed 25 projects will have a load factor greater than 15%. This raises an issue as to the role of hydro in future system development and the optimization of station size (paras. 24-28).

19. Attachment 5 shows the balance of demand and capacity which is summarized below in Table 5. The hydro program described above will result in hydro capacity increasing from nearly 40% of total installed capacity at present to almost 50% in 1990. The proportion of thermal plant will continue to increase to 68% in 1985 and then decline. The gross reserve margin, i.e. excluding adjustments for plant availability or averaging of daily peak demands, is forecast to fall from its highest for many years of 43% in 1981, to 31% in 1985 and 23% in 1990.

Table 5

Planned Generating Capacity
(ONE Interconnected System)

		Actual		Planned			
		1981		1985		1990	
		(MW)	(%)	(MW)	(%)	(MW)	(%)
Hydro		604.2	39	616	32	1,286	50
Thermal		949.4	61	1,305	68	1,305	50
of which:	Steam	784	50	1,185	62	1,185	46
	Gas Turbine	135	9	120	6	120	4
	Diesel	30.4	2	--	--	--	--
TOTAL		1,553.6	100	1,921	100	2,828	100
Maximum Demand /1		880		1,330		2,000	
Gross Reserve Margin		43%		31%		23%	

/1 Maximum demand is the estimated hourly peak for the year, not the average of winter daily peaks shown in Table 2.

20. No information is available on any planned increases in the capacity of autoproducers. ONE plans its system on the basis of no import from autoproducers since the sale of surplus energy by autoproducers is not guaranteed. However, there may be scope for increasing the level of imports, particularly if industrial peak demands occur at a different time to the interconnected system peak. Further savings could be made by using imports to reduce gas turbine generation. Given that autoproducers have almost 200 MW of plant capacity, ONE should review its existing contractual arrangements with autoproducers with the view to integrating them further into the interconnected system. ONE should examine particularly the methods of charging for purchases and sales to ensure that both parties are given the correct marginal cost signals and incentives to supply each other at both peak and off peak times. In April 1983 ONE undertook a sectorial survey with the purpose of collecting data on the structure of electricity consumption by the industrial sector. The survey should contribute to determining the opportunities for some industries to shift their unessential demand from peak to off-peak periods and thus for ONE to defer new capacity. It is recommended, however, to ensure that this preliminary load research and management study be accompanied by a review of ONE's contractual arrangements and, in particular, of its tariffs to industrial consumers.

Future Production of Electricity

21. In its generation planning studies, ONE formulates its investment plans under the assumption that the most adverse hydrological conditions would persist over the entire planning horizon. This analysis is undertaken to ensure that sufficient supply of energy will be available under the worst possible case for hydropower generation In addition, ONE determines the outputs of generating units and their cost of operation under mean hydrological conditions. Table 6 below presents a summary of projected available supply of electricity in a mean hydrological year and compares it with electricity generation in a dry year. Details are provided in Attachment 6.

Table 6

Projected Available Supply of Electricity
(Interconnected System)

	Actual		Projected			
	1981		1985		1990	
	(Gwh)	(%)	(Gwh)	(%)	(Gwh)	(%)
In an average year						
Hydro	1,024	20	1,940	27	3,450	31
Thermal	4,076	79	5,360	73	7,850	69
of which:						
steam (coal)	1,190	23	3,250	73	3,700	23
steam (oil)	2,598	50	2,080	28	4,120	36
G/T & diesel	288	6	30	-	30	-
Import	47	1	--	--	--	--
Energy Demand	5,147	100	7,330	100	11,300	100
In a dry year						
Hydro			1,205	12	1,924	18
Thermal			8,520	88	9,256	82
Total available			9,735	100	11,180	100
Margin			33%		0%	

22. The table shows that, in an average hydrological year, the share of hydroenergy will rise to 27% of total energy available in 1985, and to 31% in 1990, as a large number of hydropower sites are developed. Thermal generation will fall to about 73% of available supply in 1985, and to 69% in 1990. Towards the end of the 1980's, about one third of total electricity generation by ONE will be supplied by hydropower plants,

another third by coal-fired steam stations, and the last third by oil-fired steam stations. The contribution of gas turbines and small diesel plants will be minimal.

23. Under poor hydrological conditions, however, where hydrogeneration could be reduced by as much as 40%, the shortfall of energy available would be mainly supplied by oil-fired steam plants and by gas turbines. The margin of spare energy available in a dry year above the projected demand for energy will amount to about 33% in 1985, which suggests that there will be no problem in supplying energy; meeting peak demand will thus be the most important constraint. Thereafter, the margin will fall to 0% in 1990. However, the margin of available energy does not include support from autoproducers or bringing back plant from cold storage, which could raise the 1990 margin to over 5%.

Optimization of Hydro Projects

24. Most hydro schemes in Morocco are multipurpose. Indeed, power benefits are often regarded of secondary importance to those from irrigation and water supply. Hydro projects have been appraised in the past by taking the decision to build the dam as given and regarding the incremental power plant costs as an input to the least-cost power development plan. This approach would be correct if the decision to construct a multipurpose project to a stated design on a particular site was in fact independent of the power aspects of the project. In practice though, the power requirements will influence the choice of site, dam height, etc. For example, is it worthwhile to choose a site which would allow greater power benefits and equal or larger irrigation benefits? Would it be worth reducing the irrigation benefits slightly to allow greater power output?

25. It is recommended that the tradeoffs between different benefits of a multipurpose project be examined intensively during the preparation of the project. This will involve careful calculation of the benefits from hydro power, which simply are not the power output multiplied by the average income from electricity sales. Power benefits are related to the difference in present value power system costs between the best plans with and without the project. In some circumstances it may be better to delay construction of the power house until the electricity is required or until lower cost schemes have been commissioned first.

26. There may be some hydro projects worth undertaking for the power benefits alone. For these projects, it is necessary to firstly identify the sites and secondly to rank them in terms of economic attractiveness. To date this has not been done. It is recommended that the Administration de l'hydraulique, in collaboration with ONE, establish an inventory of potential hydro sites, carry out preliminary design work, and estimate project costs. These projects should then be ranked and integrated with multipurpose and thermal power projects in a least-cost generation development plan.

27. For both multipurpose and single purpose hydro schemes the designer has to decide what proportion of the potential hydro energy is worth capturing, taking the annual and seasonal variation in water flows into account. A tradeoff has to be achieved between the costs of installing more MW of hydro capacity and the benefits of the additional capacity to the system. The low load factors of many of the proposed hydro stations (Attachment 4) suggest that the MW capacity of some may be too large in relation to the water resource. ONE does not appear to have optimized the capacity of these stations as an element of an integrated hydro-thermal system. It is recommended that the capacity of the proposed hydro schemes be optimized when each project is revaluated.

28. ONE plans to commission 25 hydroelectric stations during the ten years 1986-1996. Even though many of these projects are small, their manpower requirements will be similar to a much larger station with the same number of generating units. A large training program will be required to man these stations adequately. At present such a program does not exist. Furthermore, constructing this number of projects will be likely to overload the management resources involved in design, procurement, and construction. For these reasons, as well as the uncertainty as to whether the hydro plant is needed to meet demand, or justified economically, it is recommended that ONE revaluate the power projects planned for commissioning in 1990 and after, to ensure that the longer term development plan is the least-cost solution.

Pricing of Inputs to Power Projects

29. Power projects should be appraised using border prices to ensure that projects selected make the best use of national resources. Previous power projects in Morocco have been evaluated using the actual prices paid by ONE. These prices have included import duties, trade and commodity taxes, and fuel subsidies which are transfers rather than resource costs. The choice between hydro and thermal generation is strongly influenced by the price of fuel. While, in the past, fuel prices have been distorted by subsidies, they are now close to border prices. However, it is recommended that in future project appraisal, ONE make certain that border prices are used for fuel and other imports.

30. Because of the opportunities for emigration, labor may, in some cases, be considered a "tradeable commodity", but this is less true today. The resource cost of labor in Morocco will depend on the alternative employment of workers engaged in construction and power station operation. It is likely that this will be less than the wages and other labor costs actually incurred. If skilled labor, such as hydro station managers, is scarce, then there may be grounds for having a shadow wage rate in excess of actual labor costs. It is recommended that the resource cost of labor, the "shadow wage rate", be used in the evaluation of future projects.

February 1984
(0756P)

MOROCCO

POWER SUBSECTOR STUDY

Forecast Consumption of Electricity by Economic Sector
(GWh)

	Actual	Forecast								
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Agriculture and fishing	253.6	200	230	260	295	330	370	415	465	520
Mining	497.5	530	560	590	620	650	680	715	750	785
Food processing	260.8	295	320	350	380	415	450	490	530	570
Textiles	270.5	305	325	345	365	385	410	430	455	480
Chemicals	205.9	255	280	305	335	365	395	435	475	515
Cement and construction materials	450.7	590	660	740	820	925	1,045	1,170	1,310	1,480
Other manufacturing	335.9	360	385	410	440	470	500	535	570	610
Water supply	205.3	220	240	265	290	315	340	370	405	440
Trade, hotels & services	187.2	275	320	375	440	510	600	700	810	940
Railways	108.6	115	120	125	130	135	140	145	150	155
Radio, TV, Army and Government	206.3	230	255	280	310	340	375	410	450	495
LV sales /1	1,177.1	1,300	1,405	1,515	1,635	1,765	1,905	2,050	2,210	2,385
Total Sales	4,159.4	4,675	5,100	5,560	6,060	6,605	7,210	7,865	8,580	9,375
Losses & station use	987.6	975	1,060	1,140	1,240	1,395	1,490	1,635	1,770	1,890
Total Generation	5,147.0	5,650	6,160	6,700	7,300	8,000	8,700	9,500	10,350	11,265

/1 LV consumers are mainly residential, but also include small consumers in other categories, e.g. shops, offices, etc.

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MOROCCO

POWER SUBSECTOR STUDY

Installed Capacity of Thermal Plants (1981-1990) /1
(MW)

Plant	Actual 1981	Forecast 1982	1983	1984	1985	1986	1987	1988	1989	1990
Jerada	165	165	165	165	165	165	165	165	165	165
Roches Noires:										
Unit 1	32	— /2	—	—	—	—	—	—	—	—
Unit 2	60	60	60	60	60	60	60	60	60	60
Unit 3	60	60	60	60	60	60	60	60	60	60
Kenitra	300	300	300	300	300	300	300	300	300	300
Oujda	17	— /2	—	—	—	—	—	—	—	—
Mohammedia	150	300	300	450	600	600	600	600	600	600
TOTAL Steam Plant	784	885	885	1,035	1,195	1,185	1,185	1,185	1,185	1,185
Sidi Kacem	15.5	— /2	—	—	—	—	—	—	—	—
Agadir	40	40	40	40	40	40	40	40	40	40
Tanger	40	40	40	40	40	40	40	40	40	40
Tetouan	40	40	40	40	40	40	40	40	40	40
TOTAL Combustion Turbines	135.5	120	120	120	120	120	120	120	120	120
Agadir	—	—	—	—	—	—	—	—	—	—
Tanger	6.4	—	—	—	—	—	—	—	—	—
Sidi Kacem	7.2	—	—	—	—	—	—	—	—	—
Other Diesel Engines	6.4	—	—	—	—	—	—	—	—	—
TOTAL Diesel Plants	20	—	—	—	—	—	—	—	—	—
Standby Plants	7.6	— /2	—	—	—	—	—	—	—	—
TOTAL THERMAL PLANTS	947	1,005	1,005	1,155	1,305	1,305	1,305	1,305	1,305	1,305
Autoproducers /3	192	192	192	192	192	192	192	192	192	192
NATIONAL TOTAL	1,139	1,197	1,347	1,497	1,497	1,497	1,497	1,497	1,497	1,497

/1 At the end of the year.
/2 Plant placed into cold storage.
/3 Capacity of autoproducers includes a very small amount of hydro.

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MOROCCO

POWER SUBSECTOR STUDY

Installed Capacity of Hydro Plants, 1980-1995 /1
(MW)

		1980	1985	1986	1987	1988	1989	1990	1995
Existing									
Commissioned before 1975		400	400	400	400	400	400	400	400
Idriss I		40	40	40	40	40	40	40	40
Oued el Makhazine		36	36	36	36	36	36	36	36
Al Massira		128	128	128	128	128	128	128	128
Lalla Takerkoust		-	12	12	12	12	12	12	12
Proposed									
Amougguez		-	-	-	67	67	67	67	67
Dchar el Oued		-	-	-	-	92	92	92	92
Sebkha Tah		-	-	-	-	10	10	10	10
M'dez		-	-	-	-	52	52	52	52
M'jara		-	-	-	-	-	-	160	240
Matmata		-	-	-	-	-	241	241	241
El Menzel		-	-	-	-	-	-	148	148
Merija		-	-	-	-	-	-	60	60
Imezdilfane	(1991)	-	-	-	-	-	-	-	68
Taskdert	(1991)	-	-	-	-	-	-	-	32
Tajemout	(1991)	-	-	-	-	-	-	-	28
Tanafit	(1992)	-	-	-	-	-	-	-	33
El Borj	(1992)	-	-	-	-	-	-	-	17
Tilougguit	(1993)	-	-	-	-	-	-	-	65
Tamajjout	(1993)	-	-	-	-	-	-	-	55
Tanga	(1993)	-	-	-	-	-	-	-	20
Ait Abbas	(1993)	-	-	-	-	-	-	-	15
Touahar	(1994)	-	-	-	-	-	-	-	25
Bab Ouender	(1994)	-	-	-	-	-	-	-	38
Rafsai	(1994)	-	-	-	-	-	-	-	30
El Menzel (usine de transfert)	(1994)	-	-	-	-	-	-	-	340
Afartane (Laou)	(1995)	-	-	-	-	-	-	-	25
Tirkou	(1995)	-	-	-	-	-	-	-	19
Oum er Rbia	(1995)	-	-	-	-	-	-	-	65
TOTAL		604	616	616	683	1,078	1,078	1,286	2,401

/1 At the end of year.

February 1984
(0756P)

MOROCCO

POWER SUBSECTOR STUDY

Existing and Proposed Hydro Stations

Station	Installed Capacity (MW)	Ultimate Production (GWh/a)	Load Factor (%)	Type	Commission	Date
Existing (December 1980)						
Bine el Ouidine	135	265	22	Storage	October	1953
Alfourer	94	525	64	Storage	January	1955
Imfout	31	150	55	ROR	December	1947
Mohammed el Khamis	23	85	42	Storage	September	1967
Sidi Said Maechou	21	60	33	ROR	December	1929
Daourat	17	90	60	ROR	May	1950
El Kansera	14	30	24	Storage	December	1934
Lalla Takerkoust /1	9	12	15	Storage	October	1938
Kasba Zidania	7	17	28	ROR	November	1935
Bou Areg	6	35	67	ROR	October	1969
Laou /2	11	50	52	ROR	1934/July	1942
Taurart /2	2	10	57	ROR	October	1951
Six Small Run of River	5	20	46	ROR	1925 to 1939	
Mansour ed Dahbi	10	27	31	Storage	July	1973
Moulay Youssef	24	60	29	Storage	September	1974
Idriss I	40	130	37	Storage	July	1978
Oued el Makhazine	36	65	21	Storage	September	1979
Al Massira	128	240	21	Storage	July	1980
	613	1,871	35			
Proposed						
Amougguez	67	115	20	Storage		1987
Dchar el Oued	92	200	25	Storage		1988
Sebkha Tah	10	25	29			1988
M'jara	240	390	19	Storage		1992
M'dez	52	50	11	Storage		1988
Matmata	241	265	13	ROR		1988/89
El Menzel	148	320	25	ROR		1990
Merija	60	120	23	ROR		1990
Imezdilfane	68	110	18	ROR		1991
Taskdert	32	55	20	ROR		1991
Tajemout	28	50	20	ROR		1991
Tanafit	33	170	59	ROR		1992
El Borj	17	90	60	ROR		1992
Tilougguit	65	90	16	ROR		1992
Tamajjout	55	120	25	ROR		1993
Tamga	20	65	37	ROR		1993
Ait Abbas	15	30	23	ROR		1993
Touahar	25	40	18	ROR		1994
Barb Ouender	38	55	17	Storage		1994
Rufsai	30	47	18	Storage		1994
Afartane (Laou) /2	25	95	43	ROR		1995
Tirkou	19	30	18	Storage		1995
Oum er Rbia Amont	65	160	28	ROR		1995
Oum er Rbia Aval	60	140	27	ROR		1996
El Menzel (usine de transfert)	340	-				1994
	1,845	2,832	18			

NOTE: ROR = Run-of-River or "Eclusée" types of station.

/1 The installed capacity and average annual production will rise to 12 MW and 15 GWh.

/2 These plants will be retired when Afartane is retired.

September 1982
(0756P)

MOROCCO

POWER SUBSECTOR STUDY

Balance of Demand and Capacity, 1981-1990
(Interconnected System)

	Actual	FORECAST								
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Maximum Demand (Average Winter Day) (1)	920	975	1,045	1,115	1,190	1,270	1,355	1,450	1,550	1,655
Maximum Demand (Hourly) (2)	960	1,015	1,085	1,160	1,240	1,320	1,410	1,510	1,610	1,720
Installed Capacity										
Hydro (3)	604	604	616	616	616	616	683	1,078	1,078	1,286
Thermal (4)	949	1,005	1,005	1,155	1,305	1,305	1,305	1,305	1,305	1,305
Total (5)	1,553	1,609	1,621	1,771	1,921	1,921	1,988	2,383	2,383	2,591
Capacity Available at Peak										
Hydro (6)	360	472	472	472	472	524	524	642	827	1,173
Thermal (7)	660	854	854	982	1,109	1,109	1,109	1,109	1,109	1,109
Total (8)	1,020	1,326	1,326	1,454	1,581	1,633	1,633	1,751	1,936	2,282
Reserve Margins (%)										
Total Capacity (5)/(2)	63	59	49	52	55	50	41	48	48	64
Available Capacity (8)/(2)	6	31	22	25	28	24	16	16	20	33
Average Winter Available (8)/(1)	11	36	27	30	33	29	21	21	25	38
Average Plant Availability (%)										
Hydro (6)/(3)	59	77	77	77	77	77	77	77	77	77
Thermal (7)/(4)	70	85	85	85	85	85	85	85	85	85
Total (8)/(5)	65	82	82	82	82	82	82	82	81	81

February 1984
(0756P)

MOROCCO

POWER SUBSECTOR STUDY

Supply of Electricity by Power Station and Fuel, 1981-1990 /1
(GWh)

	Actual	Forecast								
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Energy Supplied (Gross)	5,147	5,455	5,840	6,245	6,685	7,150	7,650	8,190	8,760	9,375
Hydro										
of which plants existing at end-1980:	1,024	900	1,215	1,210	1,205	1,210	1,195	1,200	1,205	1,200
Amougguez							10	45	45	45
Dchar el Oued								20	115	115
M'dez								15	26	26
M'jara								-	-	-
Matmata								80	210	210
El Menzel										248
Merija										80
TOTAL HYDRO	1,024	900	1,215	1,210	1,205	1,210	1,205	1,360	1,601	1,924
Thermal										
Coal-Fired Steam:										
Jerada)	1,167	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150
Roches Noires 2)	23	—	150	360	360	360	360	360	360	360
Oujda)	—	—	—	—	—	—	—	—	—	—
Mohammedia 3 & 4)				150	1,800	1,800	1,800	1,800	1,800	1,800
TOTAL COAL-FIRED STEAM)	1,190	1,150	1,300	1,660	3,310	3,310	3,310	3,310	3,310	3,310
Oil-Fired Steam:										
Roches Noires 1, 2, and 3)	669	840	690	420	420	420	420	420	420	420
Kenitra 1-4)	1,809	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100
Mohammedia 1 and 2)	121	1,700	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100
TOTAL OIL-FIRED STEAM)	2,599	4,640	4,890	4,620	4,620	4,620	4,620	4,620	4,620	4,620
Gas Turbines	227	600	600	600	600	600	600	600	600	600
Diesel & Purchases	57	—	—	—	—	—	—	—	—	—
TOTAL AVAILABLE	5,147	7,290	8,005	8,090	9,735	9,740	9,735	9,890	10,131	10,454
Margin of Available/Demand		34%	37%	30	46%	36%	27%	21%	16%	12%

/1 Projections of hydro output are for a dry year.

February 1984
(0756P)

MOROCCO

POWER SUBSECTOR STUDY

Electricity Pricing

A. Historical Review

1. As seen from Table 1 below, the average tariff paid by ONE's high and medium voltage consumers increased in nominal terms at an average annual rate of 11.5% during the period 1972-1981. In real terms, however, the increase was substantially lower, averaging only about 4%. By contrast, the tariff paid by the low-voltage consumers increased, in nominal terms, at an average annual rate of about 7.3%, but remained unchanged in real terms.

Table 1

Average Electricity Tariffs (ONE), 1972-1981
(cDH/kWh)

	Low Voltage Tariff				High, Medium Voltage Tariff				Index for the General Price Level /1
	Current	1972 Prices			Current	1972 Prices			
Year	Prices	cDH/kWh	Index	/1	Prices	cDH/kWh	Index	/1	
1972	31.1	31.1	100		11.0	11.0	100		100
1973	32.5	31.3	101		11.0	10.6	96		104
1974	33.3	31.1	100		11.7	10.9	99		107
1975	34.2	31.1	100		11.9	10.8	98		110
1976	39.1	31.0	100		14.1	11.2	102		126
1977	45.9	31.0	100		17.2	11.6	106		148
1978	49.5	31.1	100		19.7	12.4	113		159
1979	51.1	31.2	100		23.0	14.0	127		164
1980	55.5	31.2	100		25.3	14.2	129		178
1981	58.8	31.6	102		29.2	15.7	143		186

/1 1972 = 100

2. Although the increase in the tariff levels for sales at the low, medium and high voltage levels have, by and large, kept up with the increase in the general price level, the increase fell short of covering the substantial increase in ONE's fuel bill. Since 1972, the price paid by ONE for fuel oil and coal increased by about 800% and 400%, respectively, and as a

result, the higher cost of fuel was absorbed by ONE at the expense of its ability for self financing. Table 2 shows the changes over time of the domestic prices paid by ONE for fuel oil and coal and the changes in the average bulk tariff.

Table 2

Price Indices of Fuels Used for Electricity Generation
(Current prices, 1972=100)

Year	Fuel Oil	Coal	Average Bulk Tariff
1972	100	100	100
1973	100	125	100
1974	100	168	106
1975	139	187	108
1976	199	222	128
1977	199	222	156
1978	297	222	179
1979	353	275	209
1980	572	345	230
1981	865	479	266

3. During the period 1972-1979, ONE's financial performance has fluctuated between extremes; that is, for some years ONE managed to cover all of its operating costs and contribute from internal sources between 25% and 30% of the overall cost of its development program, and for the other years, its internal cash contribution dropped to less than 5%. This fluctuation has been primarily attributed to the delays by the Government in adjusting the tariffs for higher fuel prices, and the fact that a large proportion of ONE's electricity supply depends on hydroelectric plants, and in turn, on the level of rainfall (para. 4). Since 1979, however, ONE's financial position has been steadily deteriorating. Over the three-year period, the fuel cost per kWh increased by about 167% and non-fuel cost by about 27% while the average revenue increased by 32% only, as summarized in Table 3. In addition,

Table 3

ONE'S Average Operating Cost and Revenue
(cDH/kWh)

	1979	1980	1981	Percentage of Change (1979-1981)
Average Operating Cost				
Fuel	8.1	11.3	21.6	167
Others	8.2	8.6	10.2	24
Depreciation	6.5	6.4	5.2	-20
Total	22.8	26.3	37.0	62
Average Revenue	24.4	27.0	32.1	32

1981 was an exceptionally dry year which increased ONE's dependence on thermally generated electricity. However, despite the adverse effects of higher fuel costs and dry years on the utility's financial position, the increase in the bulk tariffs were less than needed to compensate ONE for the rise in its cost of operation. As a result, ONE's net operating income decreased from about DH 112 million in 1979, to DH 87 million in 1980 and to a loss of about DH 134 million in 1981. Its internal cash contribution decreased form 21% in 1979 to only 9% in 1981. The Government had earlier agreed to the inclusion of a fuel adjustment clause in ONE's tariff structure. However, as seen from the discussion above, ONE has been prevented from putting it into operation. 1/ In order for ONE to recover the cost of higher fuel prices and maintain the level of its internally generated cash unaltered, it is recommended that, once the program for the restructuringof electricity tariffs is implemented (para. 22), this fuel adjustment clause be activated and that ONE be given the authority to automatically pass on to consumer all increases in its fuel bill.

4. The large contribution of the hydropower plants to ONE's total electricity production increases the sensitivity of its financial position to changes in the hydrological conditions. Changes in the rainfall affect the financial position of any utility with sizeable hydroelectric generation. In years with above average rainfall, the utility manages to reduce its operating costs; mainly by decreasing thermal generation and thus fuel consumption. In dry years, however, fuel consumption increases and if the financial position of the utility is to remain unaltered, additional increases in the tariffs to cover the fuel cost are needed. These increases may tend to be exceptionally high, and consequently socially and politically impractical to apply; particularly if several dry years occur in sequence. Tariffs based on mean hydrological conditions should, in principle, give sufficient income to cover fuel costs over a long period. Surpluses produced in wet years should subsidize deficits in dry years. However, in practice this has not occurred. The relationship between tariff levels and hydrology has been observed by the tariff setting process and inflation. Deficits arising from dry years are difficult to finance and surpluses are politically unacceptable. A possible approach to overcoming this difficulty would be to base the energy component of the tariffs on the level of fuel consumption that would prevail under the adverse hydrological conditions. This would avoid the need for frequent and disproportionately large increases in tariffs and would allow for the creation of a fuel fund which would be replenished during the years of good or average hydrological conditions, and used to smooth out the adverse impact on ONE's finances during hydrologically poor years. Therefore, it is recommended that the Government and ONE consider the redesign of the tariff structure to allow for the energy charge to be based on the fuel consumption in hydrologically bad years, and the creation of a fuel fund to be used for

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1/ The introduction of a fuel adjustment clause is a covenant under IBRD Loan 1299-MOR.

smoothing out the increases in the bulk tariffs needed to cover the increases in the operating cost and maintaining the internal cash contribution of the utility at a relatively stable level following hydrologically bad years.

B. Institutional Responsibilty for Tariffs

5. ONE is responsible for proposing global tariff adjustments to compensate for increases in its operating costs due to higher fuel prices and to ensure, to the extent possible, a minimum cash generation ratio. However, the actual rate of increase and its distribution among various consumers are decided upon by the Prime Minister upon ONE's proposal. Tariffs are then set for each voltage level, each consumer category, and each distribution régie. It is worth mentioning that tariffs applied to the régies, both for purchases and sales of electricity, are set so as to leave the financial position of the régies unaltered, i.e., to maintain the net operating income of the régies at the level that prevailed prior to the tariff adjustment.

6. The practice for setting tariff results in differences in the rates paid by the régies for electricity supplied by ONE. These differences are dictated by the financial position of the régies, and since large and well established régies, such as Casablanca, Rabat, etc., are usually in a relatively better financial position than the smaller or new régies, such as El Jadida and Safi, the large régies cover part of the difference between the rate requested by ONE and the rate finally paid by the smaller régies. The rest of the difference is covered by ONE. However, by ensuring that the financial position of the régies remain unaffected by the increases in the bulk and retail tariffs, the régies are not induced to improve their operating efficiency or their internal cash generation.

7. These practices result in serious departure from the principles pertaining to the economic pricing of electricity. Economic pricing of electricity dictates that tariffs be set at levels that convey to consumers the real cost to the economy of the resources used to meet their demand. Adopting these principles would result in the elimination of the current practices for setting bulk tariffs primarily on the basis of the financial targets of the régies and indirect cross-subsidization among them. They would be replaced by a system where tariffs are based on the average incremental cost of supply derived from a unified national least-cost program (generation, transmission, and distribution for both ONE and the régies). This is discussed in greater detail in para. 22.

C. Level of Existing Tariffs

Economic Costs of Supply

8. The economic cost of electricity is equal to the long-run marginal cost (LRMC). LRMC is derived from the least-cost program for the development of the power subsector. It refers to the increase in the capital and operating costs (generation, transmission and distribution) needed to meet the demand for additional kWhs in the future. However, because of the lumpiness of investment in power facilities (indivisibilities), the long-run average incremental cost (LRAIC) is taken as a proxy for the LRMC. The LRAIC is usually comprised of two elements: (a) capacity cost involving the capital and operations and maintenance costs associated with the expansion of the power system to meet an extra kW of peak demand (demand-related cost); and (b) the fuel and other costs involved in supplying an extra kWh at different times of the day and year.

9. Demand-Related Costs: LRAIC's of meeting additional peak demand are shown in Table 4 below. These LRAIC's were calculated using a 10% discount rate and prices which excluded taxes and duties. Other assumptions are given in Attachment 3.

Table 4

LRAIC of Generation, Transmission and Distribution Capacity
(DH/kW/a, December 1981 prices)

Voltage Level	Generation	Transmission and Distribution			
		HV	MV	LV	Total
Generation	1,088	---	---	---	1,088
HV	1,133	186	---	---	1,319
MV	1,206	199	754	---	2,159
LV	1,325	218	829	536	2,908

10. Energy-Related Costs: The energy related components of LRMC are the costs of generating an extra kWh at each time of the day and year. At a particular time, the extra kWh is supplied from the plant with the highest marginal operating cost per kWh. The plant operating at the margin on the ONE system will depend on the output of hydro plant at the time in question. Hydro output is determined by the overall water resources available, which are influenced by rainfall, other uses of the water and by the procedures for managing hydro reservoirs. The plant operating at the margin and the consequential marginal costs can only be determined precisely by a simulation of system operation that takes seasonal water availability into account.

11. To estimate marginal costs it has been assumed that on average a thermal plant burning fuel oil is always operating at the margin. Reservoirs are assumed to be operated so that hydro energy is used first where it has the greatest value, i.e., to replace the highest cost thermal peaking plant. This tends to smooth marginal energy costs during the day and year. Estimates of marginal energy costs for 1982 are shown in Table 5.

Table 5

Marginal Energy Cost, 1982
(cDH per kWh generated, December 1981 prices)

Period	Time	Marginal Station	Fuel Price Delivered (DH/tonne)	Marginal Costs Fuel	Other /1	Total
Night	2300-0700	Mohammedia 1-2	1,240	27.9	1.7	29.6
Day	(0700-1700) (2200-2300)	Kénitra 1-4	1,272	31.8	2.4	34.2
Peak	1700-2200	Roches Noires 2-3	1,248	32.5	2.7	35.2

/1 Other costs include station labor costs which, strictly speaking, are marginal with respect to station capacity rather than station kWh output.

Adjusting for 6% station use and 2% transmission losses, and combining the day and peak costs by weighting them by consumption, the marginal energy costs corresponding to ONE's HV tariffs are:

Day	(0700-2300)	37.5	cDH/kWh
Night	(2300-0700)	32.1	cDH/kWh

Bulk Supply Tariffs

12. A comparison between the bulk supply tariffs for several régies and industries and the economic costs of supply is shown in Table 6.

Table 6

Comparison Between Bulk Supply Tariffs and Economic Costs
(prevailing charges as a % of economic costs)

Tariff	Max Demand (DH/kVA/Year)	Energy (cDH/kWh) Day	Night
Economic Cost	844/739 /1	37.5	32.1
Casablanca (largest régie)	60 (7)	43.1 (115)	34.5 (108)
Meknès (highest bulk tariff)	62 (7)	44.6 (119)	35.7 (111)
El Jadida (lowest bulk tariff)	52 (6)	37.0 (99)	29.6 (92)
Industry (main MV system)	173 (23)	40.2 (107)	32.2 (100)

/1 Régies/industry assuming a power factor of 0.8 and coincidence factors of 0.9 for régies and 0.7 for industry.

Energy rates are close to, or even higher than, the economic cost. Capacity charges are considerably below the estimated economic cost. Some of the difference is accounted for by the omission of fuel savings from the economic cost. However, a rough calculation based on the cost/kW of a gas turbine which produces no fuel savings, shows that present capacity charges of around 50 DH/kVA/a are about 18% of the most conservative estimate of LRMC of about 280 DH/kVA/a. 1/ Therefore, it is safe to conclude that capacity charges in the present bulk supply tariffs are substantially lower than their economic costs.

Retail Tariffs

13. Medium Voltage: A comparison of selected MV tariffs and the economic cost of supplying ONE's MV consumers is shown in Table 7.

1/ Based on a gas turbine cost of US$300/kW, 15-year life, 20% reserve margin, and transmission costs being half those shown in Table 3. ONE has no plans to commission further gas turbines.

Table 7

Comparison Between MV Tariffs and Economic Costs
(prevailing charges as a % of economic costs)

Region	Max. Demand (DH/kVA/Year)	Energy (cDH/kWh) Day	Energy (cDH/kWh) Night	Total /2 (cDH/kWh)
(a) Economic cost	1,295 /1	39.1	33.4	83.9
(b) Tariff	110 (9)	55.0 (141)	44.0 (132)	56.2 (67)

/1 Based on a 0.8 power factor and a coincidence factor of 0.75.
/2 Assuming a 40% load factor and day/night kWh 75%/25%.

The relation between tariff rates and economic costs is similar to that for the bulk supply tariffs. Capacity charges are in the order of 9% of the economic cost. Energy rates are 30% to 40% above the economic costs. Régies incur no energy costs, since they purchase their energy from ONE. The difference between energy rates in the MV tariffs charged by the régies and the ONE bulk supply tariff is much larger than the adjustment to compensate for losses. For example, the MV tariff for Casablanca implies average losses greater than 20%, whereas the losses for both MV and LV given by the régie are only 5.3%. There is, therefore, cross subsidization from the capacity charges to the energy rates. Consumers with low load factors are paying proportionately less than the economic costs of supplying them than high load factors consumers.

14. Low Voltage: It is difficult to compare the LV tariffs to economic costs because of the lack of data on consumer load characteristics. Residential and commercial consumers in Casablanca pay 52 cDH/kWh which is half the estimated economic cost. Small industrial consumers also pay about half the economic cost. LV consumers in some of the areas served by ONE pay as much as 70% of the economic cost. On the average, LV tariffs are well below the economic costs of supply (LRAIC). The Government control over the increases in the low voltage tariff since 1972 has maintained the real price of electricity to the households and small commercial consumers virtually unchanged while allowing the tariffs for bulk sales to increase in real terms by about 143%. This has had the effect of lowering the internal cash generation of the subsector, mainly ONE, and increasing the dependence of the subsector on budgetary allocations to finance the régies' and ONE's development programs. The budgetary contribution by the Government represents a compensation to the subsector for subsidies that are passed on to consumers.

In particular, the Government subsidizes the LV consumers to maintain households' expenditures on energy at a reasonable level relative to their income; particularly for the low income groups. However, the extension of subsidy for electricity to all the LV consumers is unjustified on both economic and social grounds. The subsidy for the large LV consumers (households and commercial consumers) lowers the marginal price of electricity. This encourages the uneconomic use of electricity and denies the Government the resources which could otherwise be mobilized, if the LV tariffs reflected the economic cost of supply. Subsidy for the electricity consumption of the low income consumers could be accommodated by introducing a system involving a two-tier tariff for electricity: a) a subsidized tariff for a minimum level of consumption needed to meet the electric energy needs for basic lighting and household needs; and b) a tariff that is at or above the economic cost for consumption above the minimum level.

15. Overall, the level of electricity tariffs in Morocco is below the economic cost of supply; particularly capacity charges. The failure of the tariffs to cover the economic cost of capacity is primarily responsible for the inability of the power subsector to achieve an acceptable level of internal cash contribution and the need for budgetary support from the Government. Economic pricing is essential for the efficient use of electricity, particularly in view of the recent efforts by the Government in bringing the domestic prices for petroleum products in line with their cost to the economy. Maintaining tariffs below economic cost distorts the price of electricity relative to the competing fuels and results in their use in a sub-optimal mix. Therefore, in order to maintain the price of electricity relative to the competing fuels at a level that would ensure their efficient use, and given the potential resources that could be mobilized by pricing electricity on the basis of economic cost, it is recommended that the Government gradually move the average tariff for electricity to achieve parity with the LRMC. The optimal strategy for moving the tariffs upwards would be dealt with in the tariff study proposed below (para. 23).

D. Structure of Existing Tariffs

Bulk Supply Tariffs

16. Some features of the bulk supply tariff structure are consistent with charging consumers for the burden which they impose on the system. For example, charging for demand in kVA instead of kW gives an incentive to improve power factors. The different day and night energy rates also indicate differences in marginal generation at different times of the day. However, the regional differences in ONE bulk supply tariffs do not reflect differences in the cost of supply. Furthermore, the declining scale of demand and energy charges does not reflect marginal costs and their elimination should be considered in the proposed tariff study (para. 23).

17. Unless there is strong evidence of substantial differences in transmission costs, each régie should face the same bulk supply tariff for supply at the same voltage. Differences in the costs of connecting a régie to the main system, which are unique to that régie, could be levied as annual fixed charges. This could also serve as the vehicle for any cross subsidization to achieve regional equity. Fixed charges could be calculated to make up any difference between income derived from a bulk supply tariff set equal to marginal cost and ONE's financial requirements. As this would effectively be a tax on the régie, régies in established areas could pay higher fixed charges in relation to their size than régies expanding their networks. Alternatively, if the income from a marginal cost based bulk supply tariff exceeds ONE's financial requirements, tariffs should continue to be set equal to economic cost to ensure efficiency, and a mechanism established for transferring the surplus accruing to ONE to a fund that would finance the development plans of the régies; for example, the FEC would be ideal for managing such a fund. It is therefore recommended that a single tariff for bulk supply be applied for all régies, unless large differences in the marginal costs are identified, in order to ensure equity and simplicity in tariff design.

Retail Tariffs

18. Medium Voltage: The structure of MV tariffs charged by the régies is consistent with the marginal costs of supply. With some exceptions, the structure of ONE's MV tariffs is also consistent with the structure dictated by LRMC. For example, some MV tariffs have time of day kWh charges, plus a maximum demand charge based on kVA. However, in addition to their failure in reflecting marginal costs, other MV tariffs seem unnecessarily complicated for the consumer to understand. An example is the Subscribed Utilization Two kWh Rate tariff (Attachment 2), which has time of day kWh rates that depend on subscribed utilization. If utilization is measured by a maximum demand meter, then the tariff should be abolished in favor of a conventional maximum demand, two kWh rate tariff. If utilization is estimated using other criteria, the consumer is given no benefit for reducing his contribution to the system peak and should be placed on a simpler tariff appropriate to his size. The scale of maximum demand and kWh charges which declines as maximum demand decreases, in the ONE tariff for Special Agreements, does not give a good representation of marginal costs. Costs of connecting a MV consumer may exhibit economies of scale, but are usually sunk. These costs should be recovered either as an initial connection charge or contribution, or as a monthly fixed charge based on the capacity or cost of his connection, adjusted for inflation. Demand and energy should be charged at rates independent of consumption.

19. Low Voltage: The existence in the tariff schedule of five consumer classifications for LV tariffs for each régie and ONE does not appear unreasonable, although the definition of some consumer groups should be examined in the proposed tariff study (para. 23). Present consumer classification depends on end use. A household faces a different tariff depending on whether it uses electricity for lighting alone, or for other

purposes. It is not clear how the tariff is changed if the consumer acquires extra appliances. The classification of LV consumer types should be checked in the proposed tariff study, when better estimates of marginal costs are available. There is scope for a considerable reduction in the number of ONE tariffs by grouping together consumers with similar cost structures. Different tariffs should apply at a particular voltage level only where differences in marginal cost can be separately identified. The optimal number of consumer categories and the definition of each with respect to the cost of supply would be addressed in the tariff study.

20. The present structure is defining the block sizes in the domestic tariff by the number of rooms in the house. Even though the number of lights will be correlated with the number of rooms, their contribution to the system peak will depend also on the number of lights switched on and their ratings. Other appliances, the ownership and use of which is likely to be related only remotely to the number of rooms, will also contribute to peak demand. This definition of kWh block size confuses the marginal cost message given to consumers. It also leads to administrative problems in changing tariffs when consumers add rooms to their home. The proposed tariff study should define the consumption blocks on the basis of kWhs consumed rather than the number of rooms in the consumers' households.

21. LV tariffs that differ between régies are justified if tariffs are to reflect the cost of supply and the financial target of each régie. However, the number of regional variations in ONE LV tariffs should be examined in relation to LRMC in the proposed tariff study (para. 23) and should be reduced where justified on efficiency and equity grounds.

E. Strategy for New Electricity Tariffs

22. Although many aspects of the tariff structure are consistent with marginal costs, the present tariffs are based on financial rather than economic criteria. The tariffs for sales by ONE to the régies are set on the basis of negotiations between the supplier and the consumer (régie), while the retail tariff is set by ONE. Therefore, at the input point (bulk purchase), the tariffs do not reflect the economic cost of supply and at the output point (retail sales), the tariffs are based on ONE's evaluation of the régies' cost of supply rather than on the basis of a least-cost plan and a financial objective for each régie. On economic grounds, tariffs should be based on a properly formulated least-cost development plan and financial targets that would ensure the development of the régies and ONE into self-financing public utilities. To achieve this objective, ONE and each régie should first formulate least-cost development programs from which the economic cost of electricity could be determined. Then, long-term financial targets should be set for ONE and the régies in order to ultimately evolve towards a satisfactory level of self-financing for the power subsector. However, in view of the difference in the financial positions of the régies and the recent

deterioration in ONE's self-financing capabilities, a strategy should be set for gradually achieving the long-term financial objective over a relatively long period of time, to avoid the need for unrealistically high increases in tariff over the next 2 to 3 years. The time horizon for achieving self-financing could be adjusted for each régie to accommodate the need for a longer time horizon for newly created utilities to achieve the targeted level of internal cash generation. Therefore, in order to ensure the economic and efficient use of electricity and provide sufficient funds needed for the development of the subsector from the internal sources of the utilities, it is recommended that the Government formulate a national least-cost development program for the sector based on the integration of such programs for ONE and the régies, and set tariffs at levels that would reflect the economic cost of supply while ensuring the gradual move of the power subsector towards self-financing.

23. Under Loan 1299-MOR, the Government undertook a detailed tariff study which was subsequently reviewed by the Bank. However, the study's recommendations for a reform of Morocco's system of electricity tariffs have not yet been implemented. In view of the changes that have taken place since the tariff study was completed in 1978, and given the fact that the study concentrated its analysis on ONE's development program rather than an integrated program for the entire power subsector, the Government should update the tariff study. A major problem in updating the study is expected to be the lack of data that is detailed enough to allow for an accurate estimate of the economic cost of supply (LRAIC). Most, if not all, régies suffer from poor quality data on their consumers' patterns of electricity consumption. A consistent system for gathering and classifying data from all the utilities in the power subsector is urgently needed. This system could be in place in a relatively short period of time because some of the data covering the régies are presently available at the régies' data center in Casablanca. The new data would serve as a basis for the formulation of a least-cost development plan for the power subsector, and in turn, the estimation of LRAIC and electricity tariffs.

24. The proposed data collection exercise should concentrate on the following areas:

a) Transmission and distribution investment and operating cost data, by voltage level, obtained from least-cost investment plans;

b) Peak and average losses by voltage level;

c) Marginal energy costs (cDH/kWh) obtained from using or adapting generating system operations models and taking the performance characteristics of thermal plant into account. These costs should be analyzed by time of day and season;

d) Consumer load characteristics, especially load factors (utilization), peak coincidence factors, appliance ownership, and demand-to-connected load ratios. These data should be collected particularly for consumers that will face simple kWh tariffs; and

e) The distribution of monthly household consumption obtained from billing data. This is essential to design an increasing kWh block tariff.

February 1984
(0756P)

MOROCCO

POWER SUBSECTOR STUDY

Typical Bulk Supply Tariffs
(Effective from December 1, 1982)

1. El Jadida Régie (lowest bulk supply tariff)

Subscribed or Actual Demand (kVA)			Max. Demand (DH/kVA/a)	Energy (DH/kWh) Day	Night
0	to	100	57.23	0.37,203	0.29,765
101	to	200	56.29	0.37,172	0.29,738
201	to	500	55.34	0.37,134	0.29,710
501	to	1,000	54.42	0.37,096	0.29,679
1,001	to	2,000	53.19	0.37,047	0.29,640
above		2,000	51.52	0.37,001	0.29,604

2. Meknés Régie (highest bulk tariff)

Subscribed or Actual Demand (kVA)				Max. Demand (DH/kVA/a)	Energy (DH/kWh) Day	Night
0	to	100	kVA	69.03	0.44,885	0.35,919
101	to	200	kVA	67.91	0.44,848	0.35,880
201	to	500	kVA	66.79	0.44,807	0.35,846
501	to	1,000	kVA	65.65	0.44,758	0.35,806
1,001	to	2,000	kVA	64.18	0.44,699	0.35,760
above		2,000	kVA	62.17	0.44,643	0.35,717

3. Final Consumers HV and VHV

Maximum Demand (kVA)			Max. Demand Charge (DH/kVA/a)	Energy Charge (DH/kWH) Day	Night
25	to	100	176.23	0.40,335	0.32,258
101	to	200	175.66	0.40,316	0.32,242
201	to	500	175.06	0.40,298	0.32,228
501	to	1,000	174.51	0.40,268	0.32,204
1,001	to	2,000	173.73	0.40,240	0.32,182
above		2,000	172.69	0.40,211	0.32,158

4. Final Consumers MV

Maximum Demand charge (DH/kVA/a	Energy charge (DH/kWh) Day	Night
103.40	0.5170	0.4136

February 1984
(0756P)

MOROCCO

POWER SUBSECTOR STUDY

Retail Tariffs
(Effective from December 1, 1982)

1.1 MV Tariffs (ONE and régies) /1

Maximum Demand DH/kVA/a	Energy Charges (DH/kWh) Day	Night
110	0.55	0.44

/1 Taxes included.

February 1984
(0756P)

MOROCCO

POWER SUBSECTOR STUDY

LV Tariffs for Régies
(Effective December 1, 1982)
(DH/kWh)

		Casablanca	Rabat	Fès	Meknès	Titouan	Tanger	Marrakech	Kinitra	Safi	El Jadida
Private Lighting	U1	0.520	0.620	0.520	0.620	0.620	0.620	0.520	0.620	0.620	0.690
Domestic Commercial	S1	0.620	0.690	0.620	0.734	-	0.620	-	0.690	-	-
	S2	0.690	-	-	-	-	-	-	-	-	-
Administrative	U1	0.520	0.620	0.620	0.620	0.620	0.620	0.520	0.520	0.620	0.690
Lighting	U2	0.520	-	-	-	-	-	-	-	-	-
	S1	0.620	0.690	0.690	-	-	-	-	0.690	-	-
	S2	0.690	0.690	-	-	-	-	-	-	-	-
Mixed (Domestic	U1	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380	0.380
3rd Block)	S1	0.420	0.380	0.500	0.500	-	0.420	-	0.420	-	-
	S2	-	0.420	-	-	-	-	-	-	-	-
Public	U1	0.400	0.500	0.400	0.500	0.500	0.500	0.400	0.500	0.500	0.500
Lighting	U2	0.400	-	-	-	-	-	-	-	-	-
(Includes public	S1	0.500	0.500	-	-	-	-	-	0.550	-	-
buildings)	S2	0.550	0.550	-	-	-	-	-	-	-	-
Administrative	U1	0.400	0.500	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.500
Power	U2	0.400	-	-	-	-	-	-	-	-	-
	S1	0.400	0.450	0.538	0.500	-	0.450	-	0.450	-	-
	S2	0.400	0.450	-	-	-	-	-	-	-	-

Notes:

1 - U denotes urban rate, S rate applying in periurban areas
2 - Subscripts 1 and 2 denote tariff blocks, e.g. U1 tariff for 1st block in urban areas, U2 tariff for 2nd block. Blocks are defined by various criteria, including the number of rooms, on subcribed maximum demand.

February 1984
(0756P)

2.6 LV Tariffs (DH/kWh)

Area	Private Lighting, Domestic 1st & 2nd Blocks	Triple Tariff, Domestic 3rd Block	Administrative Lighting	Public Lighting	Power
Agadir	0.620	0.420	0.620	0.550	0.450
Ouezzane	0.620	0.420	0.620	0.550	0.450
Essaouira	0.620	0.420	0.620	0.500 /1	0.450
Farkhana, Had Beni Chekir, Beni Anzar & Segangane	0.690	0.420	0.690	0.550	0.450
Nador	0.690	0.420	0.690	n.a. /1	0.450
Al Hoceima & Targuist & Errachidia	0.690	0.420	0.690	n.a. /1	0.450
& Erfoud Missour	0.690	0.420	0.690	n.a. /1	0.450
Oujda	0.620	0.380	0.520	0.400	0.400
Settat	0.620	0.420	0.620	0.500	0.400
Sefrou	0.620	0.380	0.620	n.a. /1	0.450
Bhalil	0.697	0.420	0.620	n.a. /1	0.500
Taza	0.620	0.420	0.520	n.a. /1	0.400
Agent ONE-RN	0.520	0.380	-	-	-
S. Ifni /1	0.520	0.380	0.520	n.a.	0.400
Goulmima	0.690	0.420	0.690	0.400	0.450
Others	0.690	0.420	0.690	0.550	0.450
Jemaa El Oued & Talembote Janoubia	0.620	0.380	0.620	0.500	0.400

n.a. = not available

/1 Tariffs instituted by Royal Decree.

February 1984
(0756P)

2. ONE Special Retail Tariffs

MV Subscribed Utilization Two kWh Rate

Applicable to the provinces of Guelmin, Tan Tan and Tata.

Subscribed Hours of Utilization (Hour/Month)			Energy Peak Hours (DH/kWh)
0	-	125	0.4,897
126	-	170	0.4,861
171	-	210	0.4,821
211	-	250	0.4,797
251	-	300	0.4,778
301	-	350	0.4,766
351	-	400	0.4,755
	above	400	0.4,748

9% discount for off-peak hours.

MV Two kWh Block Tariff

Applicable in the Saharan provinces of Laayoune, Smara, Boujdour and Oued Ed-Dahab.

First 1 - 750 kWh/month	0.522 DH/kWh
Remainder	0.456 DH/kWh

February 1984
(0756P)

MOROCCO

POWER SUBSECTOR STUDY

Assumptions Used to Calculate Long Run Average Incremental Costs

The LRAIC's of meeting additional peak demand, shown in Table 4, were calculated using the following assumptions:

1. Generation LRAIC was based on the demand forecast and corresponding estimates of capital expenditure for 1983-90 prepared by ONE in June 1982. Expenditure on projects under construction or otherwise committed was excluded. Such projects included Amougguez, Dchar el Oued, and Mohammedia. These power stations could not be advanced or delayed to meet a change in demand and are therefore not marginal. Expenditure incurred in the late 1980's on projects scheduled for commissioning in the 1990's was included in the LRAIC calculation. These projects consisted of Imezdilfane, Taskdert, Tajemont, Tanafit, El Borj and Tilougguit hydro stations, as well as a steam station burning imported coal, 1/ the Tarfaya oil shale station and the proposed nuclear station.

2. An increase in demand today would result in the commissioning dates of future power stations with low or zero fuel costs, e.g. hydro, being brought forward, compared to the least cost development program. This would result in fuel and other variable operating cost savings. Strictly speaking, these fuel and other variable cost savings should be subtracted from the LRMC of generating capacity. This would require a computerized planning model of the ONE system that took account of the constraints of hydro energy availability. The estimated of LRAIC of generation capacity shown in Table 4 are therefore biased upwards. Fuel savings should be considered correctly in the proposed LRMC tariff study.

3. Transmission and distribution (T&D) LRAIC's are based on projections of the physical development of the T&D system during 1982-85 e.g. km of 225 kV transmission line, MVA of 60/22 kV substation capacity, numbers of 60kV switchyard bays. This was costed using unit costs for typical projects at December 1981 prices supplied by ONE.

4. The T&D development plan and costs were available for ONE only. Little information is available on the least cost investment plans of

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1/ Planned by ONE in the event that implementation of the oil shale program is delayed.

the régies, if indeed they exist much beyond the current year's budget. The LRAIC's of MV and LV distribution apply, therefore, only to ONE. As ONE predominately supplies rural areas, the LRAIC's shown above in Table 4 are probably higher than for régies supplying urban areas, where distribution LRAIC's tend to be lower.

5. Peak losses were assumed to be: HV 4%, MV 6% and LV 9%.

6. Plant lives used to annuitize the capital costs/kW were: hydro 50 years, steam 30 years, nuclear 25 years, T&D 30 years.

September 1982
(0756P)