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ENERGY DEMAND MANAGEMENT IN MOROCCO

A Prefeasibility Analysis

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ABSTRACT

The following report constitutes a preliminary analysis of a possible energy demand management program in Morocco. The analysis, which is based on 2-week in-country visit and intensive review of existing information, indicates that a national energy demand management program in Morocco targeted to selected industries, mostly private, and other subsectors such as large buildings and commercial road transport could save in excess of U.S. $50 million annually in oil imports alone and U.S. $150 million at current energy market prices. In addition, the program could delay costly investments in additional electricity generation and refinery upgrading. The total annual investment needed is estimated at around $160 million, of which about half would be in foreign exchange. More detailed analyses are recommended in the short-term to finalize program targets and implementing institutions with the GOM. Immediate recommendations are that a steering committee consisting of high-level representatives of the public and private sectors be established to guide the final project design. It is also recommended that USAID provide support to the program in the form of technical assistance -- for information dissemination, training, demonstration, and technology transfer of U.S. equipment -- and financial assistance through a dedicated credit line.

LIST OF ACRONYMS AND ABBREVIATIONS

BNDE	Banque Nationale pour le Developpment Economique
CDER	Centre de Developpement des Energies Renouvelables (Renewable Energy Development Center)
CDI	Code Des Investissements
CDM	Charbonnages du Maroc (formerly Charbonnages Nord Africains) (Collieries of Morocco, formerly North African Collieries)
CGEM	Confederation Generale Economique du Maroc
EDM	Energy Demand Management
EDMP	Energy Demand Management Program
FCCI	Federation des Chambres de Commerce et l'Industrie
GDP	Gross Domestic Product
GOM	Government of Morocco
ISTI	International Science and Technology Institute
LPG	Liquified Petroleum Gases (butane and propane)
MEM	Ministere de l'Energie et des Mines
OCP	Office Cherifien des Phosphates
ONAREP	Office National de Recherche et Exploitation Petrolieres (National Office for Petroleum Exploration and Development)
ONE	Office National de l'Electricite (National Electricity Authority)
Plan	Ministere du Plan, de la Formation des Cadres et de la Formation Professionnelle (Ministry of Planning and Executive and Professional Training)
PMI	Petite et Moyenne Industrie

SR

SAMIR	Societe Anonyme Marocaine de l'Industrie du Raffinage
SCP	Societe Cherifienne des Petroles
SNPP	Societe Nationale des Produits Petroliers (National Oil Products Company)
SOCOCHARBO	Societe de Commercialisation du Charbon (Coal Marketing Company), a subsidiary of CDM
SPD	Service de Planification et de Documeration
toe	Ton of oil equivalent

Energy Units, Equivalencies and Prices

Petroleum	Unit	Heat Content (Mcal/unit)	Price (Dh per unit)	Price (Dh per toe)
Diesel oil	tonnes	10,000	4,050	4,050
Residual oil	tonnes	9,600	1,875	1,953
Coal				
Imported	tonnes	6,100	750	1,230
Local	tonnes	5,700	690	1,210
Electricity	kWh	0.86	HV 0.57	6,628
			MV 0.55	6,395
			LV 0.81	9,419

Note: 1 toe = 10,000 Mcal = 41,800 MJ = 39.7 MBtu
/kWh = 2.450 Kcal in primary energy

Currency Exchange Rate

1 U.S. dollar = 8.74 Dirham (Dh) as of October 1986

EXECUTIVE SUMMARY

Economic development in Morocco is currently constrained by a growing scarcity of both foreign exchange and local currency that can be used for investment purposes. The foreign exchange shortage has its roots in the national debt, which reached $13 billion in 1985 and is expected to exceed $14 billion by the end of 1986. This debt equals the value of 7 years of exports, and requires more than one-third of Morocco's annual export revenues to service. It has been fueled over the past decade by a continuous rise in oil imports and a continuous decline in the international price of phosphate, the country's major export. Between 1975 and 1984, the ratio of phosphate price to oil price dropped by 75 percent. Moreover, oil demand grew at an average 6.5 percent per year while phosphate production remained roughly constant. As a result, most of the increase in energy demand over this period was met by increased imports, mainly oil. While Morocco's efforts to develop domestic energy resources have done little to correct the trade imbalance, fuel import diversification has been more successful. Between 1980 and 1985, coal imports rose from 28,000 tonnes to 450,000 tonnes; nonetheless, over this period oil imports grew from 4 million tonnes (Mt) to 4.8 Mt.

The scarcity of public domestic funds is illustrated by the country's 1985 budget deficit, which exceeded 6 percent of gross domestic product.

Most recent macroeconomic projections indicate that if the economy is to grow at the expected 5.5 percent annual rate in the next 5-year plan (1986-1991), the country will have to substantially increase its imports of both oil

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and coal. Although the recent drop in oil prices provides some temporary foreign exchange relief, the long-term outlook is not favorable. Most analysts agree that world oil prices are likely to climb, and this increase, coupled with rising imports, will perpetuate the burden on the economy. In addition, the lack of local funds is constraining new exploration and development projects in the energy sector and is affecting the investment program of ONE, the national electric utility. In light of these constraints on development, the Government of Morocco (GOM) has assigned a high priority to the optimization of energy use. It has already sponsored and encouraged a number of energy conservation activities, primarily in the industrial sector, where most of the obvious no-cost and low-cost conservation measures have been implemented, as well as some investment projects, mainly conversion from oil to coal in cement and power plants. In addition, ONE has implemented a load shedding scheme in large industrial facilities to cope with rising power demand and a low supply of hydroelectric power during some periods of the year.

The most effective way of reducing energy demand, however, may have been the GOM policy to raise domestic prices to a level equal to or higher than international prices. For example, the government more than doubled petroleum product prices between 1980 and 1985. A review of energy conservation activities, including pricing, indicates that energy demand growth slowed after 1980, and price increases probably played the major role in this slowdown.

Not everyone in Morocco has been able to adapt to higher energy prices, however. Large industrial facilities that must remain internationally

competitive to survive have relied on their highly competent personnel and access to financing to introduce energy saving measures. For the rest -- small and medium-sized enterprises, the transportation and buildings sectors, and households -- much remains to be done. Here, international experience, especially with new technologies, can prove useful to Morocco.

THE NEED FOR A NATIONAL ENERGY DEMAND MANAGEMENT PROGRAM

Morocco's foreign debt and domestic investment budget problems can be alleviated by implementing an aggressive energy demand management (EDM) program aimed at identifying financially and economically justified actions and investments at the energy end-use level. An EDM program would constitute a second phase in Morocco's efforts to achieve higher energy efficiency, the first phase being the measures already introduced by large industrial enterprises. In this second phase, Morocco would "switch gears" to benefit from recent international advances in energy management in less conventional areas, e.g., end-use electric load management, transportation energy management, and the broad use of new technologies such as advanced electronic controls. International experience suggests that intensive energy demand management activities can reduce Morocco's energy consumption by 5-10 percent over and above improvements achieved by using new, more efficient equipment.

The GOM has recognized the need for implementing such activities in Morocco and is assigning high priority to the design of a program aiming at achieving this level of foreign exchange savings. USAID has offered to assist

the GOM in such a design phase and funded a two week in-country study carried out by two consultants from Hagler, Bailly & Company, a US consulting firm specializing in energy management. The following paragraphs summarize their findings and recommendations.

Findings

To determine the feasibility of an EDM program, the literature was reviewed and Moroccan government and industry representatives were interviewed. The results of the review and the interviews suggest that an EDM program would save Morocco around 750,000 tonnes of oil equivalent (toe) per year by 1996 (about 7 percent of the country's projected total energy demand). Of these savings, 560,000 toe would be fuel savings and the balance would be electricity (700 GWh). In addition, the program could lead to a reduction or postponement of up to 200 MW of electric capacity through better electric load management and the promotion of non-utility power generation (see Exhibit 1). Other program benefits would be a reduction in refinery investment as the fuel demand structure (e.g., diesel oil vs. fuel oil) is better balanced through optimization. Important secondary benefits would be an improvement in industrial efficiency through energy cost reductions.

Of the projected fuel savings, about 55 percent would be in the energy and industrial sectors and 36 percent in the transportation sector. Of the projected electricity savings, 45 percent would be in the energy and industrial sectors, and an equal proportion in the buildings sector, e.g., hotels. The balance of the potential lies mainly in large pumping stations.

Exhibit 1

Preliminary Estimate of Potential Savings (1996)
(all numbers are rounded)

	Potential	
	Fuel (toe/yr)	Electricity (GWh/yr)
A. Energy Savings		
Subsector		
Energy & Industry		
Energy sector	170,000	100
Large manufacturers industry	60,000	80
Other L.M.I.	10,000	60
Medium & small industry	70,000	60
Subtotal	**310,000**	**300**
Transport		
Road transport	200,000	-
Services		
Large buildings		300
Agriculture		
Pumping		100
Other	50,000	-
Total (rounded)	**560,000**	**700**

B. Investment Savings	Potential
Refineries	N/A
Power plants	200 MW

N/A = not available

Source: Hagler, Bailly & Company

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Of course, not all this potential can be attributed to an EDM programs, as some of it will be realized anyway, especially in large industrial plants. In sectors other than industry, several obstacles will prevent the realization of much of this potential. Five major obstacles or barriers have been identified.

Lack of Information and Awareness

Large energy users in the private and public sectors, including parastatal energy suppliers, are well informed about energy efficiency as a result of international specialized publications and ongoing relationships with leading firms and organizations of developed countries, primarily European. Small and medium-sized enterprises and energy users in the transportation, commerce, and agriculture sectors, however, have little or no information about energy efficiency techniques and associated benefits. In small and medium-sized industrial firms there is little awareness of energy-efficient systems and, more importantly, little knowledge about energy as a cost factor.

Lack of Market for EDM Services and Equipment

Few experienced engineers and managers work in the consulting/engineering area because there is generally believed to be no market for such activities in the country. As a result, only a few "risk-takers" have entered this market, with mixed results. Market size and resistance to change are cited as the major barriers.

According to the manager of a specialized consulting firm, energy audits cannot be sold as such, because people do not see the tangible benefits resulting from such activities.

Almost any kind of equipment can either be found in Morocco or imported. There is basically no restriction on technology imports, but duty taxes are high. For example, imported metering equipment costs more than twice what it does in Europe or the United States. In addition, because of the perceived lack of maturity of the market for energy demand management equipment, the cost and effort required to create a demand is considered to far outweigh the possible benefits.

Lack of Non-Price Incentives

With very few exceptions, most interviewees mentioned a lack of incentives as a key barrier to energy conservation. When asked about the type of non-price incentives needed to induce end users to save energy, the interviewees mentioned duty tax exemptions, grants for first installation of a new type of device, and tax credits.

One of the non-price incentives that companies would be most responsive to, and that would be most justified, is the elimination or reduction of import duty taxes on selected equipment considered to be EDM equipment.

Lack of Adequate Financing

Almost all financing available to industry in Morocco is aimed at new plants or the expansion of existing facilities where the key criteria are job and

value added creation. It is extremely difficult to finance a small productivity improvement project, unless there is a dedicated credit line with a foreign exchange risk guarantee.

Lack of Institutional Coordination

Various ministries are concerned with present and future energy use. In addition to the Ministry of Energy and Mines, three other ministries -- the Ministry of Industry, the Ministry of Transport, and the Ministry of Housing -- play an important role, but there is little coordination among them.

PROGRAM TARGETS

The preliminary analysis of the energy conservation potential indicates that the following subsectors are prime targets for an EDM program:

- Industrial facilities (small and medium; selected large, older units)
- Large buildings (mostly hotels and office buildings)
- Commercial transportation
- Irrigation pumping

Large plants (ONE, refineries, phosphate), especially newer ones, are not likely to benefit much from the program because they are already reasonably efficient, they intend to continue increasing their energy efficiency, and they have highly qualified, motivated, and well-informed personnel. Private

transport and household would be better served by such measures as information campaigns and standards for appliances.

The EDM program would have two components:

- Technical Assistance
- Financial Assistance (credit line)

The technical assistance (TA) component would include a series of activities aimed at addressing the most urgent and significant non-financial needs. The credit component would seek to make adequate financing available for EDM investments.

Technical Assistance

The TA component would consist of consultant services (local and foreign) and specialized equipment and materials to enable the Moroccan parties to achieve program objectives. This component would involve five sub-components: information and awareness, training, technical support, technology transfer, and general policy guidance (see Exhibit 2).

Information and Awareness

The main objective of this sub-component will be to assist Moroccan organizations in their efforts to increase public awareness of the potential benefits of energy conservation and thus involve the public in national energy demand management activities. It will include activities such as television and newspaper campaigns and the publication of pamphlets, booklets, and do-it-yourself leaflets.

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Exhibit 2

	TARGET(S)
1. INFORMATION AND AWARENESS	
• National campaigns on TV, radio and newspapers, with spots, brochures, posters	National
• Series of workshop and seminars on techniques, equipment and practices of energy demand management	Professional associations; management and technical staff of large energy-using facilities in industry, commerce, transport (fleets) and agriculture (large pumping units). Technical and management staff.
• Publication of pamphlets, booklets and do-it-yourself leaflets	
2. TRAINING (in Morocco and the U.S.)	
• Energy audits	Technical staff in large energy-using facilities and PMI, consulting and engineering firms.
• Cost control	Management staff/accountants of selected energy using facilities.
• Project preparation, evaluation, and implementation	Management and technical staff (Includes demonstration projects)
• General (policy, advanced technologies)	Government officials
3. TECHNICAL SUPPORT	
• Energy audits of large industrial units, commerce buildings, transport, fleets, and large pumping station	All sectors - large energy users, consulting/engineering firms
• Project feasibility studies of fuel switching, major rehabilitizations, electric load management	same as above
• Demonstrations of new practices or technologies in industry, transport and large buildings.	Users, vendors, consultants, engineers, and architects
4. TECHNOLOGY TRANSFER	
• Auditing instrumentation	Certified consulting/engineering firms. Selected organizations and individuals.
• New devices/systems (energy demand management system for buildings; controls)	Selected users, vendors, consulting engineering firms.
5. GENERAL: POLICY GUIDANCE	
• Energy manager association	Plant engineers
• "Think tank"	Government, parastatals, private sector managers, representatives of financial, institutional, and professional associations.

Source: Hagler, Bailly & Company.

Training

The basic objective of this sub-component will be to assist Moroccan organizations in upgrading or updating local capabilities in areas where they are currently deficient to ensure timely and efficient planning and implementation of the program. The training will include: short overseas study tours and degree courses; seminars and workshops given by foreign consultants and tailored to Moroccan needs (e.g., energy audits); and vocational training (e.g., for boiler operators).

Technical Support

The objective of this sub-component is to provide the necessary technical support (through foreign consultants and, wherever feasible, through local sources) to help plan and implement the program. Various types of technical support will be provided at a variety of levels, including: to local organizations and the private sector on energy audit techniques, project feasibility analysis, and the operation, manufacture, and/or import of energy-efficient equipment; to R&D organizations on testing, development, and certification of energy-efficient appliances; and to various national entities on planning and implementing demonstration projects.

Technology Transfer

Various U.S. technologies and equipment are among the most efficient and cost effective in the world. U.S. technology that could be transferred to Morocco to accelerate energy demand management may include: energy audit equipment for industry and buildings; combustion controls; equipment for

demonstrating transportation fuel-saving devices; and electric load and demand management systems. These technologies would facilitate training and the preparation of demonstration projects.

General Policy Guidance

Support to a group of representatives of the government (parastatals) and the private sector will be provided (see below "Steering Committee"). Support activities for this group may include visits to similar groups in other countries, particularly the U.S. and selected developing countries (e.g., Tunisia, the Philippines), and consulting services for special studies (e.g., cost/benefit analysis of policy initiatives such as electric load management at the end-user level).

Financial Assistance (Credit Line)

Because financing is a major stumbling block to implementing an energy demand management program on a large scale, the program would need to establish a credit line for related investments. The credit line would provide foreign exchange funds to enterprises and organizations unwilling to obtain direct supplier credit or unwilling to assume the associated foreign exchange risk. To make this credit line attractive to borrowers and thus ensure that the funds will be used, competitive terms and reasonable guarantees will be needed. The credit line, dedicated to the purchase of U.S. equipment, will be for U.S. $10 million. It would be used as a revolving fund and be disbursed by commercial banks.

POSSIBLE INSTITUTIONAL ARRANGEMENTS

In light of international experience, together with the institutional situation in Morocco and the overall trend of the economy toward privatization and increased reliance on international market forces, it is possible to highlight a few critical prerequisites for program success:

- To the extent possible, the project must be led, designed, and implemented by existing Moroccan organizations.
- Implementation should be primarily left to the private sector.
- Public policy in energy and other matters (e.g., industrial development, importing of equipment) must be adapted to support the program.
- Whatever the program, highly respected and experienced individuals must be in charge of it.

Rather than creating a new entity to run the proposed program, efforts must be made to use existing institutions and expand their capabilities. Trade associations or the Federation of the Moroccan Chambers of Commerce and Industry would be attractive candidate organizations to coordinate program implementation.

Mobilizing the Private Sector

The private sector is the key to the success of the program. It is thus essential that the private sector assume a leading role in the energy demand management program by: participating actively in its design and definition

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(steering committee or working group) and being directly responsible for implementing the program.

To gain the support (and later the leadership) of the private sector, it is essential to initiate a series of activities, including:

- The establishment of a project steering committee or working group composed of representatives of the government (Ministry of Energy and Mines, ONE, SCP, public industrial corporation) and the private sector (textiles, food industries; architects; transportation companies; consulting/engineering firms)

- A public relations initiative or promotion campaign aimed at energy users and consisting of seminars, lectures, awards, group activities, site visits, and other events in key Moroccan cities. This initiative should develop awareness and interest among users before program implementation so that early results can be achieved.

PROGRAM BENEFITS

In addition to saving foreign exchange and deferring investments, an energy demand management program would: improve the trade balance by reducing the operating costs of export-oriented manufacturing companies, increase productivity, and lower domestic prices.

The expected benefits directly related to the program are a only fraction of the potential mentioned above because some of it would be captured anyway, especially in the large industry. These program benefit targets are estimated

at 386,000/toe per year by 1996 or a cumulative 2 million toe for the 1987-1996 period and 100 MW of avoided electricity peak generation. Benefits resulting from delaying refinery upgrading investment cannot be estimated at this time, but would be substantial.

In performing the cost/benefit analysis, economic and financial perspectives have been taken. The economic analysis is based on the assumption that all energy savings result in oil import reductions. Two scenarios have been selected for future oil price: a low scenario where oil prices remain constant at $15.5 per barrel and a high price scenario where international oil prices increase at 5 percent per year in real terms (US $24 per barrel by 1996 in constant 1986 dollars).

Under the low oil price scenario, the foreign exchange value of these benefits is estimated at U.S. $158 million through 1996. Under the high oil price scenario, the economic value of the savings -- which is assumed to be equal to their foreign exchange value -- exceeds $200 million.

In financial terms, the value of annual savings in 1996 is $149 million, for a cumulative present value of $377 million.

Total investment needed for the program would be around $150 million, about half of it in foreign exchange, for a payback on foreign exchange of less than 2 years (see Exhibit 3).

PROGRAM COSTS

The technical assistance cost is estimated at $9.5 million for a 5-year program, of which $7.0 million are in foreign exchange. In addition, about

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Exhibit 3

Preliminary Estimate of Costs and Benefits of An EDMP
(all cost and benefit figures are in 1985 U.S. dollars, millions)

Subsector	Target Annual Savings - 1996 1/				Value of Annual Savings - 1996			Present Value of Savings - 1996 4/			Investment Cost (1986-1996) 5/				
					Economic Analysis 2/		Financial Analysis 3/	Economic Analysis		Financial Analysis	Economic Analysis			Financial Analysis	
	Fuel Oil (TOE)	Diesel Oil (TOE)	Electricity (GWh)	Total (TOE)	Low Oil Prices (0% Growth)	High Oil Prices (5% Growth)		Low Oil Prices (0% Growth)	High Oil Prices (5% Growth)		Foreign Exchange	Local	Total	Duty	Total
Energy & Industry	126,000		160	165,000	18.9	29.3	38.3	59.0	76.2	96.8	30.2	20.2	50.4	7.6	58.0
Transport		150,000		150,000	17.2	26.6	69.5	53.6	69.3	176.0	27.4	18.4	45.8	6.8	52.6
Services			270	66,000	7.5	11.7	17.0	23.6	30.5	43.0	12.0	8.0	20.0	3.0	23.0
Agriculture			90	22,000	2.5	3.9	5.7	7.9	10.2	14.4	4.0	2.6	6.6	1.0	7.6
Other		40,000		40,000	4.6	7.1	18.5	14.3	18.5	46.9	7.4	4.8	12.2	1.8	14.0
TOTAL	126,000	190,000	520	443,000	50.7	78.6	149.0	158.4	204.7	377.1	81.0	54.0	135.0	20.2	155.2

Note: See Exhibit 4.b for assumptions.

Source: Hagler, Bailly & Company.

$155 million will be needed for investment, $81 million or 53 percent of it in foreign exchange (see Exhibit 4).

CONCLUSIONS AND RECOMMENDATIONS

The preliminary analysis of the program indicates that it is economically and financially justified and could be successfully implemented, provided the private sector plays a key role in its definition, guidance, and implementation.

To be successful, the program must be carefully designed to identify the specific actions or initiatives needed to remove the barriers to energy demand management. At this point in time, there is insufficient information to do so.

Based on the above findings, three activities should be undertaken in the design and development phase of the program:

- Establish a steering committee
- Develop and implement a promotion campaign
- Conduct special studies

These activities -- which constitute an action plan -- are presented in Exhibit 5.

The action plan should make use of available resources as much as possible. ISTI contractors, and especially the energy conservation advisor, should play a key role in (1) advising on the selection of steering committee members; (2) providing inputs for design and implementation of the promotion campaign; and (3) drafting terms of reference for special studies.

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Exhibit 4

Program Cost Summary (1986 $ US million,
(all figures are rounded)

	Local			Foreign			Total
	GOM	Private Sector	Total	USAID	Other Donors	Total	Foreign & Local Exchange
Technical Support	1.0	1.5	2.5	5.0	2.0	7.0	9.5
Investment Requirement	30.0	45.0	75.0	10.0	70.0	80.0	155

Source: Hagler, Bailly & Company.

Exhibit 5

Proposed Action Plan

ACTION	COST (1986 dols, thousand)	SOURCE OF FUNDS	TARGET DATE
A. ESTABLISH STEERING COMMITTEE	N/A	N/A	March 87
Objective: guide program design and promotion activities (see below B)			
Members: MEM, ONE, SCP, public firms (5) Private representatives (cement, sugar, textiles)			
B. CONDUCT PROMOTION CAMPAIGN	150	ISTI Contract	May 87-April 88
Objective: gain early support for program and mobilize private sector			
Implementing Organization local firm with assistance from ISTI contractors			
C. CONDUCT SPECIAL STUDIES	250	Mission	March-June 87
- detailed analysis of potential energy demand management by subsector	(50)		
- detailed program economic and financial analysis, including risk analysis	(35)		
- Detailed institutional analysis (local capabilities)	(35)		
- Potential for non utility power generation	(80)		
- Market studies for EDM services and selected U.S. EDM equipment (Energy Management Systems for load management systems; control) in order to refine credit line estimate.	(50)		

Source: Hagler, Bailly & Company.

INTRODUCTION

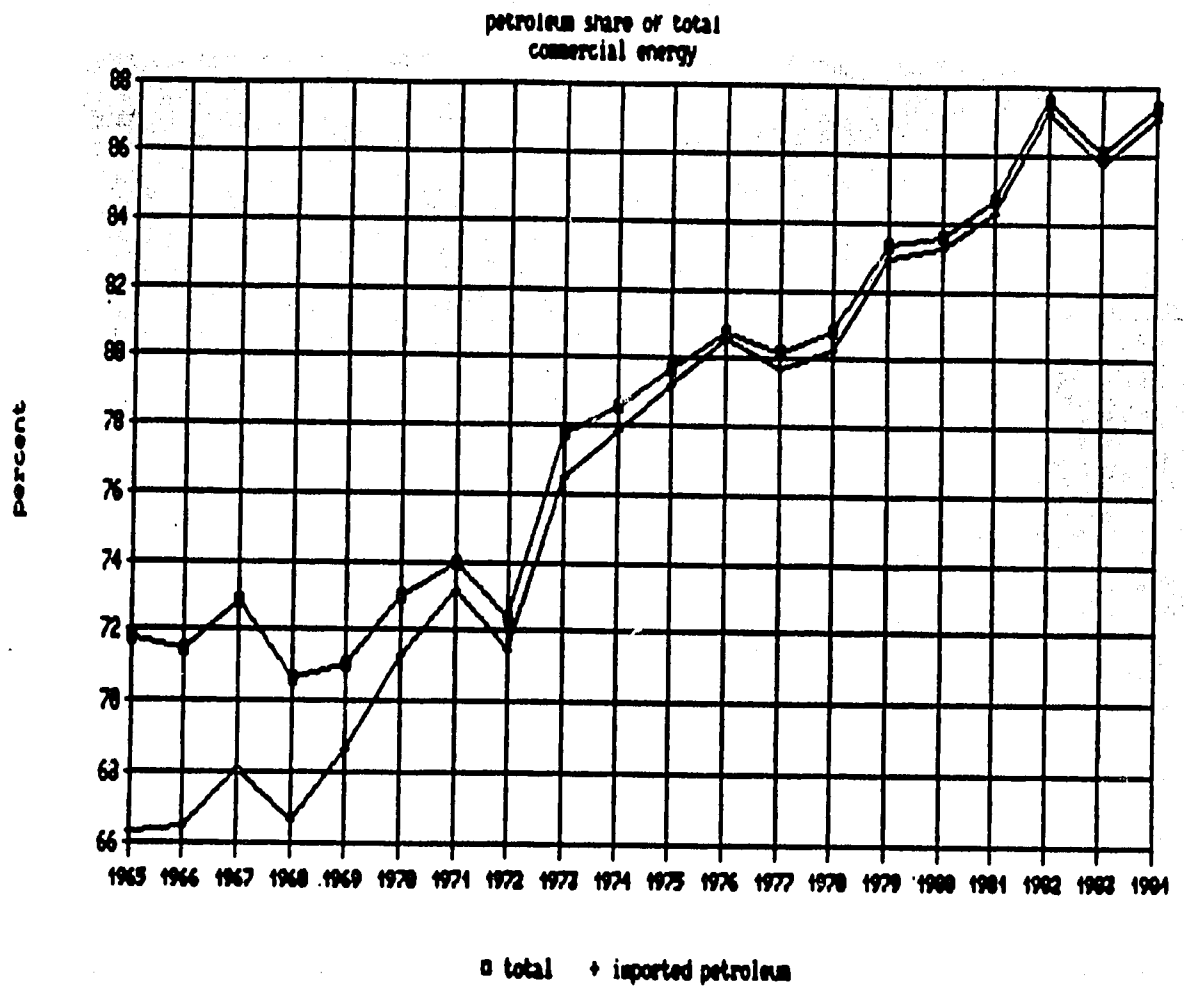
Morocco is a large energy importer. In 1985, the country imported 4.8 million tonnes of oil, nearly 1 million tonnes more than in 1980, and about 450,000 tonnes of coal. This imported oil and coal represented 88.7 percent of all commercial energy used, a 10 percent increase over 1973 usage (see Exhibit 1). Moreover, the 1985 energy import bill was close to U.S. $1 billion, nearly half the total value of exports.[1]

Energy use also puts heavy pressure on the domestic budget. Energy sector investments included in the 1981-1985 five-year plan accounted for Dh 11,642 million (U.S. $1.8 billion) or about 10 percent of total investments.[2] While this figure is lower than in many other countries, it nonetheless represented a drain on investment funds both in local currency and foreign exchange in general because oil prices were rising vis-a-vis the prices for soft phosphate rock -- a major export product. Indeed, between 1975 and 1984, the ratio of phosphate prices to oil prices fell four fold. Moreover, oil demand grew at an average 6.5 percent per year, while phosphate production remain roughly constant. As a result, most of the increase in energy demand over this period was met by increased imports, mainly oil. Thus, Morocco's

[1] The macroeconomic importance of the energy sector in Morocco. IDEA - October 1986

[2] Morocco: Issues and Options in the Energy Sector - March 1984 - pp 38 and 39.

Exhibit 1: Petroleum Share of Total Commercial Energy



Source: Draft Report, The Macroeconomic Importance of the Energy Sector In Morocco, IDEA, Inc., 1986

outstanding foreign debt reached U.S. $13 billion in 1985, or over six times the value of total 1984 exports.

In light of these problems, the Government of Morocco has taken steps to optimize energy use. It has initiated an aggressive exploration and development program to exploit domestic oil, natural gas, and shale oil reserves (mostly with ONAREP) and hydroelectricity potential (with ONE). In addition, with the establishment of the Ministry of Energy and Mines (MEM) in 1979, several activities were undertaken to promote energy conservation by end users. Domestic energy prices have been increased substantially to reach or exceed parity levels. (See Exhibit 2.)

As part of this effort, an energy conservation service was established within MEM in 1979; high-level and comprehensive seminars were organized (1979-1984) and a survey of large energy users was conducted (by Transenerg with bilateral technical assistance from France) to define an energy audit program. The potential for energy conservation was also investigated by the World Bank (1982 and 1985), although no project has yet resulted from the study. MEM not only recommended high domestic prices for energy products, but took the lead in incorporating incentives for energy conservation investments in the Code des Investissements or CDI (1983). Such incentives stipulate that energy conservation investments may receive a subsidy of Dh 500 per tonne-of-oil equivalent (toe) saved, under specific conditions . (See Appendix E.)

Government actions also took the form of a campaign launched in early 1984 to educate the public about the need to reduce energy waste and economize on electricity and gasoline. In addition, the government adopted specific measures, such as shortening the work week to five days, shortening TV

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Exhibit 2

Petroleum and Coal Wholesale Prices and Import Parity Equivalents (per toe)

Product	November 1982				September 1986			
	Domestic Prices		Import Parity	Domestic/ Import Ratio	Domestic Prices		Import Parity	Domestic/ Import Ratio
	(DH/toe)	($/toe)	($/toe)		(DH/toe)	($/toe)	($/toe)	
Gasoline	6,149	981	416	2.36	8,187	937	161	5.81
Kerosene	2,833	452	415	1.09	3,927	449	139 **	3.24
Gas Oil	3,059	488	351	1.39	4,050*	463	121	3.82
Fuel Oil	1,498	239	187	1.28	1,875*	215	70	3.06
LPG	2,413	385	443	0.87	2,958	338	105	3.22
Imported Coal	1,460	233	164	1.42	n.a.	n.a.	-	-
Domestic Coal	560	89	100	0.89	1,035	118	29	4.07

* In bulk purchase.
** Jet Kerosene, slightly more expensive than regular kerosene.

All 1986 prices are FOB Mediterranean

Exchange rates: November 1982 DH 6.2676/$
September 1986 DH 8.74/$

Source: Joint UNDP/World Bank Energy Sector Management Assistant Program

broadcasting time, advancing the clock permanently by one hour to shift the peak load on electricity consumption, and applying selective power cuts to agricultural and industrial facilities during peak evening hours. The extent to which these measures have affected energy use, particularly the use of electricity, is not accurately known. However, the five-day work week is expected to eventually reduce peak demand by an estimated 30-40 MW and the one-hour advance by about 30 MW in summer and 60 MW in winter.

In the services sector, reductions in the energy used by commercial buildings and hotels for water heating, lighting, and air conditioning are possible, as are energy savings through architectural design. Hotels alone are estimated to consume about Dh 50 million of energy products, 20 percent of which could be saved by investing in energy conservation measures with typical payback periods of no more than 3 years. Energy conservation in commercial buildings and hotels has been slow to develop, partly because of a lag in information about the potential savings and partly because of a lack of direct financial incentives (the CDI does not apply to this sector).

Measures have also been taken to effect changes in energy use for power generation, industry, and households. Plans to convert industrial facilities to gas have been stalled because the Meskala gas field has not yielded the large output expected. However, in an alternative move, a major switch from fuel oil to coal has been initiated both in the industrial and power generation sectors. Further fuel substitution may occur if the present exploration efforts yield sizable natural gas reserves, or if international oil prices continue to decline.

The coal substitution effort, spearheaded by ONE and the country's cement plants, was prompted by two factors: the attractive price differential between coal and fuel oil, and the relatively small investment required for conversion at several installations because they had previously used coal.[3]

ONE started burning coal in the multifuel 60 MW Unit II of the Roches Noires thermal plant in 1982. The plant now consumes between 150,000 and 200,000 tonnes of coal a year. Units III and IV (150 MW each) of the Mohammedia plant now require 800,000 tonnes of coal per year. The cement industry has also converted most if its plants to coal.

In addition, MEM's Service Planning and Documentation has initiated a project, supported by USAID, that includes an energy conservation component developed with the assistance of a long-term advisor. The advisor's role is to coordinate energy audits in large energy-using facilities and to develop a local market for energy conservation equipment and services.

The combined net impact of all these conservation measures is not known with precision. MEM estimates that current national energy consumption is about 1-1.5 Mtoe lower than it would have been if the pre-1980 trend had continued. In a recent study[4] for MEM, SPD reached a similar conclusion, estimating achieved savings at 1.4 Mtoe in 1982 and up to 1.78 Mtoe in 1984.

[3] The above paragraphs are excerpts or summaries of ref. 2 - p. ii.

[4] "Evaluation des economies d'energie realisees de 1974 a 1984", August 1986.

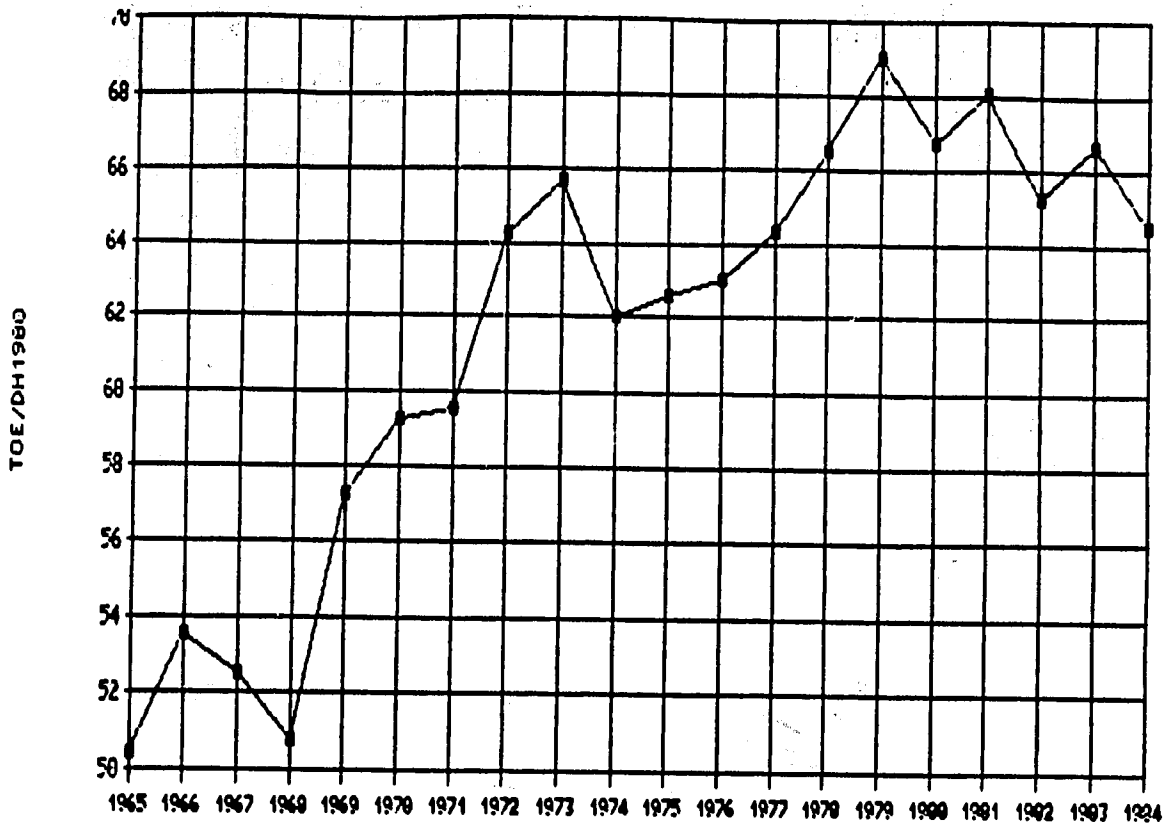
However, several analyses of the ratio of energy/production (also called E/GDP) indicate that actually some of such ratios have increased over the period 1980-1984, e.g., electricity (see Exhibit 3).

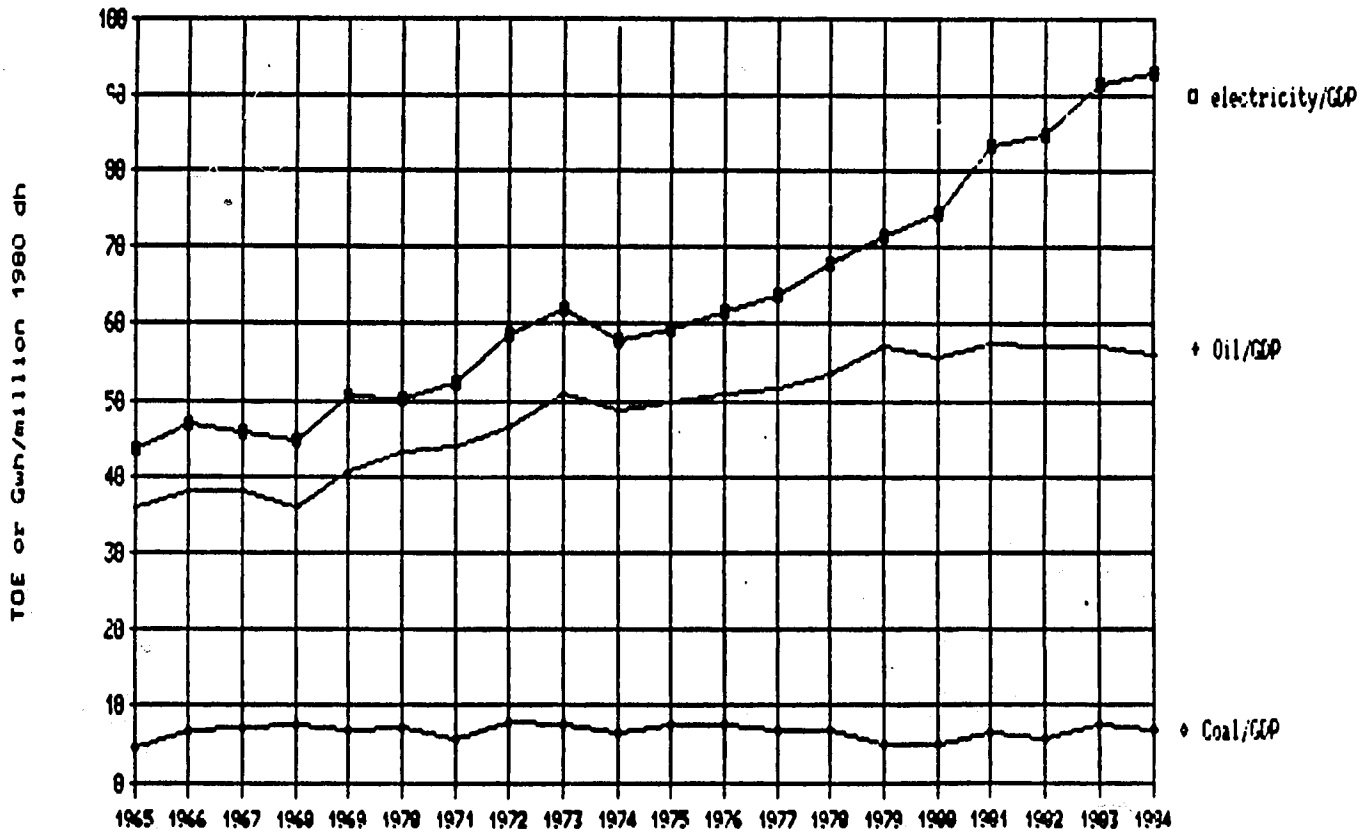
A major factor that could lead to further progress in energy conservation is the current government policy aimed at encouraging the private sector to become more independent and to compete in the international market. This policy will do the most to promote substantial progress in cost control and thus efficient energy use.

In summary, Morocco is facing the double challenge of capital shortage and increasing dependence on oil imports. To address the capital shortage, Morocco is implementing a policy of rationalization in major sectors of its economy, consisting of industrial restructuring, privatization of more than 300 units, and reduction in government spending, which is likely to seriously limit the implementation of new programs.

The challenge of oil dependence is not going to vanish or even lessen in the foreseeable future. All macroeconomic projections show that the share of petroleum in the overall energy balance is not going to decrease substantially and that the quantity of petroleum product imports will continue to increase to promote economic development. In addition, while the current low world oil price of around $15/barrel provides some temporary relief, the consensus on future prices is that oil is unlikely to stay at its current level. The most likely scenario is an average annual increase of 5-10 percent per year, reaching $20-25/barrel by 1990 in constant 1986 dollars.

Exhibit 3. Energy/GDP Ratios





Source: IDEA - opus cited.

In a recent AID-sponsored workshop held in Bangkok, Thailand, representatives from more than 12 countries of Asia and the Near East, including Morocco, gathered to share their experience and discuss future directions in energy demand management.[5] Of particular importance was the consensus on higher oil prices over the next 5 years, and the need for continuing efforts in energy demand management. The delegation from Morocco, which included senior representatives of MEM, ONE and SCP and a USAID energy specialist, made a substantial contribution to the workshop by stressing both the need for a sustained commitment to the rationalization of energy demand and the importance of public support.

THE NEED FOR A NATIONAL ENERGY DEMAND MANAGEMENT PROGRAM: SWITCHING GEARS

The foreign debt and domestic investment budget situations can be significantly improved by implementing an aggressive energy demand management (EDM) program. Such a program would entail identifying financially and economically justified actions and investments at the energy end-use level. An EDM program would actually constitute a second phase in Morocco's efforts to achieve higher energy efficiency. The first phase (1974-1985) resulted in the realization of most of the primary potential ("gisement d'economies d' energie") by raising domestic prices and encouraging large energy users to conserve. During this first phase, common sense housekeeping measures were implemented and conventional investments made.

[5] Asia and Near East Workshop on energy conservation and private power generation. Bangkok, Thailand, Sept. 29 - Oct. 3, 1986.

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In the second phase, Morocco would "switch gears" to benefit from recent international advances in energy management in less conventional areas, e.g., end-use electric load management, transportation energy management, and the broad use of new technologies such as advanced electronic controls. Improving electricity end use, for instance, by improving load management and power factors, could provide two types of benefits at the national level in addition to the cost savings to the user: (1) reduced fuel consumption at ONE thermal powerplants, i.e., foreign exchange savings, and (2) reduced investment requirements for additional generation, transmission, and distribution capacity. Similarly, motor fuel rationalization in the transportation sector and improved maintenance could reduce diesel oil consumption (and in turn save foreign exchange) and reduce refinery imbalances, therefore postponing the need for capital-intensive refinery investments such as a coker or a visbreaker. At the national level, international experience suggests that intensive energy demand management activities can reduce energy consumption by 5-10 percent over and above the improvements achieved by using new, more efficient equipment. The importance of these activities has been recognized in a number of recent studies, and USAID has included possible support in its most recent (FY 1988) Country Development Strategy Statement.

Subsequently, USAID has agreed to assist the GOM in studying the feasibility of such a project and provided the services of Hagler, Bailly and Company, a specialized U.S. management consulting firm. The consultants, funded by the Office of Energy of AID/Washington under the centrally-funded Energy Conservation Services Program, visited Morocco during October 15 and October 31, 1986.

Program Goals

The envisioned program goal is to save foreign exchange and reduce investments in the energy sector by promoting the more efficient use of energy. To do this, the program would develop a local capability and facilitate economically justified investments in energy demand management.

Study Scope

This study examines the possible components of a national energy demand management program in Morocco. The key sectors involved in such a program would be energy transformation (e.g., petroleum refineries, thermal power plants), industry, large buildings (e.g., hotels, hospitals, office buildings), transport (commercial) and other large energy users (e.g., irrigation pumping). The study, which addresses a 10-year period from 1986 to 1996, considers energy demand management improvements not only in existing faciiities, but in new and replacement installations.

Report Organization

The report consists of this introduction and five chapters. In Chapter 1, a preliminary estimate of the potential savings is presented. In Chapter 2, key constraints and barriers to realizing the savings are identified and analyzed. In Chapter 3, possible approaches to overcoming the barriers are discussed. In Chapter 4, a preliminary cost/benefit analysis of the program is presented. Finally, in Chapter 5, conclusions and recommendations are presented and an action plan is proposed.

CHAPTER 1: POTENTIAL FOR IMPROVED ENERGY DEMAND MANAGEMENT

In this chapter, the potential for improved energy demand management is estimated. The methodology used to make this estimate consists of three steps: reviewing the current (i.e., 1985) energy balance and identifying large energy-using subsectors (e.g., sugar mills, water pumping); projecting energy demand by subsector over the next 10 years; and estimating the reduction in energy end use resulting from improved demand management. Data used in developing this estimate have been gathered through an extensive literature search (e.g., statistics, industrial studies on the industry sector, energy audits) and complemented by more than 30 interviews with government agencies, end users, and others (e.g., consulting engineering firms, professional associations, financial institutions) (see Appendix A for a list of interviews and a detailed bibliography).

In this preliminary analysis, a number of assumptions, simplifications, and hypotheses have been used:

1. Except in refineries and the ONE, production patterns within a subsector will not change drastically.

2. Energy consumption for 1985 has been taken either from existing statistics, e.g., from ONE for electricity or from information provided during in-country meetings. Because 1985 fuel consumption is unavailable at a disaggregated level, the year 1982 was used as a basis (See Exhibit 1.a).

Exhibit 1.a

Detailed Energy Balance of Morocco - 1982

	Subsector	Light Oil (gasoil) toe	Fuel Oil toe	Coal t	Natural Gas toe	Electricity GWh
1.	Agriculture	276,572	1,351			246.4
2.	Phosphate Industry	19,110	113,179	1,108	31,337	313.1
	Phosphate extraction (O.C.P.)		170,779		31,337	313.1
	Phosphoric Acid and fertilizers		31,630			
3.	Other Ores	28,577	49,247			164.7
4.	Energy and Water	7,222	880,952	675,020	20,784	252.5
	O.N.E.		869,095	628,820		
	Water pumping					201.3
	Refinery			20,784		
	Coal Mines					51.2
5.	Agroindustry	16,112	114,323	45,676		246.84
	Beet Sugar		63,911	26,936		6
	Cane Sugar		496			1.8
	Refined Sugar	1,151	38,886			
	Other	14,597	11,030	18,740		239
6.	Textiles	5,546	50,863			282.5
7.	Leather Industry	31	2,415			16.21
8.	Construction Materials	53,923	498,410	22,795		442.22
	Cement		311,704	4,710		257.9
	Glass		8,340			84.32
	Bricks/Tiles		178,366		18,085	
9.	Metal Industry	4,036	5,192	14,590		96.75
10.	Chemical Industry	4,470	16,407			210.15
	SNPE		10,400			102
	Rubber		--			
	Other	4,470	6,007			108.15
11.	Other Industries	2,002	49,771		6,966	169.6
	Pulp industry		21,462			48.3
	Paper industry		11,806	6,966		
	Other	2,002	16,503			121.3

- continued -

Exhibit 1.a (continued)

	Subsector	Light Oil (gasoil) toe	Fuel Oil toe	Coal t	Natural Gas toe	Electricity GWh
12.	Buildings, Civil Works	9	1			13.63
13.	Transport	789,062	49,158			168.72
	Road					
	Rail					
	Air					103.9
	Sea					
14.	Communication	9	1			29.11
15.	Commercial Services	184,459	14,991			239.45
16.	Non-commercial Services	49,994	18,062			179.70
17.	Household	620,683	513	12,133		1362.52
	Urban	566,762	513	6,067		1280.52
	Rural	54,921	0	6,066		82
	Total	**2,061,817**	**1,874,836**	**771,322**	**59,087**	**4434.06**

Source: Hagler, Bailly & Company.

3. Production growth rates are based on projections provided by the Ministry of Planning and Parastatals.

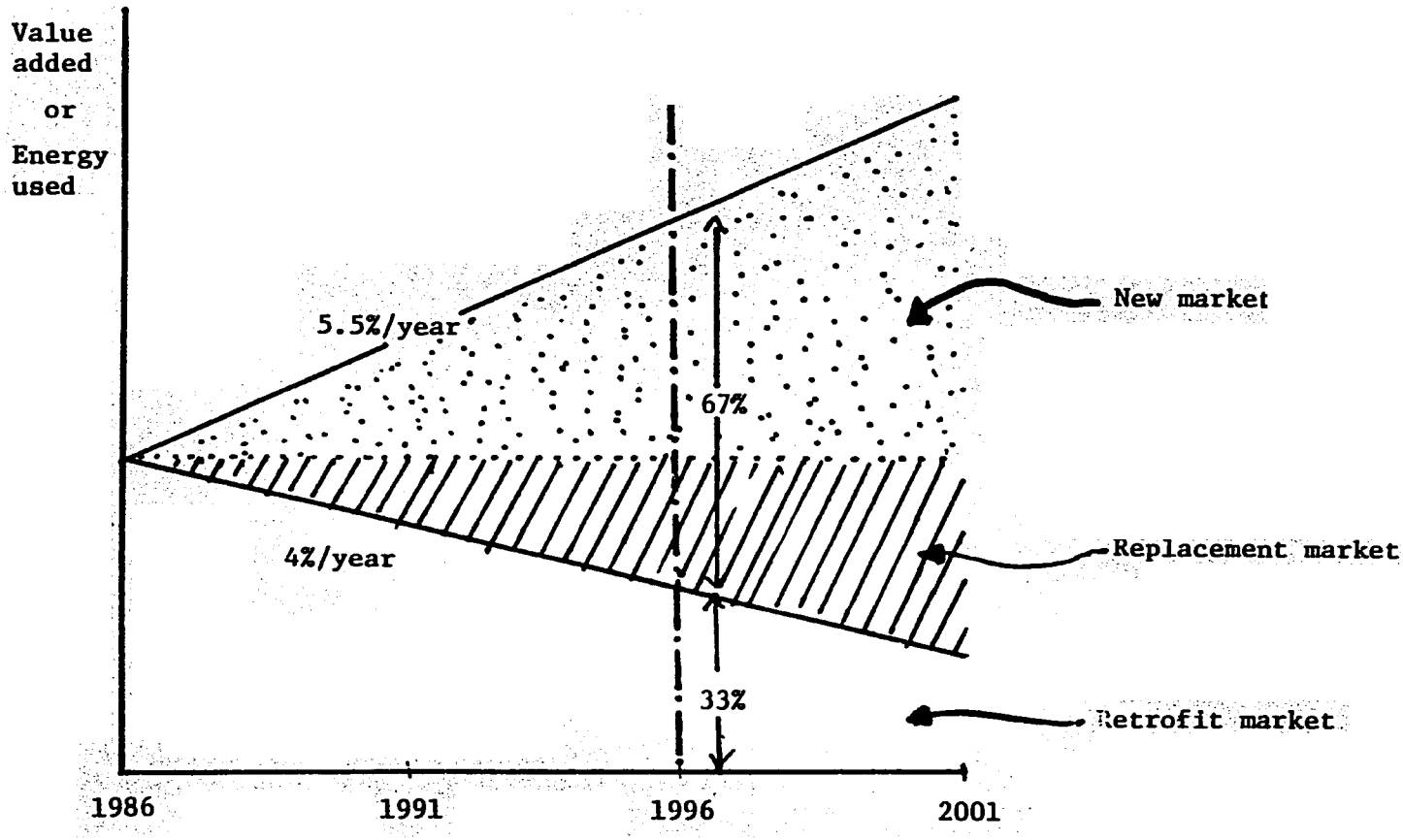
4. The estimate of the potential for energy savings resulting from improved energy demand management is based, as far as possible, on information from such sources as detailed energy audits or surveys. If such information was not available, rough estimates were made based on the experience of similar developing countries. Estimates of reductions in investments (e.g., for refineries, new power plants) are based on information from SCP, SAMIR, and ONE, and assumptions are based on experience in similar situations in the United States (electric load management) and developing countries.

5. In a relatively rapidly growing country like Morocco, it is critical to understand the dynamics of equipment changes. Of all the energy-using equipment in place today, only about 60 percent will still be operating 10 years from now, assuming an average equipment life span of 25 years. In addition to the equipment that needs to be replaced, new equipment is being installed in new plants. In a subsector growing at 7 percent a year, for example, new and replacement equipment would represent about 75 percent of all operating equipment in 10 years.

   In Morocco, assuming an average growth rate of 5.5 percent a year (according to MEM/SPD), this proportion would be 66 percent (see Exhibit 1.b). The actual benefits of an energy demand management program will thus be those benefits that occur in addition to the

Exhibit 1.b

THE DYNAMICS OF ENERGY - USING CAPITAL STOCK



In 10 years, today's operating equipment will consume one third only of total energy used.

Two thirds will be used by replacement and new equipment.

Source: Hagler, Bailly & Company.

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benefits accruing from technology improvements. This factor has been taken into account in the analysis.

ENERGY SAVINGS POTENTIAL ANALYSIS

The potential for improved energy demand management has been estimated for four groups:

- Energy transformation and production sector
- Large manufacturing industries
- Small manufacturing industries
- Other energy-intensive subsectors (including road transport, large buildings, and irrigation pumping).

Details on projected energy balance and savings estimates are provided in Appendix B and Appendix C.

Energy Transformation and Production Sector

The major subsectors analyzed in this category are petroleum refining and electricity generation.

Petroleum Sector

Two refineries -- SAMIR with a capacity of 6.75 million tonnes/year and SCP with a capacity of 1.2 million tonnes/year -- are operating in the country, both relatively efficiently. However, both refineries have:

- High product losses (above 1.5 percent)

- Non-optimally used steam plants, mainly because of reliability problems in the power generation system.

Both refineries are considering projects to cope with this inefficiency:

- Product loss reduction. SAMIR is considering flare gas recovery with a gas compressor. SCP has several projects under way to install floating roofs in the crude and light products tanks at its reception tank farm in Casablanca and at the refinery.

- Steam plant operations. Both refineries generate large quantities of steam by heat recovery from products inside the process units. Consequently, steam plants are operated at a low rate. SAMIR's operations strategy consists of maintaining a minimum power rate in its turbogenerators, so the refinery can continue operating if ONE's power supply is interrupted (which happens only infrequently).

However, when SAMIR encounters problems with its turboalternator, most steam is passed directly to the condenser and power is generated at a very low efficiency.

SCP has decided to electrify the major prime movers in its refinery. It has restricted steam use mainly to stripping operations; steam is supplied by a process waste heat boiler and by the boiler plant.

Substantial energy savings could be still achieved while optimizing the steam system at the refineries. ISTI, as part of its current mission, has recommended an energy audit at the SAMIR refinery.

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Oil demand is expected to increase over the next 10 years, but not enough to justify a capacity expansion project. The growing demand could be met by available capacity at the SAMIR refinery, which keeps old units that have not been designed in accordance with current energy efficiency criteria (the refinery was built in 1962 and last revamped in 1972).

Assuming an oil demand of 7.5 million tonnes in 1995, 70,000 tonnes per year of energy could be saved (see Appendix B-1). These savings have been well identified by the refineries, and cannot be included as part of the benefit of an energy demand management program. The refineries' energy saving target for the EDM program would be only 20,000 toe. Nevertheless, such a program would study the refineries' yield pattern to match it with the evolving demand pattern:

- Increasing demand for LPG and gasoil (Morocco currently imports LPG)
- Decreasing demand for gasoline and fuel oil (Morocco currently exports excess naphta)

This demand pattern might justify a new conversion unit project to upgrade residual oil to gasoil (with a visbreaker) and naphta to LPG (with a catalytic coker or hydrocracker).

As part of an energy demand management program, low-cost initiatives could put the oil products demand pattern back into balance. These initiatives include:

- Slowing down LPG demand in the household sector by encouraging the use of solar energy for domestic hot water production.
- Slowing down the dieselization of vehicles through an adjusted pricing policy for gasoil and gasoline.
- Allowing industry to convert back to fuel (most installations that converted to coal are fuel/coal flexible), with a pricing system reflecting international prices (residual fuel/steam coal).
- Encouraging the commercialization of heavy residual fuel (in the cement industry, for example) to maximize gasoil refinery output.

Electricity Sector

L'Office National de l'Electricite (ONE) is in charge of the production and transmission of electricity in Morocco. Electricity accounts for 30 percent of the primary energy demand in Morocco.

Hydropower's share in total electricity production has fallen from about 25 percent in 1980 to 7 percent because of drought conditions for several consecutive years. Thus, thermal electricity production accounts for 93 percent of total power generation.

ONE faces a sharp increase in power demand during peak hours (seasonal and daily) and must provide adequate equipment to meet this demand. One of the main components of an energy demand management program would therefore be the reduction of peak demand.

Such a reduction would:

- Promote direct energy savings by increasing the share of steam turbines versus combustion turbines (better power heat rate)
- Decrease capital investment by postponing the need for new power facilities.
- Enable hydropower projects to meet the rise in power demand in a timely manner, which could preclude investing in a gas turbine.

ONE could realize energy savings in three areas:

- Improvement in the efficiency of old steam turbine power plants at Jerada power station and Roches Noires power station
- Reduction of auxiliary and transformer losses
- Reduction of transmission and distribution losses.

All these opportunities for energy conservation can be addressed by ONE management. In terms of technical potential, the improved efficiency of the thermal equipment and the transmission and distribution system could save on estimated 50,000 to 130,000 toe and 50 to 100 GWh by 1996.

Large Manufacturing Industry

Following discussions with MEM, ISTI, professional associations (sugar, cement, textile), and engineering firms, it appears that the large industrial energy users have already significantly improved their energy efficiency.

At first, industry cut energy waste through no-cost/low-cost improvements (using steam heat, preventing heat losses through uninsulated surfaces,

preventing condensate-losses). For example, CDTEF, a textile mill located at Fes, has improved its energy efficiency by roughly 20 percent since the 1982 Transenerg visit.

Second, many new plants have been built within the last 10 years (see Exhibit 1.c). Most of the plants are major energy users and have taken advantage of the best available technology (e.g., cement industry, sugar industry, phosphate industry). Little scope for further energy improvement exists in these plants.

Other large manufacturing facilities were created by restructuring old, scattered small facilities. Generally, production is concentrated at a few sites and major investments have been made to revamp those sites using the best available technology. FROMAT (orange juice manufacturer) is a good example of such a successful restructuring.

The plant located at Kenitra (which was visited) has been completely rebuilt and equipped with the most advanced technology (mainly U.S.-licensed equipment manufactured in Brazil or France). The restructuring has resulted in a major increase of plant capacity and considerable energy savings.

The situation in those facilities established before 1973 and not the target of restructuring is quite different. Some plants have committed themselves to a major energy conservation investment plan, such as those cement plants that have switched from oil to coal, and La Cellulose du Maroc (a pulp and paper company), which has implemented a comprehensive energy conservation program.

However, La Cellulose du Maroc is an exception in Moroccan industry. Most facilities have limited their energy conservation program to no-cost/low-cost

Exhibit 1.c

Distribution of Industrial Plants by Age (195)

Age Range (year)	Number of Plants		Production Value		Export	
	number	%	Million Dh	%	Million Dh	%
Before 1973						
Before 39	155	4	5,926	10	1,351	9
39-55	437	10	13,463	22	3,604	24
56-59	164	4	3,960	7	901	6
60-64	309	4	4,143	7	901	6
65-67	186	4	6,147	10	2,535	17
68-72	455	11	5,753	10	1,351	9
After 1973						
73-78	994	24	15,170	25	2,853	19
79+	1,464	35	5,363	9	1,351	9
Total	**4,164**	**100**	**59,929**	**100**	**15,018**	**100**

Source: Ministere de l'industrie

actions. Some of them (e.g., COTEF) have identified energy savings opportunities but do not have the resources to explore those opportunities and implement an effective action plan (project feasibility analyses). As a result, decision-makers do not have the minimum information needed to make appropriate investment decisions. Other facilities have identified some capital-intensive improvements but do not have enough knowledge to identify all the potential projects, and to consider how they would be integrated in the facility's energy system, so they are unable to decide on priorities (e.g., CMCP -- a paper mill; a lead ore processing organization; several sugar plants).

Some large manufacturing industries are analyzed below.

Mining Industry (excluding phosphate extraction)

Mining (other than phosphate) is a major activity in Morocco. It covers coal and such ores as iron and lead. The main type of energy used is electricity. Following visits to the Jerada Coal Mine, the ISTI team estimates the electricity saving potential at 15 percent. Given an energy demand of 100 GWh in coal mines and 250 GWh in other mines, the potential for energy savings would be 50 GWh in 1996.

Phosphate Industry

The phosphate industry is dominated by the conglomerate named Groupe Office Cherifien des Phosphates (OCP). Among this group's activities are phosphate extraction, phosphate conversion into phosphoric acid and fertilizers, and transportation.

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Phosphate extraction is a major consumer of electricity (for extraction) and fuel (for drying). The drying furnaces at OCP are probably among the most efficient in the world, with fuel gas temperatures as low as 80-85°C, close to the dew point. The dryers' fuel specific consumption has dropped from 14 kg foe to 11.5 kg foe per tonnes of dry phosphate, which is considered the minimum.

There is still an opportunity for energy conservation by improving the dryer control system, which could save an additional 5 percent. Potential savings in 1996 would be around 10,000 toe/year.

Cement Industry

Cement industry performance is very close to international standards. The Professional Association of the Cement Industry has published long-term trends of energy performance showing a drop in fuel use and a rise in electricity consumption per tonne of cement. Thus, the industry's energy saving potential is estimated at 27,000 toe per year by 1996.

Glass Industry

Visits to SEVAM plants have indicated that the glass furnaces could save up to 20 percent of current fuel consumption. The potential is estimated at 2,200 toe per year.

Pulp and Paper Industry

No substantial additional energy savings are possible at la Cellulose du Maroc, the only pulp plant in Morocco. However, the Transenerg team identified some opportunities for saving energy in paper plants. Thus, the estimated energy savings are put at 1,900 per year.

Sugar Industry

The major energy saving opportunities in the sugar industry are:

- The reduction in process steam demand use, with potential fuel savings of 15,000 toe/year in 1996.
- The use of excess bagasse in the sugar, with potential fuel savings of 30,000 toe/year in 1996.

Other Large Manufacturing Industries

The other large manufacturing industries are mainly the metal and chemicals industries.

These industries are rather old and the potential for savings are high:

	Fuel	Electricity
Metal Industry	-15%	-5%
Chemical Industry	-10%	-10%

Small Manufacturing Industries

According to widespread opinion, which was confirmed by the interviews and site visits conducted for this study, there is a large scope for energy conservation opportunities in medium-sized and small manufacturing industries. However, the share of energy demand in these industries is low compared with energy demand for all industries. The following activities are classified in the medium-sized and small industries:

- brick/tile and other construction materials industry
- agro industry (excluding sugar)

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- textile industry
- miscellaneous (i.e., wood industry, leather industry).

Based on reports, (most of them in agro industry and the textile industry) and on experience in other developing countries, a 15 percent savings in fuel use and a 5 percent savings in electricity use can be realized by 1996.

Other Energy-intensive Subsectors

A more cursory analysis has been performed of energy-intensive subsectors. The analysis focused on a small number of well-identified subsectors that international experience has shown can achieve tangible and substantial savings within a few years. Based on the literature review and the interviews conducted, three such subsectors have been selected:

- Road transportation (commercial only)
- Large buildings (hotels, hospitals, offices)
- Water pumping stations

Diesel oil consumption by road transportation is projected to rise to 1.97 million tonnes by 1996. Thus, potential savings for this subsector are estimated at 147,000 toe per year (mostly through driver training, improved maintenance, and driving regulations).

For large buildings such as hotels, the 1996 potential for savings is estimated at 265 GWh/year in electricity (equivalent to 67,000 toe) and a possible maximum peak load reduction of 50-100 MW by 1996. (See Appendix D for details on load management technologies).

Savings potential in irrigation pumping is estimated at 100 GWh/year and up to 50 MW peak load by 1996. (See Exhibit 1.d and 1.e).

OVERALL POTENTIAL

Total potential energy savings are estimated at 560,000 toe for fuel consumption and 700 GWh per year by 1996. Cumulative savings would be 3 million toe by 1996 and peak load reduction, 100-200 MW (see Exhibit 1.f). In addition, investments in refinery upgrading may also be reduced, although that is more difficult to quantify in terms of energy savings. The potential in industry and energy as a whole is estimated at 310,000 toe and 300 GWh per year (see Exhibit 1.g), or 4 percent of total energy consumption in 1996. Several points should be made in connection with this estimate:

- The potential in energy-intensive operations, while significant in absolute numbers, is small in relative numbers, because most plants already operate efficiently and are staffed by highly competent, well-trained and well-informed people (e.g., ONE, OCP, Cellulose du Maroc).

- In contrast, less energy intensive industries, as a group, can save 62,000 toe per year or roughly 10 percent of their expected energy consumption.

- The potential in the transportation sector may be the largest single source of energy savings in the medium term.

Exhibit 1.d

Potential Benefits of Energy Demand Management In Selected Target Activities

Sector/Activity	1984 Energy Consumption		Annual Growth Rate 1984-1996(%)	Projected 1986 Consumption	
	Diesel oil (tonnes)	Electricity (GWh)		Dies.	Elec.
Road Transport					
Commercial and fleets: (trucks, buses and taxis)	783,000[1]	-	8	1,971,000	-
Large & administrative buildings	-	586[2]	10	-	1,839
Pumping					
Large pumping stations, including irrigation	N/A	325[3]	10	-	1,020

Sources: 1/ "Les Economies d'Energie dans le secteur du transport au Maroc". E^3 I and DSI - Mai 1983 p.84 assuming 80% of total diesel oil is used by commercial and fleets vehicles, and Statistiques Energetiques - MEM 1985 for 1981-1984 adjustment.

2/ ONE - Consommations par categorie d'usagers de l'Energie Electrique Categories moyenne tension; Commerce et hotellerie; Presentations et Services; Administration.

3/ Same as above - Category = peche, agriculture and elevage and interview with Direction de l'Equipement Rural.

Exhibit 1.e

Target Benefits

	1996 Potential[1/]			
	Diesel oil (tonnes)	GWH	TOE[2/]	MW
- Road transport	197,000[3/]	-	197,000	-
- Buildings	-	265[4/]	67,000	100
- Pumping	-	102[5/]	25,000	50

1/ From Exhibit 1.d

2/ TOE= Diesel oil + GWh (1GWh = 245 Toe)

3/ 10% - source = opus cited

4/ 15% of consumption - consultant estimate

5/ 10% - international experience

Source: Hagler, Bailly & Company.

Exhibit 1.f

Preliminary Estimate of Potential Savings (1996)
(all numbers are rounded)

	Potential	
	Fuel toe/yr	Electricity GWh/yr
A. Energy Savings[1/]		
Subsector		
Energy & Industry		
Energy sector	170,000	100
Large manufacturers industry	60,000	80
Other L.M.I.	10,000	60
Medium & small industry	70,000	60
Subtotal	**310,000**	**300**
Transport		
Road transport	200,000	-
Services		
Large buildings		300
Agriculture		
Pumping		100
Other	50,000	-
Total (rounded)	**560,000**	**700**

B. Investment Savings	Potential
Refineries	N/A
Power plants	200 MW

1/ From Exhibits 1.c to 1.d.

Source: Hagler, Bailly & Compan

Exhibit 1.g

Energy Conservation Potential and Targets in Industry (1996)

	Potential		Targets	
	Fuel toe/yr	Electricity GWh/yr	Fuel toe/yr	Electricity GWh/yr
Energy Sector				
ONE	100,000	50-100	5,000	-
Petroleum Refineries	70,000	-	25,000	-
Subtotal	**170,000**	**50-100**	**30,000**	**negligible**
Large Manufacturing Industry				
Mining	-	50		
Phosphates	10,000			
Cement	30,000	(-55)		
Glass	2,500			
Pulp and Paper	2,000			
Sugar	15,000			
Subtotal	**59,500**	**50-80**	**30,000**	**50**
Other Large Manufacturing Industry				
Metal Industry	3,000	10		
Chemical Industry	5,000	50		
Subtotal	**8,000**	**60**	**6,000**	**60**
Medium and Small Manufacturing Industry				
Brick/tile & Other	45,000	10		
Agroindustry (excluding sugar)	10,000	25		
Textile Industry	10,000	15		
Other	5,000	60		
Subtotal	**70,000**	**60**	**60,000**	**50**
GRAND TOTAL	**310,000**	**220-300**	**26,000**	**160**

Source: Hagler, Bailly & Company.

Potential for Non-Utility Power Generation

Although ONE has the monopoly of generation and transmission of electricity, it also purchases small amounts of power from several independent producers (e.g., Maroc phosphore, Maroc Chimie, SUNAB sugarmill). Should they be allowed and encouraged to do so, a number of sugar mills (currently undergoing detailed energy audits), paper mills, and metal industries could generate significantly more power, especially from cogeneration units. A preliminary estimate of the potential for non-utility power generation is around 100 MW by 1990-1995, or the same order of magnitude as an electric load management program. Developing this potential would require policy changes (ONE generation monopoly) but would greatly benefit Morocco because most of this power (e.g., from sugar mills) can be generated in winter, when thermal central power generation is at its peak, and for a relatively low incremental capital cost (in the range of $600-800/kW) and a low operating cost, because of the low fuel value. Although not considered directly in this study, independent power generation seems to represent an option worth investigating.

CHAPTER 2: KEY CONSTRAINTS AND BARRIERS

The potential foreign exchange and investment savings stemming from an energy demand management program are not likely to materialize because of a number of institutional, technical, economic, and financial barriers. Institutional barriers include the lack of coordination among government ministries in policy formulation and the traditional protection of the industrial sector from international competitive markets. Examples of technical barriers are the characteristics of the existing equipment, which is primarily of European design, mostly French, and often not suitable for retrofit using non-European equipment, especially cheaper or more efficient equipment, such as U.S. electronic controls and Japanese burners.

Economic barriers include distortions of energy prices and electricity tariffs at the end-user level. For example, high-voltage current may be more expensive than low-voltage current for certain categories of customers (which is the opposite of the opportunity or marginal costs of such current), and therefore discourage energy efficiency at the end use. Similarly, fuel oil, which is currently in surplus at the national level, is sold at a price much higher than its production cost and therefore is not in great demand. Finally, financial barriers include the lack of suitable, adequate credit for investment in energy efficiency improvements.

Clearly, energy prices in Morocco are equal to or higher than their true opportunity costs, and constitute a strong incentive to save energy for those users facing domestic and foreign competition. Pricing policies have been

responsible for most of the reduction in the growth rate of energy consumption achieved since 1978. However, studies and audits of large energy-using facilities such as power plants, mines, refineries, industrial plants, and commercial buildings indicate that there is still a substantial untapped potential for energy cost reduction. On the basis of a review of the literature and interviews conducted during the in-country visit, five key barriers to improving energy efficiency were identified:

- Lack of information and awareness
- Lack of market for energy demand management (EDM) services and equipment
- Lack of non-price incentives
- Lack of adequate financing
- Lack of adequate institutional coordination

LACK OF INFORMATION AND AWARENESS

Large energy users in the private and public sectors, including paratastal energy suppliers, are well informed about energy efficiency as a result of international specialized publications and ongoing relationships with leading firms and organizations of developed countries, primarily European. Small and medium-size enterprises and energy users in the transportation, commerce, and agriculture sectors, however, have little or no information about energy efficiency techniques and associated benefits. In small and medium-size industrial firms, ("PMI") there is little awareness of energy-

efficient systems and, more importantly, little knowledge about energy as a cost factor. Even when plant managers know what fraction of their costs is accounted for by energy, they have no reference for determining how much they could save. Moreover, assuming they know how much they can save (by comparing their specific energy consumption with that of similar firms engaged in the same activity), they usually do not know what to do about it. According to local technical services firms (e.g., DMC, AGA), most PMI could save at least 20 percent of their current energy consumption if they knew about such simple techniques as carrying out a combustion tune-up, determining a proper fuel reheat temperature, or selecting proper lighting equipment and electrical motors.

LACK OF MARKET FOR EDM SERVICES AND EQUIPMENT

Although a large number of competent and knowledgeable people can be found in Morocco, they tend to be employed by large public and private organizations such as ONE, SCP, and Cellulose du Maroc. Few experienced engineers and managers work in the consulting/engineering area because there is generally believed to be no market for such activities in the country. As a result, only a few "risk-takers" have entered this market, with mixed results. For example, AGA Ingenierie was created to provide services primarily to the sugar industry, which it perceived as a captive market. Discussions with AGA management, however, revealed that expectations have not been fully met. As a result, AGA has had to expand its services to other areas of the food industry, also with mixed results. Market size and resistance to change are cited as major barriers.

SMD, another consulting and engineering company providing services to industry and hotels, mentioned the same problems. In SMD's case, the problems are exacerbated by the fact that it does not operate in a captive market. Rather, it must obtain maintenance contracts (e.g Regie des tabacs, Club Med, Brasseries du Maroc) or include the cost of its consulting services with the sale of equipment. According to the manager of its energy conservation division, energy audits cannot be sold as such, because people do not see the tangible benefits resulting from such activities.

Almost any kind of equipment can either be found in Morocco or imported. There is basically no restriction on technology imports, but duty taxes are high. For example, imported metering equipment costs more than twice what it does in Europe or the United States. In addition, because of the perceived lack of maturity of the market for energy demand management equipment, the cost and effort required to create a demand is considered to far outweigh the possible benefits.

LACK OF NON-PRICE INCENTIVES

Over the years, the government has been the key promoter of any major change in industrial policy or investment priorities, and energy end users still tend to look for financial incentives or regulations to modify their way of doing business. With few exceptions, most interviewees mentioned a lack of incentives as a key barrier to energy conservation. The fact that fuel prices are high compared with current international prices is seen not as an incentive to take action, but as a constraint. When asked what would be the most efficient way to induce energy end users to save energy, most

interviewees replied that the government should reduce energy prices. When asked about the type of non-price incentives needed, the interviewees mentioned duty tax exemptions, grants for first installation of a new type of device, and tax credits. Tax credits were of greater interest to large, efficient enterprises.

Although broadly perceived as such, the lack of non-price incentives does not appear to be a barrier because of the high profitability of energy conservation investments. For example, at current residual oil prices of Dh 1875.50/tonne or roughly $214/tonne, compared with a border price of $70/tonne, paybacks on representative investments such as combustion control systems, insulation, and heat exchangers are often 1 year or less.

One of the non-price incentives that companies would be most responsive to, and that would be most justified, is the elimination or reduction of import duty taxes on selected equipment such as energy demand management equipment (see Appendix F for a list). Taxes on control and electronic equipment may be greater than 100 percent (e.g., infra-red scanners) and thus discourage imports of energy auditing equipment, electronic combustion controls, and electric load management systems.

LACK OF ADEQUATE FINANCING

For retrofit or replacement investments, e.g., changing a boiler or switching from oil to coal, financing is an issue.[1]

[1] Financing is not an issue for no-cost, low-cost, or "housekeeping" measures, which can save up to 10 percent of energy used.

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Long-term credit (up to 15 years) can be obtained from the government-owned Banque Nationale pour le Developpement Economique (BNDE) only after a cumbersome and lengthy bureaucratic process. The process is necessary in particular if the company seeking the loan wants to benefit from the Code des Investissements (CDI), which (1) may grant duty and income tax reductions, reduction in interest rates, and other concessions if it can be shown that the project will create jobs or value added, and (2) may provide additional incentives for energy conservation. Since 1983, the CDI has authorized a subsidy of Dh 500 per toe saved under specific conditions (see Appendix E). However, obtaining the CDI concessions is a cumbersome process and only a handful of investors have been able to benefit from them. In addition, concessions on long-term financing from BNDE mostly apply to new or expansion projects and not to modernization and productivity improvement projects.

Medium-term financing (i.e., up to 5 years) can also originate from BNDE, but only at a current 14-percent interest rate with a possible grace period. It, too, is available primarily for new or expansion projects.

Finally, only short-term financing (e.g., working capital) is provided by commercial banks such as WafaBank, but the total amount that a commercial bank can lend is limited ("encadre") to a level that is felt to be much too low in light of the availability of funds and industry needs.

For these reasons, private enterprises that seek short/medium-term financing (e.g., 3 years) for an energy conservation project must seek credit from the supplier, and assume the foreign exchange risk. Given the current perceived weakness of the Moroccan currency, few firms are willing to accept this

risk. Thus, adequate financing is currently unavailable in Morocco for energy demand management investments or any other investments in productivity improvement.

LACK OF ADEQUATE INSTITUTIONAL COORDINATION

The Government of Morocco, and particularly the Ministry of Energy and Mines, has assumed a leading role in promoting energy efficiency in the country since 1979. However, a number of other ministries are also concerned with energy use, either because it is an important factor in the proper functioning of the activities they oversee or because it may be a constraint on their development. These ministries include Industry, Transport, Housing, and Agriculture. The Ministries of Finance, Economic Affairs, and Interior are also concerned about energy use because of the economic and financial importance (e.g., caisse de Compensation, pricing) of the energy sector or because of the social importance of energy at the end-use level (e.g. regies, under the Ministry of Interior).

The Ministry of Industry plays a multifaceted role in energy demand related policy formulation. It is in charge of the largest energy users (with the exception of offices such as ONE and OCP). It is also involved in developing and implementing the regulations on equipment standards (from large industrial equipment down to irrigation pumps) and on industrial development and investment.

Similarly, the Ministries of Transport, Housing, and Agriculture play a major, although indirect, role in the orientation of energy use.

Unlike many other countries, e.g., the Philippines, Pakistan, Jordan, Tunisia, Central America, Morocco does not have a formal plan for energy conservation. Rather, the government has assumed a lower-key approach consisting of high energy prices, modification of existing legislation (e.g., Code des Investissements), and establishment of a small conservation cell within the Ministry of Energy and Mines.

While such an approach could be successful in a fluid and well-coordinated institutional system, the interview results indicate that cooperation among ministries is limited and the institutional framework for energy demand activities is fragmented. Interviewees perceived this fragmentation as a major barrier to proper policy formulation and coordination. Examples of the problem can be found in exchanges between the Ministry of Energy and Mines and the Ministry of Industry as to which ministry should oversee foreign technical assistance in industrial energy audits. Similar examples can be found in building codes (the Ministry of Housing and Ministry of Energy and Mines), selection of transport vehicles (the Ministry of Transport and Ministry of Energy and Mines), and the distribution of electricity (the Ministry of Interior and Ministry of Energy and Mines).

This lack of coordination and of clear role definition is also perceived as a lack of guidance by energy users, who do not feel comfortable when making long-term or capital decisions such as switching from oil to coal.

Exhibit 2.a

Barriers to Efficient Energy Demand Management

Category	Barrier	Examples/Comments
Technical	Lack of information Lack of awareness	- PMI does not know its precise cost structure - Most PMI and non-industrial operators have little knowledge of practices and techniques in EDM. - Except for large energy users, operators have no reference for good energy consumption standards in Morocco and other countries
	Unavailability of suitable equipment	- Local supply of energy-efficient systems (e.g., controls) is limited
Economic	Energy price structure	- Low voltage electricity is priced below its true cost
Financial	Lack of adequate financing	- Current system makes it difficult to finance productivity improvements with high foreign exchange content - Required guarantees/collateral often unacceptable (up to 100 percent)
Institutional	Lack of direction	- No publicized national energy plan
	Lack of communication and cooperation among ministries	- Ministry of Energy and Mines and Ministry of Industry are playing roles, but overall action among government agencies is fragmented.
	Current legislation/ regulations	- Private and public enterprises cannot generate electricity for sale to the grid (monopoly of ONE above 300 kW). - No standard and codes for energy efficiency in transport, indus trial equipment, buildings, and irrigation pumps.

CHAPTER 3: APPROACH TO ELIMINATING BARRIERS

To achieve a higher level of energy efficiency in the Moroccan economy, key barriers and constraints must be addressed. Each barrier and constraint represents a need that can be met by a series of actions, initiatives, or programs (see Exhibit 3.a). In attempting to identify the most appropriate responses to these needs, a number of criteria have been applied.

First, responses must be result-oriented, proven, and cost-effective. Second, program leadership must be assumed by concerned parties. Third, expected program impact at the national level must be measurable and substantial. Fourth, implementation schemes and organizations must be selected on the basis of their credibility, their potential to achieve expected results, and their potential long-term role in energy demand management.

First, targets are identified, second, program components are presented and, finally possible institutional arrangements for program implementation are discussed. Program goals and scope were presented in the introduction.

On the basis of these criteria, an energy demand management program should be organized as described below.

PROGRAM TARGETS

The preliminary analysis of the potential presented in Chapter 1 indicates that the following subsector are prime targets for an EDM program:

Exhibit 3.a

Needs and Possible Responses

NEED	POSSIBLE RESPONSES
Awareness For	
- small and medium enterprises - construction/architects - transport fleet operators - households	- specialized campaigns/radio, TV, newspapers and professional publications) - series of workshops, seminars
Information (Same as above)	(Same as above)
Specialized Equipment	
- control systems for industry and large buildings - energy demand and load management systems - control, maintaining and training equipment for transport fleets	- develop/accelerate market diffusion through demonstrations and information - organize specialized workshop with local and foreign suppliers to accelerate diffusion
Energy Price Structure	
- electric tariffs (low voltage) - fuel prices	- tariff studies and reforms
Lack of Adequate Financing	
- availability - appropriate terms and guarantees	- establish credit line in commercial banks - develop leasing and other innovative financing mechanisms
Lack of Adequate Institutional Coordination	
- leadership - credibility - availability	- private sector takes leadership • through existing organizations • through a specialized organization to be established.

Source: Hagler, Bailly & Company.

- Industrial facilities (small and medium; selected large, older units)
- Large buildings (mostly hotels and office buildings
- Commercial transport
- Irrigation pumping

Large plants (ONE, refineries, phosphate), especially newer ones, are not likely to benefit much from the program because they are already reasonably efficient, they intend to continue increasing their energy efficiency, and they have highly qualified, motivated, and well-informed personnel. Private transportation and households would be better served by such measures as information campaigns and standards for appliances.

PROGRAM COMPONENTS

The program would have two components:

- Technical Assistance
- Credit line

The technical assistance (TA) component would include a series of activities aimed at addressing most urgent and significant non-financial needs. The credit component would seek to make adequate financing available for EDM investments. These two components are described in more detail below.

TECHNICAL ASSISTANCE

The TA component would consist of consultant services (local and foreign) and specialized equipment and materials to enable the Moroccan parties achieve program objectives. This component would involve five sub-components:

- Information and awareness
- Training
- Technical support
- Technology transfer
- General policy guidance

Information and Awareness

The main objective of this sub-component will be to assist Moroccan organizations in their efforts to increase public awareness of the potential benefits of energy conservation and thus involve the public in national energy demand management activities. It will include activities such as television and newspaper campaigns and the publication of pamphlets, booklets, and do-it-yourself leaflets. These activities will be carefully designed on the basis of past experience to maximize impact. Some surveys may be required to target each activity.

Training

The basic objective of this sub-component will be to assist Moroccan organizations in upgrading or updating local capabilities in areas where they are currently deficient to ensure timely and efficient planning and implementation of the program. The training will include: short overseas study tours and degree courses; seminars and workshops given by foreign consultants and tailored to Moroccan needs; and vocational training (e.g., for boiler operators). Training will embrace a large variety of personnel, including government officials, consulting engineers, plant managers, and technicians. A substantial part of the training will be conducted on-the-job (e.g., energy audits, project identification and evaluation).

Technical Support

The objective of this sub-component is to provide the necessary technical support (through foreign consultants and, wherever feasible, through local sources) to help plan and implement the program. Various types of technical support will be provided at a variety of levels, including: to local organizations and the private sector on energy audit techniques, project feasibility analysis, and the operation, manufacture, and/or import of energy-efficient equipment; to R&D organizations on testing, development, and certification of energy-efficient appliances; and to various national entities on planning and implementing demonstration projects.

Technology Transfer

U.S. technology that could be transferred to Morocco to accelerate energy demand management may include: energy audit equipment for industry and buildings; combustion controls; equipment for demonstrating transportation fuel-saving devices; and electric load and demand management systems. These technologies would facilitate training and the preparation of demonstration projects.

General Policy Guidance

Support to a group of representatives of the government (parastatals) and the private sector will be provided (see Chapter 5 "Steering Committee"). Support activities for this group may include visits to similar groups in other countries, particularly the U.S. and selected developing countries (e.g., Tunisia, the Philippines), and consulting services for special studies (e.g., cost/benefit analysis of policy initiatives such as electric load management at the end-user level).

A summary of activities and targets is provided in Exhibit 3.b.

FINANCIAL ASSISTANCE (CREDIT LINE)

Because financing is a major stumbling block to implementing an energy demand management program on a large scale, the program would need to establish a credit line for related investments. The credit line would provide foreign exchange funds to enterprises and organizations unwilling to obtain direct supplier credit or unwilling to assume the associated foreign exchange

Exhibit 3.b

	TARGET(S)
1. INFORMATION AND AWARENESS	
• National campaigns on TV, radio and newspapers, with spots, brochures, posters	National
• Series of workshop and seminars on techniques, equipment and practices of Energy Demand Management	Professional associations; management and technical staff of large energy-using facilities in industry, commerce, Transport (fleets) and agriculture (large pumping units). Technical and management staff.
• Publication of pamphlets, booklets and do-it-yourself leaflets	
2. TRAINING (in Morocco and the U.S.)	
• Energy audits	Technical staff in large energy using facilities and PMI, consulting and engineering firms.
• Cost control	Management staff/accountants of selected energy using facilities.
• Project preparation, evaluation, and implementation	Management and technical staff (Includes demonstration projects)
• General (policy, advanced technologies)	Government officials
3. TECHNICAL SUPPORT	
• Energy audits of large industrial units, commerce buildings, transport, fleets, and large pumping station	All sectors - large energy users, consulting/engineering firms
• Project feasibility studies of fuel switching, major rehabilitizations, electric load management	same as above
• Demonstrations of new practices or technologies in industry, transport and large buildings.	Users, vendors, consultants, engineers, and architects
4. TECHNOLOGY TRANSFER	
• Auditing instrumentation	Certified consulting/engineering firms. Selected organizations and individuals.
• New devices/systems (energy demand management system for buildings; controls)	Selected users, vendors, consulting engineering firms.
5. GENERAL: POLICY GUIDANCE	
• Energy manager association	Plant engineers
• "Think tank"	Government, parastatals, private sector managers, representatives of financial, institutional, and professional associations.

Source: Hagler, Bailly & Company.

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risk. To make this credit line attractive to borrowers and thus ensure that the funds will be used, competitive terms and reasonable guarantees will be needed. The credit line, dedicated to the purchase of U.S. equipment, will be for U.S. $10 million. It would be used as a revolving fund and been disbursed by commercial banks.

POSSIBLE INSTITUTIONAL ARRANGEMENTS

In attempting to select appropriate institutional arrangements to implement the program components outlined above, it is useful to review international experience in similar efforts. Particularly relevant are the programs under way or recently completed in Pakistan, the Philippines, Thailand, Tunisia, Jordan, Jamaica, the Dominican Republic, and Central American countries (see Appendix D for details). Experience from these countries -- whose level of economic development is not very different from that of Morocco, with a per capita GDP varying from $400 to $1,300 -- points to several factors: (1) the optimal arrangement is highly country-specific and dependent on the relative weight of the public and private sectors (e.g., Pakistan, Jamaica); (2) activities tend to slow down after foreign assistance ends (e.g., Jordan, Dominican Republic); (3) the most effective programs are those that rely heavily on existing organizations rather than those implemented by new organizations, especially organizations established for the purpose of the program (e.g., Philippines); and (4) credit lines are not used if not carefully studied and designed (e.g., Jamaica).

In light of these lessons, together with the institutional situation in Morocco and the overall trend of the economy toward privatization and increased

reliance on international market forces, it is possible to highlight a few critical prerequisites for program success:

- To the extent possible, the project must be led, designed, and implemented by existing Moroccan organizations.
- Implementation should be primarily left to the private sector.
- Public policy in energy and other matters (e.g., industrial development, importing of equipment) must be adapted to support the program.
- Whatever the program, highly respected and experienced individuals must be in charge of it.

While actual program implementation could theoretically be based on a spectrum of institutional arrangements ranging from a new government agency to the simple reinforcement of an existing private organization, it is worthwhile to consider two possible implementation "models." One model (model A) would entail the establishment of a small, independent but highly visible organization that would play the double role of think tank for advising and orienting public policy and private activities and focal point for coordination of program implementation. Under this model, most implementation activities (e.g. training, demonstration projects) would be subcontracted to competent, "certified" private-sector firms. Such an organization could be, for example, a non-profit institute deriving some of its revenues from subscriptions from large energy users (including parastatals) and sales of direct services (e.g., information, training).

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Another model (Model B) would entail strengthening an existing organization and expanding its current activities to include the promotion of energy demand management.

The selection of a model must be made after a careful identification and evaluation of the capabilities of key Moroccan technical and management organizations, including professional associations, research centers, and utilities. Based on the analysis and interviews conducted, it may be wise to use both models, successively. That is, the program would be initiated using an existing organization and, if the program goes well, it would be transferred to a specially created institute, e.g., the Moroccan Institute for Energy Management (Institut Marocain de Gestion de l'Energie: IMGE)

A possible host organization for the initial stage is the Federation of the Moroccan Chambers of Commerce and Industry (FMCCI), which is the leading private-sector organization. The federation is undergoing aggressive modernization efforts and is in the process of establishing specialized cells to provide technical assistance to its members.

The PMCCI, headquartered in Casablanca, represents the Chambers and has as primary objectives to promote economic information and private enterprise development through rationalization of industrial and commercial operations, domestic and foreign competition and technology acquisition. One of the current most important activity of the FMCCI is in the field of productivity, (or reduction and optimum resource utilization, with technical assistance from the International Labor Office). Inventory management, raw material management and general cost control are priority targets for its action as an energy costs. The FMCCI is getting increasing financial support from its

members (basic fee has been recently multiplied ten fold) and higher subsidies from the GOM in order to facilitate the privatization activities and ease the transition of Moroccan enterprise to international competition. Under its current plan, the FMCCI is establishing a number of "assistance cells" aimed at providing information and technical support to enterprises. One such cell could well be devoted to energy problems or to energy as a factor of competitiveness.

A possible alternative to FMCCI is the Confederation Generale Economique Marocaine (CGEM) which is an association of large private corporations and banks (however, it was not possible to meet with them during the in-country visit). Finally, the professional (trade) associations are clearly also prime candidates for leading the program implementation.

Mobilizing the Private Sector

The private sector is the key to the success of the program. Given current government policies, the share of energy used by private industry and other private-sector energy-intensive activities (e.g., transport, commercial buildings) is expected to grow from an estimated at present 30 percent (excluding households) to about 50 percent by 1996. It is thus essential that the private-sector assume a leading role in the energy demand management program by:

- Participating actively in its design and definition (steering committee or working group)
- Being directly responsible for implementing the program.

However, the private sector exhibits no clear unity. The best group to work with is probably the professional associations. To mobilize these associations and their members, it is necessary to:

- Clearly demonstrate the tangible benefits that are expected from the EDM program
- Provide incentives such as free training, trips and site visits, and awards to encourage early participation in the Program.

Such incentives are justified because of the lack of information and awareness about energy demand management. Every private-operator asked to participate in the program is likely to ask: "What is in it for me?".

To gain the support (and later the leadership) of the private sector, it is essential to initiate a series of activities.

These activities should include:

- The establishment of a project steering committee or working group composed of representative of the government (Ministry of Energy and Mines, O.N.E, SCP, public industrial corporation) and the private-sector (textiles, food industries; architects; transportation companies; consulting/engineering firms)
- A public relations initiative or promotion campaign aimed at energy users and consisting of seminars, lectures, awards, group activities, site visits, and other events in key Moroccan cities. This initiative should develop awareness and interest among users

before program implementation so that early results can be achieved.

PROGRAM COSTS AND POSSIBLE CONTRIBUTION FROM USAID

The technical assistance component is estimated at $9.5 million (see Exhibit 3.c of which $5 million could be ear marked by USAID and a reasonable first estimate for the USAID line of credit for the energy demand management fund is $10 million.

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Exhibit 3.c

Level of Effort (1986 U.S. dollars, thousand)

	Quantity	Cost				
		Foreign			Local 1/	Total
		U.S.	Other	Total		
1. Information and Awareness						
1.1. National campaign	3	150	-	150	250	400
1.2. Workshops and seminars	15	200	-	200	100	300
1.3. Publications	-	100	-	100	100	200
Total		450	-	450	450	900
2. Training						
2.1. Audits	20	400	-	400	200	600
2.2. Cost control	10	150	-	150	200	350
2.3. Project preparation	5	150	-	150	100	250
2.4. General	-	100	-	100	200	300
Total		800		800	700	1,500
3. Technical Support						
3.1. Audits	50	1,000	200	1,200	200	1,400
3.2. Project feasibility study	20	300	800	1,100	100	1,200
3.3. General	-	700	-	700	50	750
Total		2,000	1,000	3,000	350	3,350
4. Technology Transfer						
4.1. Auditing instrumentation	20	200	-	200	50	250
4.2. Demonstration of new technologies	-	1,400	1,000	2,400	450	2,850
Total		1,600	1,000	2,600	500	3,100
5. General: Policy Guidance						
5.1. Energy Manager Association		50	-	50	300	350
5.2. Think tank		100	-	100	200	300
Total		150	-	150	500	650
Grant Total		5,000	2,000	7,000	2,500	9,500

Note: Based on a 5-year program.

1/ GOM and private sector - local cost includes duty taxes on equipment.

Source: Hagler, Bailly & Company.

CHAPTER 4: ECONOMIC IMPACT

In addition to saving foreign exchange and deferring investments, an energy demand management program would: improve the trade balance by reducing the operating costs of export-oriented manufacturing companies, increase productivity, and lower domestic prices of manufactured goods. The cost of the program will be the direct program costs, both local and foreign, and the investment made in energy demand management by users. In this chapter, a preliminary cost/benefit analysis of the program is presented. The analysis is performed at the subsector level and then aggregated, which allows the review of various program options, each option consisting of a selected combination of subsectors.

METHODOLOGY

The selected methodology consists of conducting a preliminary cost and benefit analysis, from both an economic and financial viewpoint. The economic analysis represents the national perspective and is based on "opportunity costs" or the true economic value of the energy saved and investment made; that is without taking into consideration taxes and other transfer payments. The financial analysis reflects the value of the costs and benefits to the investor and therefore considers market prices for energy and other inputs, and taxes, especially import duties on equipment. To carry out both analyses, we have successively:

- Estimated the economic value of the annual energy savings at the end of the period, i.e. 1996, assumming that imported oil is saved at the margin and using two scenarios: a low scenario where the price of oil is assumed to remain constant at its current level of $15.50/barrel in 1986 dollars, through 1996; a high scenario where the value of oil increases at an average 5%/year in real terms.[1]

- Estimated the financial values of these annual savings using energy market prices, depending on the type of energy saved (e.g. diesel, fuel oil, electricity).

- Computed the percentage value of the economic and financial benefits over the period using a 12% public discount rate and a 16% discount rate for the financial analysis. These values were gathered during in-country interviews with finance and economic development specialists of the GOM and USAID.

- Estimated very roughly the magnitude of investment needed over the period, both in local and foreign exchange currency requirements.

Because no detailed project information was available during the visit, we assumed, based on discussions with industry and MEM, observations made during plant visits, and our experience with similar projects and processes (e.g., in France, in Tunisia), that most projects that are likely to be implemented would have a financial payback not longer than 1.5 to 2 years. This would yield an economic payback of less than 4 years (this ratio being

[1] Based on the expert opinions emitted at the USAID-sponsored workshop on Energy Conservation and Private Power Generation held in Bangkok between September 25 and October 3, 1986.

directly related to the average ratio of domestic energy prices to international energy prices).

Benefits

The expected benefits directly related to the program are energy savings of 443,000 TOE/per year by 1996 and about 100 MW of avoided electricity peak generation capacity. Benefits resulting from delaying refinery upgrading investment are estimated at about Dh 1 billion, but are not considered in this analysis.

Under the low oil price scenario, the foreign exchange value of these benefits is estimated at U.S. $51 million in 1996. Under the high oil price scenario, the economic value of the savings -- which is assumed to be equal to their foreign exchange value -- rises to $79 million (with oil at $24 per barrel in 1996). Under the low price scenario, the present value (at a discount rate of 12 percent) is estimated at $158 million for cumulative savings achieved over the 1987-1996 period.

In financial terms, the value of savings in 1996 is $149 million, for a cumulative present value of $377 million. (See Exhibit 4.a.)

Costs

Total investment needed for the program would be about $160 million, including import duties. About half of it is in foreign exchange. The payback on foreign exchange expenditures throughout the 10 year program is less than 2 years. In terms of foreign exchange, the net present value of the

85X

Exhibit 4.a

Preliminary Estimate of Costs and Benefits of An EDMP
(all cost and benefit figures are in 1986 U.S. dollars, millions)

Subsector	Target Annual Savings - 1996 1/				Value of Annual Savings - 1996			Present Value of Savings - 1996 4/			Investment Cost (1986-1996) 5/				
					Economic Analysis 2/		Financial Analysis 3/	Economic Analysis		Financial Analysis	Economic Analysis			Financial Analysis	
	Fuel Oil (TOE)	Diesel Oil (TOE)	Electricity (GWh)	Total (TOE)	Low Oil Prices (0% Growth)	High Oil Prices (5% Growth)		Low Oil Prices (0% Growth)	High Oil Prices (5% Growth)		Foreign Exchange	Local	Total	Duty	Total
Energy & Industry	126,000		180	165,000	18.9	29.3	38.3	59.0	76.2	96.8	30.2	20.2	50.4	7.6	58.0
Transport		150,000		150,000	17.2	28.6	69.5	53.6	89.3	178.0	27.4	18.4	45.8	6.8	52.6
Services			270	68,000	7.5	11.7	17.0	23.6	30.5	43.0	12.0	8.0	20.0	3.0	23.0
Agriculture			90	22,000	2.5	3.9	5.7	7.9	10.2	14.4	4.0	2.6	6.6	1.0	7.6
Other		40,000		40,000	4.6	7.1	18.5	14.3	18.5	46.9	7.4	4.8	12.2	1.8	14.0
TOTAL	126,000	190,000	520	443,000	50.7	78.6	149.0	158.4	204.7	377.1	81.0	54.0	135.0	20.2	155.2

Note: See Exhibit 4.b for assumptions.

Source: Hagler, Bailly & Company.

Exhibit 4.b

Assumptions

1. As estimated in Exhibit 4.

2. For the economic cost-benefit analysis the value of all energy savings is assessed on the basis of the price of imported crude oil, assumed to be the marginal source of energy to the Moroccan economy. Imported crude oil is assumed to cost $15.50 in 1987 (1986 dollars) and, in the alternative scenarios, to remain constant or rise at 5% per year in real terms through 1996.

3. The following domestic prices are used to evaluate energy savings in the financial analysis:

Fuel Oil #2	1875 Dh/T
Diesel Oil	4050 Dh/T
Electricity MT	0.55 Dh/kWh

Translating to 1986 dollars at the current exchange rate of 8.74 Dh/$ and converting the oil products to TOE, these prices are:

Fuel Oil #2	$214.53/TOE
Diesel Oil	$463.39/TOE
Electricity MT	$0.0629/kWh

For the purposes of the financial analysis, these are assumed to remain constant in real terms through 1996 under either crude oil price scenario.

4. Energy savings are assumed to reach the 1996 target according to the following percentage schedule:

1987	10	1992	82
1988	24	1993	86
1989	39	1994	91
1990	53	1995	95
1991	68	1996	100

Annual energy saving values are discounted at 12% in the economic analysis and 16% in the financial analysis.

5. The investment cost associated with the energy saving program is estimated on the basis of the following assumptions:

   - 2/3 of target energy savings (evaluated at $15.50 per barrel of displaced crude oil, i.e., at economic values) can be attained with investments with an average 4-year economic payback corresponding to a payback of between 1 (diesel) and 2 (fuel oil) years calculated on the basis of financial values of energy savings.

   - 1/3 of target energy savings require no investment.

   - 60% of investment cost is in foreign exchange

   - For the financial analysis, an average 25% duty on the foreign exchange component is added to the investment cost.

envisioned EDMP is $80 - 125 million, depending on the international oil price scenario. In financial terms, the program net present value is about $220 million.

These estimates are very much on the conservative side. Benefits do not include the reduction in ONE and refinery investments, nor the secondary benefits to the economy of improving the competitiveness of Moroccan industries and services.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

The preliminary analysis program indicates that it is economically and financially justified and could be successfully implemented, provided the private sector plays a key role in its definition, guidance, and implementation.

An energy demand management program consisting of well-defined information, training, technical and managerial support activities, and adequate financing could save up to $100 million a year in foreign exchange by 1996. These savings in addition to those that would be achieved by the natural course of efficiency improvements in existing facilities and technical advances in systems and processes. In addition, implementing such activities would reduce investment in the energy sector, saving up to 100 MW of additional electricity capacity (fuel oil-fired gas turbine) and major refinery modifications. While it is not possible at this preliminary level of analysis to precisely estimate the economic value of this reduction in investment, it is clearly on the same order of magnitude as the energy savings, with little or no increase in cost[1].

However, because this value was not quantified, the financial and economic analyses did not take it into account.

The base case oil price is low -- a flat $15.5/per barrel over the period. In addition, the analysis does not take into account the secondary benefits resulting from the improved efficiency and competitiveness of enterprises that

[1] Reducing peak/intermediate electric load and providing refinery modifications are direct benefits from end use reduction or modification.

carry out energy demand management activities. For these reasons, the estimated benefits under this scenario are conservative.

To be successful, the program must be carefully designed to identify the specific actions or initiatives needed to remove the barriers to energy demand management. At this point in time, there is insufficient information to do so.

Based on the above findings, three activities should be undertaken in the design and development phase of the program:

- Establish a steering committee
- Develop and implement a promotion campaign
- Conduct special studies

These activities -- which constitute an action plan -- are presented in Exhibit 5.a and described below.

The action plan should make use of available resources as much as possible. ISTI contractors, and especially the energy conservation advisor, should play a key role in (1) advising on the selection of steering committee members; (2) providing inputs for design and implementation of the promotion campaign; and (3) drafting terms of reference for special studies.

The Steering Committee should be established in early 1987 and could include a dozen members:

- one high level representative of the Ministry of Energy and Mines
- 1-3 representative of parastatals: O.N.E. and SCP.

Exhibit 5.a

Proposed Action Plan

ACTION	COST (1986 dols, thousand)	SOURCE OF FUNDS	TARGET DATE
A. ESTABLISH STEERING COMMITTEE	N/A	N/A	March 87
Objective: guide program design and promotion activities (see below B)			
Members: MEM, ONE, SCP, public firms (5) Private representatives (cement, sugar, textiles)			
B. CONDUCT PROMOTION CAMPAIGN	150	ISTI Contract	May 87-April 88
Objective: gain early support for program and mobilize private sector			
Implementing Organization local firm with assistance from ISTI contractors			
C. CONDUCT SPECIAL STUDIES	250	Mission	March-June 87
- detailed analysis of potential energy demand management by subsector	(50)		
- detailed program economic and financial analysis, including risk analysis	(35)		
- Detailed institutional analysis (local capabilities)	(35)		
- Potential for non utility power generation	(80)		
- Market studies for EDM services and selected U.S. EDM equipment (Energy Management Systems for load management systems; control) in order to refine credit line estimate.	(50)		

Source: Hagler, Bailly & Company

- 1 representative of the cement industry
- 1 representative of the textile industry
- 1 representative of the chemical industry
- 1-2 other representatives of other industries (e.g., food, sugar)
- 1 representative of the private transport sector
- 1 representative of the hotels and other large building.
- 1-2 representative of the financial institutions.

The role of the steering committee would be (1) to guide the team in charge of program design and (2) be the focal point of energy demand policy dialogue.

The promotion Compaign will aim at mobilizing the private sector and will have the double objective of increasing the awareness of selected energy users in EDM techniques and benefits and building up a momentum that should lead to the creation of a "constituency" for the future EDMP. The campaign should start by mid-1987 and last for about one year. It should mainly consist of series of workshops and seminars targeted at professional associations and consulting/engineering firms. Detailed activities should be defined during the program preparation phase (March-May 1987).

Special Studies during detailed program preparation, it will be necessary to conduct a series of special studies to refine estimates made in this prefeasibility analysis and select the most suitable institutional arrangement. These studies are needed to resolve a number of important remaining issues or uncertainties (see Exhibit 5.b for a list of such issues).

Major Design Issues

Design Issue	Comments/Implication for Project Preparation
1. Assessment of institutional capabilities and roles in EDM	(a) Review existing organizations of the private and parastatal sectors.
	(b) Select institutions to host, lead and implement project.
	(c) develop mobilization plan for private sector
	(d) Analyze relationships with various GOM agencies under this project.
2. Detailed estimate of cost and benefits	(a) Refine estimate of expected foreign exchange and investment savings in light of low oil prices
	(b) Refine cost estimates and conduct risk analysis
3. Establishment of credit line (revolving fund)	(a) Review international relevant experience (Jamaica, Dominican Republic)
	(b) Establish lending guidelines and criteria and define optimal credit amount.
4. Review of other options for assistance in the energy sector	(a) Assess need for Policy Reforms and implementation.
	(b) Assess probability of success of alternate supply option
5. Development of scope of work for technical assistance contract(s)	(a) Outline future tasks and responsibilities of DP staff.
	(b) Define role and function of resident advisors and short-term experts
	(c) Assess other (institutional) requirements for technical assistance contractor.

Five studies are recommended:

- Detailed analysis of potential for energy demand management improvement by subsector
- Detailed program economic and financial analysis, including risk analysis
- Detailed institutional analysis (local capabilities)
- Potential for non utility power generation
- Market studies for EDM services and selected U.S. EDM equipment (Energy Management Systems; load management systems; control) in order to refine credit line estimate.

APPENDIX A: LIST OF INTERVIEWS AND BIBLIOGRAPHY

Part A: Rabat

October 15 - Ministry of Energy and Mines (MEM)
Service Planification et Documentation (SPD)
MM Amanou and Boudi. (Tel: 789-46)

October 16 - MEM - General meeting
Direction de l'Energie
M. Bouhaouli, Directeur de l'Energie (Tel: 736-62)
M. Benchaqroun, Directeur Adjoint
MM. Amanou and Boudi, SPD (Tel: 789-46)
M. A. Basri, Chef du Departement Commercial Emplissage S.C.P. (Tel: 622-15)
M. A. Lamhandaz, Directeur Emplissage et Fabrication de Bouteilles, S.C.P. (Tel: 619-11)
M. Alami Souni, Directeur Industriel, S.C.P. (Tel: 607-78)
MM. El Orf and Saber, DPP (Tel: 738-16)
M. Garrigues, USAID/SPD (Tel: 788-74)

October 17 - MEM/DPP
MM. Sennoun and El Fetouaki
MEM/DE
M. Afsahi, Chef de la Division de l'Energie Electrique (Tel: 651-35)

October 20 - S.C.P.
M. Alami, Directeur Industriel, S.C.P. (Tel: 607-78)
M. Basri, Chef du Departement Commercial Emplissage S.C.P. (Tel: 622-15)
M. Lamhandaz, Directeur Emplissage et Fabrication de Bouteilles, S.C.P. (Tel: 619-11)
M. Mansouri, Directeur de Raffinage S.C.P. (Tel: 628-89)
M. Faupin, Ingenieur Assistant du Directeur Industriel S.C.P. (Tel: 607-78)

- USAID
  M. C. Johnson, Mission Director (Tel: 622-65)

- MEM/DDRE
  M. Barrakad, Chef de la Division de Devel oppement des Ressources Energetiques (Tel: 606-14)

October 21

- Ministry of Transportation
  M. Ottmani, Directeur des Etudes Planification et Coordination des Transport (Tel: 735-40)
  M. Zhar,
  M. Lasfar , Ingenieur Statisticien (Tel: 735-05)

- Ministry of Housing
  M. Ben Haddo, Directeur de l'Habitat
  M. Onolomi, Charge d'etudes Techniques
  M. Samah, Ingenieur Statisticien

- Office National du Tourisme
  MM Bennani and Ben Chequroun, Division des Investissements

- Ministere de l'Agriculture
  Direction de l'Equipement Rural
  M. El Gueddari

- USAID
  Private Sector
  Mrs. Sydney Lewis, Charge de l'Elaboration des Projets (Tel: 622-65)
  M. George Callen, Consultant en commerce International (Tel: 622-65)

- Ministere de l'Interieur
  Direction des Regies
  MM. Bougzouc and Youari

- Ministry of Industry
  M. Moulay Tahiri, Chef de la Division des Industries Chimiques et Parachimiques (Tel: 651-50)

- AGA Ingenierie
  M. Houssani, Directeur General (Tel: 553-56)

- Societe Sucrerie Nationale du Beht
  M. Debbarh, Directeur General (Tel: (050) 28-89)

October 22

- Banque Nationale pour le Developpement Economique
  M. Mohamed Amroui, Directeur du Departement des Credits Specialises et de la Promotion (Tel: 664-52)

- Cellulose du Maroc
  M. M'Hammed Mezzour, Directeur General (Tel: 683-05)

- SPD

- SAMIR
  M. Benabderrazik, Secretaire General (Tel: 2501)
  M. Joudali, Responsable Raffinage

Part B: Casablanca

October 23

- WafaBank
  M. Farid Benjelloun, Directeur Division Energie Mines et Chimie (Tel: 22-41-05)
  M. Mohamed Mikou, Directeur de la Division des Produits Alimentaires (Tel: 22-41-05)

- Sococharbo
  M. Lahlou, Directeur du Departement Thermique (Tel: 24-04-82)

- US Embassy
  M. Charles Buck, Consul Attache Commercial (Tel: 22-41-49)

- Office National de l'Electricite
  M. A. Berrada, Directeur Financier et Chef des Services Administratifs (Tel: 22-65-53)
  M. Smouni, Direction Production et Transport/Mouvement d'Energie (Tel: 24-59-41)

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MM. Kerroumi, Direction Production et Transport/Production Thermique (Tel: 36-98-99) Mohammedia
M. Charouki, Centrale Casablanca
M. Kettani et Fadili, Direction des Services de l'Equipement/Etudes et Planification
MM. Baakil, Direction des Services de la Distribution (Tel: 22-33-30)

- S.N.P.P. (Societe Nationale des Produits E-SDG Petroliers)
  M. Es. Sdiqui Directeur General (Tel: 27.84.16)
  M. Anzane, Directeur Planification - Approvisionnement et Distribution

- Federation des Chambres de Commerce et d'Industrie du Maroc
  M. Abdellah Azmani, President (Tel: 765-23)

October 24

- SMD-Unifer
  M. Abdelkader Darhnaj, Directeur Technique
  M. Goret (Tel: 28-96-87)

- Corps International de Services des Experts
  M. German F. Kortschak, Directeur General Adjoint (Tel: 30-91-11)

- CERPHOS - Groupe Office Cherifien des Phosphates (OCP)
  M. Larbi El Omri, Directeur (Tel: 24-12-69)
  M. Mohamed Smail Smani (Tel: 24-12-69)

- Centre de Developpement des Energies CDER
  M. Narrakech)
  M. Fakihani, Direceur General (Tel: 312-15)
  M. Mzabi, Secretaire General (Tel: 309-92)
  M. Serrakh, Division Planification Programmation
  M. Fabre, RTI (Tel: 345-86/342-75)

October 27

- Ministere du Plan
  M. Tadili - Faress, Directeur de la Statistique
  M. Abzahd, Chef de Division des Enquetes aupres des Menages

October 28	- USAID Briefing
	- MEM Briefing
October 29	- O.N.E. M. Smouni, Directeur Production et Transport/ Mouvements d' Energie
	- O.N.E. M. Kerroumi, Directeur Production et Transport/Production Thermique
October 30	- FRUMAT (Orange Juice Plant) Kenitza M. Lakhdar, Directeur (Tel: 36-43)
	- COTEF (Textile Mill) Fes M. Manjra - Directeur Technique (Tel: 413-09) M. Douni - Directeur Technique Adjoint
October 31	- SMESI (Engineering firm from Groupe Office Cherifien des Phosphates - OCP) Casablanca M. Bekkali, Directeur (ref 360025) M. Oueld Guejdi, Department Manager
	- USAID Briefing
	- Ministere de l'Industrie - Rabat M. Alami, Chef de Division des Statistiques Industrielles, de la Normalisation et de la Promotion des Investissements Mme Bennani, Statisticienne

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- Structure industrielle de l'O.N.E.
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- Variations saisonnieres de l'energie appelee
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APPENDIX B: POTENTIAL ENERGY SAVINGS BY SUBSECTOR

In this appendix, we present details of our estimate of the potential for future energy savings over the period 1986-1991. First, large consumers such as O.N.E., petroleum refineries, CDM, and OCP are analyzed. Then, the potential in each industry is reviewed. Estimates are based on (1) an extensive review of all studies available, (2) direct interviews and plant visits, and (3) consultant international experience and familiarity with European manufacturing processes, especially French.

B.1: POWER UTILITY (OFFICE NATIONAL DE L'ELECTRICITE) O.N.E.

1. O.N.E. Fuel Demand Assessment in 1996

O.N.E. fuel consumption in 1996 will depend on:

- the level of national power demand
- the share of hydropower in overall power generation
- the characteristics and performance of thermal equipment
- the specific consumption of this equipment

1.1. The Level of National Power Demand

Annual growth of power demand is expected to be 7% (mini 6%, maxi 8%).

From O.N.E. sources the power demand is expected to be as high as 13,700 GWh in 1996

Projected Power Demand (gross production)

Year	1985	1990	1996	2000
GWh	6,502	9,150	13,700	18,000

Source O.N.E.

In order to be consistent with the projected energy demand in 1996 estimated in Appendix C, it is considered in the following paragraphs that power demand will be 11,800 GWh in 1996 instead of the 13,700 projected by O.N.E.

1.2. The Share of Hydropower In Overall Power Generation

Hydropower production has been as high as 1500 GWh in 1980 and as low as 350 Gwh in 1984 due to drought conditions.

Taking into account the construction of new hydropower facilities:

x 1989	67 MW,	
x 1992	241 MW,	(MATMATA)
x 1994	52 MW,	(M'DEZ)

it is expected that hydropower production should be as high as 1500 MWh in 1996 (consultant estimate).

1.3. Projected Mix of Power Sources

	1985		1996	
	Capacity MW	Production GWh	Capacity MW	Production MWh
Hydropower	610.15	366.4	970	1,500 (e)
Steam Turbine	1,092 (1)	5,936.2	1,817	9,900 (e)
Gas Turbine	135.5	68.4	335.5	375 (c)
Diesel	24.146	11.8	24.146	25 (e)
Total		6,382.8		11,800

Source O.N.E.

(1) average for the year 1985 (1217 MW at the end of 1986)
(e) consultant estimate
(c) calculated (balance)

Projected gas turbine production is calculated considering that the average load factor of the steam turbine equipment will be 62% (value in 1985).

1.4. Specific consumption of each thermal equipment

In 1985 this specific consumption was:

	Gross Production (GWh)	Fuel (toe)	Specific Consumption Mcal/kWh
Steam Turbine	5936,2	1437996	2,42
Gas Turbine	68,4	26946	3,94
Diesel	11,8	3960	3,35
Total	**6016,5**	**1468922**	**2,44**

Source: O.N.E. using following conversion factors

1t fuel oil	= 0,96	toe
1t coal	= 0,57	toe
1t gasoil	= 1	toe

Note: for the steam turbines there is a wide range in the efficiency of different equipment.

Power Station	Mcal/kWh
Mohammedia	2,11
Kenitra	2,47
Jerada	3,16
Roches Noires	2,57

It is assumed that the newly installed steam turbine characteristics will be equivalent to Mohammedia's ones (in terms of thermal efficiency).

1.5. Fuel Requirements in 1996

	GWh		Mcal/kwh		toe
Steam Turbine	9,900	(old) 5,900	x 2,42	=	1,427,800
		(new) 4,000	x 2,11	=	844,000
Gas Turbine	1,375		x 3,94	=	147,500
Diesel	25		x 3,35	=	8,370
		Total			2,427,670

In conclusion, O.N.E. fuel demand is estimated to increase from 1,470,000 toe in 1985 up to 2,427,670 toe in 1996.

2. ENERGY SAVINGS AT O.N.E.

Three areas for energy savings are:

1. Thermal efficiency of equipment
2. Auxiliaries and transformer losses
3. Transmission and distribution losses.

Thermal Efficiency of Equipment

Following discussion with production manager, thermal equipment are operated at their design efficiency. In each power plant operation, data is collected on a hourly basis and is transmitted to a statistics division which calculate the thermal efficiency everyday. Any bias with the design efficiency is analyzed and corrective actions are taken (operation or maintenance).

At Mohammedia Power Station (the most efficient site), a calculator displays automatically the efficiency of boilers every 8 hours or every time the plant load varies by plus or minus 7.5 MW.

O.N.E. considers that the efficiency of a steam power station is a characteristic of its initial design and that it is not conceivable (either not technically feasible, or not profitable) to go into a major retrofit program in the least efficient facilities.

Nevertheless, some improvements are scheduled

At Jerada	- revamping of the control system
	- replacement of the flue gas filter
At Casablanca	- condensor retubing

No energy saving considerations have been explicitly involved in the decision of above revampings.

In terms of technical potential, if we consider that a specific consumption of 2.2 Mcal/kWh is a good target for the old steam turbine power plant, the energy saving potential would be:

$$(2.42-2.2)\ 10^{-4} \times 5{,}900 \times 10^{6} = 130{,}000 \text{ toe/yr}$$

Auxiliaries and Transformers Losses

In 1985, auxiliaries and transformers losses on thermal equipment were estimated at 8.12%. Those losses are regularly checked and analyzed by the production staff.

Transmissions and Distribution Losses

In 1985, transmission losses in O.N.E. network amounted to 6.92% and distribution losses had been estimated at 1.99%.

Following discussions with the transmission manager, these losses are regularly checked and are in constant decrease due to development of network (trend to higher voltage transmission).

For example, transmission losses have dropped from 7.8% in 1981 down to 6.7% in 1985.

The power factor of the network is high. O.N.E. expects to increase the power factor penalty threshold from 0.8 up to 0.85.

In term of technical potential it can been assumed that the auxiliaries and transmission losses can be reduced by 1% (on total electricity production) by 1996 horizon. The saving would be roughly 100 GWh/yr.

In conclusion, energy management at O.N.E. is underway and no substantial additional benefit can be expected from the envisioned energy demand management program.

BENEFITS OF A PEAK LOAD MANAGEMENT PROGRAM

Need for Gas Turbine in the Short Term

Peak demand is expected to increase at the same rate as energy demand (see Exhibit B1.2). Consequently, O.N.E. doesn't expects a drastic change of the demand curve shape in the future.

The need for additional power supply is a resultant of:

- the rise of peak demand
- the rise of base load demand (energy demand)

O.N.E. future projects includes (see Exhibit B1).

- new hydropower stations
- new coal steam power stations
- new combustion turbine stations

However, due to some delays in hydropower and steam power station projects, O.N.E. is considering installation of two 90 MW gas turbines using fuel oil for the short term to meet the power demand during peak hours and baseload hours. Actually the need for additional gas turbine capacity is strengthened by the drought conditions.

Structure of the Peak Demand

Traditionally peak load happens in December during the cold and short-daylight season. This peak demand is due to cumulative demand for lighting, (household, commercial, and public) TV, cooking, sanitary hot water and heating.

Since a few years, peak demand has occurred in July due to pumping for irrigation.

Both in July and in December the peak demand happens at sunset (between 19 and 22 o'clock).

O.N.E. meets peak demand with its hydropower and gas turbine facilities.

The most critical situation happens in winter because of low level of water in hydropower station's reservoirs.

What Is Being Done By O.N.E. to Get Through the Peak Load

Since a few years, because of the drought, O.N.E. has enacted load shedding arrangements with end users to face winter peak demands.

Such end users are cement producers who account for 80 MW. Cements plants operate 24 hours a day. However, they have storage facilities which allow to postpone grinding operations:

- clinker grinding can be stop during 3 to 4 hours a day and account for 30% of the cement industry power demand (24 MW).

- raw material grinding can be postponed for 1 to 2 hours a day without affecting kiln operation. This adds another 24 MW of load shedding.

During load shedding hours, only the whole kilns are kept running and, the power demand reduction can reach 50 MW for all cement industry.

Until now, these arrangements have been concluded under the threat of total black-out. In extreme condition, power supply to one or two cement plants

had to be totally cut. O.N.E. is now considering the modification of its tariff to give some incentives to industrial facilities which have the opportunity to reduce power demand during peak hours.

O.N.E. has also successfully experienced:

- daylight saving time
- TV broadcasting hours delay

which account for an additional 50 MW in power demand reduction.

What Can Be Done By the Envisioned EDMP

The following areas can be explored to further reduce power demand during peak hours:

- power savings
- displacement of power demand from peak hours to off-peak hours
- incentive for self generation in industrial facilities to maximize power availability during peak hours.

Power savings can be expected from the two main contributors to peak demands:

- lighting
- water pumping

Our experience shows that lighting energy demand can be reduced in large buildings by 10% and that there is usually some opportunity for energy savings in large water pumping stations (5 MW and more).

Displacement of power demand from peak hours to base load hours can be envisioned with major end users other than cement industry. Some areas to be investigated are:

- irrigation pumping
- drinking water pumping
- phosphate extraction (large scrappers, power rate can be up to 5 MW per unit)

Self power producing industries are presented in Exhibit B1.3.

Currently Maroc Phosphore is the only industry which exports electricity to the grid (2.5 to 10 MW). International experience shows that industries with cogeneration capability can efficiently back up the public utility during peak hours.

Those industries could be:

- phosphate (acid phosphoric and fertilizers)
- sugar
- pulp and paper
- petroleum refining (SAMIR).

B.2: PETROLEUM REFINING INDUSTRY

In 1985, 4814 kt of crude oil have been processed in the two refineries SAMIR and S.C.P.

Energy consumption at both refineries are displayed in the following table.

	SAMIR		S.C.P.	
	t	%	t	%
Crude	3,675,522	100	1,138,797	100
Product Losses	65,226	1.77	21,499	1.89
(crude storage)			(13,088)	
(process)			(8,411)	
Fuel (oil + gas)	203,350	5.53	46,511(1)	4.08
Electricity(2)	14,347	0.39	7,960	0.7
Coke	-	-	3,234	0.28
Total Energy Losses	**282,923**	**7.69**	**79,204**	**6.95**

(Source SAMIR and S.C.P.)

(1) Including fuel gas purchased

(2) Electricity is converted into fuel equivalent at a rate of 0,25 kg of fuel per kwh

S.C.P. refinery is operated at a throughput very closed to its nominal capacity (1,200,000 t/year)

SAMIR refinery has a low rate of capacity utilization (56%)

Any increase in oil demand in Morocco will be faced by SAMIR refinery.

Assuming that oil demand will be 7,500,000 by 1996, (see Appendix C) the breakdown of production between the two refinery would be:

- S.C.P. 1,200,000 t
- SAMIR 6,300,000 t

The major energy saving opportunity at S.C.P. is the reduction of product losses.

1114

6.5% autoconsumption would be a good target for this type of refinery (instead of 6.95% currently)

Savings would be as high as 5,400 toe/yr in 1996

For SAMIR refinery the major energy saving opportunities are:

- reduction of the flare gas waste
- improvement in the steam system

In addition, if the refinery throughput is higher than 4,5 Mt/year, corresponding to the capacity of the last expansion (1979), old process units should be run.

The recent unit has been built with energy efficient design criteria while older units have not been retrofitted after the oil price rise (due to the low load factor).

The potential for energy savings at SAMIR refinery is estimated as follows:

- product loss reduction	0.5% on throughput
- steam system improvement	0.5% on throughput

energy saving would be in 1996

$$6{,}300{,}000 \times 0{,}01 = \underline{63{,}000 \text{ toe/year}}$$

The energy saving potential for both refineries would therefore be <u>70,000 toe/year</u>

B.3: CHARBONNAGES DU MAROC (CDM)

Coal Mines

Jerada mine is expected to increase production rate from 837500 t/y in 1984 to 1,000.000 t/y in 1995. (consultant estimate).

Based on the present trend, the electricity consumption of the mine can be expected to be as high as 100 GWh at this date.

A preliminary energy audits report indicates that there is some scope for electricity saving at Jerada, through improvement of air compressor system management. (Source: Transenerg, ISTI).

We assume that this saving could be as high as 15% i.e., 15 GWh.

B.4: OFFICE CHERIFIEN DES PHOSPHATES (O.C.P.)

Phosphate Industry

The major energy consuming industrial activity is the extraction of phosphate and its processing (drying and conversion to phosphoric acid and fertilizers).

Phosphate production could be increased from 21,517 kt in 1984 up to 23,000 kt in 1996 (consultant estimate).

Specific consumption is currently (1982)

fuel	11,37 toe/kt
electricity	17,83 kWh/kt

Assuming that energy demand is strictly proportional to production level and extrapolating the current trend of energy conservation rate, the 1996 energy demand would be:

fuel	215,000 toe
electricity	350 GWh

We assume that 5% of energy saving could be achieved through optimization of drying furnaces (source seminaire sur les economies d'energie - janv. 84)

Energy savings would therefore be 10,000 toe/an

Phosphoric acid and fertilizers production is supposed to increase at 6.5% per year. (consultant estimate)

1996 energy consumption would be in 1996

fuel	170,000 toe

This production should be met with new units, taking into consideration for energy conservation.

There will be very little scope for energy saving in its activity.

B.5: CEMENT INDUSTRY

The professional association of cement producers has recently published figures giving energy guidelines in cement industry:

Year	1982	1985	1996 (e)
Production (kt)	3848	4270	7300
Fuel (Specific)			
Consumption (kgoe/t)	90,8	74,6	70,8
Total Fuel			
Consumption (toe)	349400	318542	517000
Electricity (specific)			
Consumption (kWh/t)	93	102,5	803
Total Electricity			
Consumption (GWh)	357,9	437,6	762

(Source: seminaire sur les economies d'energie, janv. 84)

Note: (e) extrapolated by consultant from source/data.

The expected amount of energy saving is:

7,300 (74,6 - 70,8) = 27,000 toe
7,300 (102,5 - 110) = - 55 GWh

115X

B.6: GLASS INDUSTRY

Glass industry has been visited by pre-audit teams who noted some scope of energy savings, in SEVAM plants. (Source: Transenerg)

Plant	Fuel toe	Electricity GWh
Tit Melli	6,052	7.5
Casablanca	5,229	4.9
	11,281	12.4

A 20% fuel saving is assumed, equivalent to 2,200 toe/an

B.7: PULP AND PAPER INDUSTRY

There is just one pulp plant in Morocco (La Cellulose du Maroc) considered as an energy efficient plant, with little opportunities for additional energy savings. (Source ISTI)

Two paper plants (CMCP and Papelera) have received preliminary audit teams and are supposed to have an energy saving potential as high as 15% of their fuel consumption. (Source: Transenerg)

	Year	Fuel	Electricity Purchased
Papelera de Tutuan	1982	7,524 t	21.65 GWh
CMCP	1983	5,198 t	- GWh
		12,722 t	21,65 GWh

15% saving is equivalent to 1,900 toe/year.

1174

B.8: SUGAR INDUSTRY

	Sugar Plants				
	Energy Audit	Expansion Project	Conservation Projection in Progress	Coal Use	Bagasse Use
Beet Sugar					
SUBM	x	x			
SUTA	x				
SUNAT	x		x		
SUNABEL	end 86				
DOUKKALA		x			
SUCRAFOR					
SUNAB	x		x	x	
SUNAGT				x	
SUNAGK				x	
ZEMAMRA	new plant				
Cane Sugar					
SUCRAL	new plant				x
SURAC	new plant				x
SUNACAS					x

1. Beet Sugar Industry

Currently (1984) 1 ton of processed beet sugar requires the production of 420 kg of steam of which 28% are not expanded through backpressure turbine resulting in a power loss. (Source: AGA)

Power loss is estimated at

$$85 \text{ kWh} \times 0{,}12 = 10{,}2 \text{ kWh/t beet}$$

for a production estimated at 3.000.000 of beet in 1996 (consultant estimate), power waste would be 30,6 GWh.

Two alternatives can be considered to recover this energy:

- either O.N.E. accepts to buy the excess power generated by the sugar plants

savings would be

30,6 (250 110) = 4,284 tep

- or O.N.E. doesn't accept to pay for this available power.

Technology is available to reduce the steam demand down to the level where all the process steam is expanded through turbines to meet the power demand.

Assuming that half of the excess steam could be saved, the energy saving would be

0,06 x 85 kgoe/*ts x 3.000.000 = 15,300 toe/year

Required investment can be estimated at 100 MDH.

2. Cane Sugar Industry

Cane sugar industry is self-sufficient for its energy requirement: a by product (bagasse) is used as a fuel.

There is currently excess bagasse which is generally incinerated.

Excess bagasse roughly amounts to 10% of the sugar-cane processed. (source: seminaire sur les economies d'energie - janv. 84)

Bagasse fuel heat equivalent is

190 kgoe/t

Cane sugar production is expected to increase substantially over that next 10 years:

Year	1985	1995
Sugar cane	1,127,000t	1,620,000t

Making use of this excess bagasse would save by 1995:

162,000 x 0,1 x 0,190 = 30,780 tep

Exhibit B1.1

O.N.E. Future Power Plants

Expected Date of Completion	Type Of Power Plant	Name	Power Rate MW	Average Annual Energy Production GWh	Fuel Requirement t
1988	Diesel [1]	Laayonne	21		
1989	Hydro		67		
1989/1990	Gasturbine	N/A	18(		
1990	Hydro	SIDI DRISS	3,1	17	4,250
1992	Hydro	MATMATA	224	265	6,000
1992/1993	Thermal (coal)	CORF LASFAR	600	42,000	900,000[2]
1994	Hydro	M'DEX	35	50	
1995	Hydro	DCHAR EL "QUED	92	200	
1994	Hydro	ABDEL MOUMEN	29	57	
1995	Hydro	EL MENLEL	148	320	
1996+	Hydro	MJAARA	240	390	

1/ Not connected to the grid.

2/ Equivalent to 14,750,000 tons of imported coal.

Exhibit B1.2

Energy Demand and Peak Power Demand Forecast

Year	Energy Demand		Peak Power Demand	
	GWh	Annual Growth %	MW	Annual Growth %
1985	6,502	-	1,150	-
1990	9,150	+7%	1,570	+6.6%
1995	12,800	+7%	2,150	+6.5%
2000	18,000	+7%	3,000	+6.9%

Source: O.N.E.

Exhibit B1.3

Industrial Cogeneration

	Power Rate MW	Electricity Generated in 1984 (GWh)
Phosphate Industry		
Maroc Phosphore	76	320
Maroc Chimie	28	59
Sugar Industry		98
Pulp and Paper Industry		
Cellulose du Maroc		47
CMCP		38
Petroleum Refining		
SAMIR	16	63
Other		146

Source: Annum's statistique 1985.

APPENDIX C: PROJECTION OF ENERGY DEMAND IN 1996

To project energy demand, the following steps has been followed:

1. Detailed energy balance of Morocco for a basic year (Exhibit C.1). 1982 has been chosen as a basic year due to the available disaggregated data on energy consumption by subsector. (Source Development Sciences Inc., Energy Consumption in Morocco in 1982, November 26, 1984).

2. Projection of production growth rates in each subsector (Exhibit C.2). Production growth rates are based on projection given by S.P.D., the Ministry of Planning and Parastatals.

3. Projected energy balance of Morocco in 1996 (Exhibit C.3). The energy balance is projected to 1996 using:

   - 1982 as a reference year (Exhibit C.1).
   - projected production growth rates (Exhibit C.2).
   - assessment of elasticity of energy consumption to production in each subsector, so that energy conservation trends or energy penetration rates (electricity for example) are kept in the projection.
   - Energy guidelines resulting from discussions with professional associations, engineering and consulting firms, plant executives.

Using information from Exhibit C.1 and Exhibit C.2, the overall fuel demand in manufacturing industry is calculated in Exhibit C.4 (for year 1982 and 1996).

Exhibit C.5 shows the projected overall energy demand of Morocco, excluding fuel consumption by O.N.E. Output of this exhibit is the total power.

Calculation of total electricity production by O.N.E. from the total power demand is made in Exhibit C.6, assuming that losses (distribution, transmission, transformers, auxiliaries) will be the same in 1996 as they were 1985.

Appendix B.1 develops an analysis to estimate the amount of fuel required by O.N.E. in 1996 to provide the above calculated power demand.

The above O.N.E. fuel demand is used as an input of the Exhibit C.7 to calculate the overall fuel demand in Morocco.

Some reasonable forecast are made in Exhibit C.8 to estimate the penetration of coal use in the different subsectors.

Taking into account the new coal steam power plant of Jarf Lasfar, the O.N.E. coal use is estimated in Exhibit 3.9.

Outputs of Exhibits C.8 and C.9 allow to estimate the overall cost demand in Morocco in 1996 (Exhibit C.10).

Exhibit C.11 displays the overall energy demand in Morocco for each source of primary energy, resulting from the above calculations and assumptions.

Exhibit C.1

Detailed Energy Balance of Morocco - 1982

	Subsector	Light Oil (gasoil + toe)	Fuel Oil toe	Coal t	Natural toe	Electricity GWh
1.	Agriculture	276,572	1,351			246.4
2.	Phosphate Industry	19,110	113,179	1,108	31,337	313.1
	Phosphate extraction (O.C.P.)		170,779	31,337	313,1	
	Phosphoric Acid and fertilizers		31,630			
3.	Other Ores	28,577	49,247			164.7
4.	Energy and Water	7,222	880,952	675,020	20,784	252.5
	O.N.E.		869,095	628,820		
	Water pumping					201.3
	Refinery				20,784	
	Coal Mines					51.2
5.	Agroindustry	16,112	114,323	45,676		246.84
	Beet Sugar		63,911	26,936		6
	Cane Sugar			496		1.8
	Refined Sugar	1,151	38,886			
	Other	14,597	11,030	18,740		239
6.	Textiles	5,546	50,863			282.5
7.	Leather Industry	31	2,415			16.21
8.	Construction Materials	53,923	498,410	22,795		442.22
	Cement		311,704	4,710		257.9
	Glass		8,340			84.32
	Bricks/Tiles		178,366		18,085	
9.	Metal Industry	4,036	5,192	14,590		96.75
10.	Chemical Industry	4,470	16,407			210.15
	SNPE		10,400			102
	Rubber		--			
	Other	4,470	6,007			108.15
11.	Other Industries	2,002	49,771		6,966	169.6
	Pulp industry		21,462			48.3
	Paper industry		11,806	6,966		
	Other	2,002	16,503			121.3

125x

Exhibit C.1 (continued)

	Subsector	Light Oil (gasoil + toe)	Fuel Oil toe	Coal t	Natural toe	Electricity GWh
12.	Buildings, Civil Works	9	1			13.6
13.	Transport	789,062	49,158			168.7
	Road					
	Rail					
	Air					103.9
	Sea					
14.	Communication	9	1			29.1
15.	Commercial Services	184,459	14,991			239.4
16.	Non-commercial Services	49,994	18,062			179.7
17.	Household	620,683	513	12,133		1362.5
	Urban	566,762	513	6,067		1280.5
	Rural	54,921	0	6,066		82
	Total	**2,061,817**	**1,874,836**	**771,322**	**59,087**	**4434.0**

Exhibit C.2

Projected Growth By Subsector

Subsector	1982	1984	1985	Annual Growth Rate	1996
1. Agriculture					
Industrial Culture (1000Qx)	28,453	33,120		+6%	66,644
Irrigation (Pumping)				+10%	
2. Phosphate Industry					
Phosphate Prod. (1000t)	21,621	21,517			23,000
Acid Phosphoric (t) (and fertilizers)	901,323	1,372,507		+7%	3,090,000
3. Other Ores					
Iron Ore (t)	223,820	162,967			250,000
Lead Ore (t)	147,959	143,655			150,000
4. Energy and Water					
O.N.E. (GWh)			6,502		11,742
Refinery (kt)			4,814		7,500
Water Pumping (10^3 m^3)		365,181		8%	919,587
Coal Mine (t)		837,500			1,000,000
5. Agroindustry					
Sugar Beet (kt)	2,247	2,404			3,000
Sugar Cane (kt)	501	775	1,127		1,680
Refined Sugar (kt)	591	631		3%	900
Other Agroindustry (index)	117	127		+5%	228
6. Textile Industry (index)	109	100		+2%	127
7. Leather Industry (index)	145	141		+4%	225
8. Construction Materials					
Cement (kt)	3,848		4,270	+5%	7,300
Glass (index)	102	75		+5%	130
Brick/Tiles	108	95		+5%	170
9. Metal Industry (index)	84	72		+2%	90
10. Chemical Industry (index)	161	206		+8%	510
11. Other Industries					
Pulp (index)	105	127			180
Paper (index)	117	119			120
Other (index)	106	114		+3%	162

Exhibit C.2 (continued)

	Subsector	1982	1984	1985	Annual Growth Rate	1996
12.	Buildings/Civil Works				+5%	
13.	Transport					
	Road Vehicles	680,089	723,833		+8%	
	Rail (1,000t)	25,508	29,898		+8%	
	Air (1,000 voy.)	3,377	3,461		+8%	
	Sea (1,000t)	30,405	36,688		+5%	
14.	Communication				+8%	
15.	Commercial Services				+2%	
16.	Non-commercial Services				+10%	
17.	Household					
	Urban				+4%	
	Rural				+2%	

Exhibit C.3

Projected Energy Balance of Morocco (1996)

	Sector	Fuel (toe)	Electricity GWh
1.	Agriculture	757,200	810
2.	Phosphate Industry	385,000	350
	Phosphate Extraction (O.C.P.)	215,000	350
	Phosphoric Acid and Fertilizers	170,000	-
3.	Other Ores	106,300	250
4.	Energy and Water		
	O.N.E.		
	Water Pumping		536
	Refinery		
	Coal Mines		100
5.	Agroindustry	243,516	472.8
	Beet Sugar	110,500	6
	Cane Sugar	496	1.8
	Refined Sugar	61,520	-
	Other	71,000	465
6.	Textiles	65,700	330
7.	Leather Industry	3,800	25
8.	Construction Materials	817,860	943
	Cement	517,000	803
	Glass	10,600	
	Bricks/Tiles and Other	290,260	140
9.	Metal Industry	26,000	140

129x

Exhibit C.3 (continued)

	Sector	Fuel (tep)	Electricity GWh
10.	Chemical Industry	49,788	510
	SNEP	16,600	160
	Rubber		
	Other	33,188	350
11.	Other Industries	68,514	238.3
	Pulp Industry	21,462	48.3
	Paper Industry	18,772	-
	Other	28,280	190
12.	Buildings and Civil Works	20	30
13	Transport	2,598,631	523
	Road		
	Rail		
	Air		
	Sea		
14.	Communication	30	110
15.	Commercial Services	220,000	294
16.	Non-commercial Services	170,000	808
17.	Household	1,652,686	3583.1
	Urban		
	Rural		

Exhibit C.4

Projected Fuel Demand In Industry

	1982 Fuel (toe)	1996 Fuel (toe)
Phosphate	164,401	385,000
Other Ores	77,824	106,300
Agroindustry	162,408	243,516
Textiles	56,409	65,700
Leather Industry	2,446	3,800
Construction Materials	568,289	317,860
Metal Industry	19,441	26,000
Chemical Industry	20,877	49,788
Other Industries	58,739	68,514
Building/Civil Works	10	20
Total	**1,130,844**	**1,766,498**

Exhibit C.5

Projected Energy Demand In Morocco (O.N.E. excluded)

	1982		1996	
	Fuel toe	Electricity GWh	Fuel toe	Electricity GWh
Agriculture	287,923	246,4	757,200	810
Energy Sector	-	252,5	-	636
Industry	1,130,844	1,955	1,766,498	3,289
Transport	838,220	168,7	2,598,631	523
Building	267,516	448,2	390,030	1,212
Household	628,233	1362,5	1,652,686	3,583
Total	3,152,736	4,434	7,165,045	10,053

Exhibit C.6

Calculation of O.N.E. Production From Power Demand

	1982	1985	1996
Total Power Demand (GWh)		5,493.7	10,053
Transmission & Distribution loss (%)		8.77	8.77
Net Available Energy (GWh)		6,022.1	11,019
Other Producers (GWh)		23	65
Net O.N.E. Production (GWh)		5,999.1	10,954
Auxiliaries & Transformation Loss (%)		7.74	7.74
Gross O.N.E. Production GWh		6,502.3	11,872

Exhibit C.7

Total Fuel Demand in Morocco (including O.N.E.)

	1982 Fuel	1996 Fuel
Fuel Demand (O.N.E. excluded)	3,152,736	7,165,045 (2)
O.N.E. Fuel Demand	1,227,522 (1)	2,427,670
Adjustment (3)	66,197	66,197
Total Fuel Demand	**4,446,455**	**9,658,912**

(1) Source O.N.E.

(2) See Appendix B.1 for details of calculations.

(3) Consultant estimate

Exhibit C.8

Coal Penetration

	1982		1991	
	% of Subsector	toe	% of Subsector	toe
Phosphate Industry	0,67	775		775
Agroindustry				
Beet Sugar	22,78	18,855	60%	66,300
Other	33,86	13,118	50%	35,500
Construction Materials				
Cement	1,05	3,297	90%	465,300
Brick/Tiles	6,63	12,659	30%	87,000
Metal Industry	52,5	10,213	52,5%	13,650
Other Industries				
Paper Industry	0%	0	50%	9,000
Services	0%	0	10%	39,000
Household	1,35%	8,493	3%	50,000
Total		**67,410**		**766,525**

766,525 toe are equivalent to 10,950,000 metric ton of coal

Exhibit C.9

O.N.E. - Coal Consumption in 1996

Power Plant	Power MW	Coal Consumption t cost/yr	PCE toe/t	toe
Jerada	165	577,000	0,57	328,890
Mohammedia	2 x 150	700,000	0,6	420,000
Jorf Larsfar	2 x 300	1,400,000	0,6	840,000
Total				**1,588,890 tep**

Exhibit C.10

Total Coal Demand in 1996

	toe
O.N.E.	1,588,890
Other Sectors	766,525
Total	**2,355,415**

Exhibit C.11

Energy Demand in Morocco (10^3 toe)

	1982[2/]	1985[2/]	1996[3/]	
Coal	438	662	2,354	
Oil (1)	4,086	4,287	7,540	
Natural Gas	60	66	70	
Hydro Power	149	126	390	
Total	**4,733**	**5,141**	**10,354**	**(+6.5%/year)**

1 t of coal = 0,58 toe

1 GWh = 260 toe

1000 m^3 nat gas = 0.76 toe

(1) Including lube (1982 151,666 toe - 1996 305,181 toe)

(2) Source: MEM

(3) Consultant estimate.

APPENDIX D: LOAD MANAGEMENT

DEFINITION

A load management technique means any technique (other than a time-of-day or seasonal rate) to reduce the maximum kilowatt demand on the electric utility, including ripple or radio control mechanisms and other types of interruptible electric service, energy storage devices, and load-limiting devices.

KEY TECHNIQUES

Direct Load Control

Singular or cyclical interruption of customer equipment and appliances in response to peak-load levels on the utility system.

- Remote utility control of:
  - -- Residential space heaters
  - -- Residential storage space heaters
  - -- Residential air conditioners
  - -- Residential water heaters
  - -- Commercial-customer water heaters and nonessential loads
- Communications systems for remote utility control:
  - -- Ripple control
  - -- Power line carriers
  - -- Sine wave alteration
  - -- Radio control
  - -- Telephone control
- Other means of control:
  - -- Local control
    - -- Site-specific activation
    - -- Time-specific activation
    - -- Direct utility activation
  - -- Customer control
  - -- Multiple building computer control

- Incentive programs for energy conservation
  - -- Reduced electricity rates for interruptible service
  - -- Subsidized insulation and other energy conservation retrofits sales and installation
  - -- Interest-free/reduced interest for energy conservation loans
  - -- Energy saving sweepstakes
  - -- Energy saving new or retrofited home awards
  - -- Conservation awards

- Conservation services:
  - -- Customer insulation programs
  - -- Free trippers for swimming pool
  - -- Free energy audits
  - -- Free energy conservation products

- Public appeals for conservation

Energy Storage

Thermal, mechanical, or electrical storage of energy during off-peak hours to reduce demand during peak hours.

- Storage Water heaters:
  - -- Clock timer control
  - -- Remote utility control
  - -- Ceramic heat storage
  - -- Pressurized water heat storage
  - -- Non-pressurized water heat storage
  - -- In-Ground heat storage
  - -- Eutectic salts heat storage

- Storage space heaters:
  - -- Clock timer control
  - -- Remote utility control
  - -- Ceramic heat storage
  - -- Pressurized water heat storage
  - -- Non-pressurized water heat storage
  - -- In-Ground heat storage
  - -- Eutectic salts heat storage

- Storage air conditioners:
  - -- Clock timer control
  - -- Remote utility control
  - -- Ice cool storage
  - -- Eutectic salts cool storage

- Combined heat and cool storage:
  -- Non-pressurized hot water/cool water/ice
- Compressed air storage
- Pumped hydro storage
- Battery storage
- Hydrogen from water storage

APPENDIX E: CODES DES INVESTISSEMENTS

Royaume du Maroc

MINISTERE DU COMMERCE, DE L'INDUSTRIE
ET DU TOURISME

CODE DES INVESTISSEMENTS INDUSTRIELS

Février 1983

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Toute entreprise implantée dans la zone III telle que définie à l'article 7 précité peut formuler une demande à compter du 12e mois qui suit celui de la notification du visa de conformité ou de la signature de la convention. Le ministère chargé de l'industrie établit, conjointement avec le ministère chargé de l'emploi, la liste nominative des employés occupant un emploi stable pour lesquels l'entreprise peut bénéficier de la prime, en précisant la date depuis laquelle ils occupent leur emploi et la fait certifier conforme par le directeur de la Caisse nationale de sécurité sociale ou par son délégataire avant de la transmettre au ministère chargé des finances aux fins de versement à l'entreprise, de la partie du coût du terrain prise en charge par l'Etat.

Les versements prévus aux deux alinéas ci-dessus du présent article doivent intervenir dans un délai de 180 jours à compter de la date du dépôt auprès du ministère chargé de l'industrie ou de la date de réception par ce dernier, de la demande de versement.

ART. 18. — Pour l'application des dispositions du 2e alinéa de l'article 24 de la loi n° 17-82 précitée, le ministère chargé de l'industrie délivre à l'entreprise sur sa demande, une attestation constatant la part de la provision ayant été effectivement utilisée dans les conditions fixées par le titre V de ladite loi.

Cette attestation est délivrée dans un délai maximum de 30 jours à compter de la date du dépôt ou de la réception de la demande.

Ampliation de cette attestation est transmise au Premier ministre et au ministère chargé des finances.

TITRE X

De la prime d'équipement pour économie d'énergie ou d'eau et pour la préservation de l'environnement

ART. 19. — La prime d'équipement à la charge de

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l'Etat prévue en faveur des programmes d'investissement comportant des équipements spécifiques destinés à la réalisation d'économie d'eau ou d'énergie, à l'utilisation des ressources d'énergies nationales autres que celles d'origine pétrolière ou à la préservation de l'environnement est accordée en prenant en considération les éléments suivants :

1°/ Les investissements spécifiques pour économie d'énergie doivent permettre de réaliser, en permanence, une économie de 5% au moins de la dernière consommation annuelle d'énergie connue rapportée au même volume de production sans, toutefois, que cette économie puisse être inférieure à 250 tonnes d'équivalent pétrole par an.

Ces investissements doivent avoir un coût total hors taxe rapporté au nombre de tonnes d'équivalent pétrole d'énergie économisée par an supérieur ou égal à 1.000 DH.

Le taux de la prime est de 500 dirhams par tonne d'équivalent pétrole économisée par an sans, toutefois, que le montant de cette prime dépasse 20% du montant global de l'investissement.

10.000 thermies sont égales à une tonne d'équivalent pétrole.

2°/ Lorsque les équipements spécifiques acquis permettent, de manière permanente, l'utilisation de ressources nationales autres que celles d'origine pétrolière, pour un minimum de 40%, le taux de la prime est de 20% du montant global de l'investissement.

3°/ Les investissements spécifiques pour économie d'eau doivent permettre de réaliser en permanence une économie de 30% au moins de la dernière consommation annuelle d'eau connue rapportée au même volume de production.

Le taux de la prime est de 20% du montant global de l'investissement.

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APPENDIX F: PRELIMINARY LIST OF ENERGY DEMAND MANAGEMENT EQUIPMENT

The technologies to be demonstrated have already been tested, proven and made available in the United States and other countries. Nonetheless, their application to Morocco will, in most cases, be innovative. Successful demonstrations are expected to be replicated in other plants, buildings, and commercial units and centers as plant equipment and building stock is changed or replaced. Successful demonstration should provide the impetus to accelerated technology transfer, including promotion of local manufacture of equipment with support of the GOM, the private sector, and other donors.

This annex is divided into three sections, an illustrative list of equipment that can be applied to the Moroccan modern sector, a description of the equipment, and some suggested studies and workshops. The lists are by no means final; they will be added to by the design team and during implementation as other equipment becomes available and workshop ideas evolve.

ILLUSTRATIVE LIST OF ELIGIBLE EQUIPMENT AND COMMODITIES

Energy Conservation and Fuel Conversion Equipment

Heat Recovery Technology
- Condensing heat exchangers
- Metallic recuperators
- Economizers
- Air heaters
- Waste heat boilers

Instrumentation and Control Systems
- Automatic actuated valves
- Stack gas characterization equipment
- Data acquisition equipment

Insulation Materials
- High temperature refractory brick
- Furnace/boiler outside walls
- Steam pipe insulation
- Fiberglass

Coal Handling Equipment
- Conveyance/feeding
- Storage
- Grinding

Steam Generation Equipment
- Upgrade equipment (de-aerators water treatment)
- High efficiency package boilers (oil and gas)
- Coal fired package boiler (stoker and fluidized bed and gasification systems)
- High efficiency and multifuel burners
- Steam distribution equipment

Furnaces/waste fuel boilers
- Oil/pulverized coal melting furnaces
- Fuel processing equipment
- High efficiency and multifuel furnaces

Motor Power Factor Correction Equipment
- Upgrade equipment (capacitors and test apparatus)
- High efficiency motors

Cogeneration Equipment
- Packaged cogeneration systems
- Waste fuel fired systems

High Efficiency Lighting Equipment

Energy Audit Equipment
- Stack gas monitoring instrumentation
- Thermal imaging systems
- Temperature monitoring equipment
- Flow meters and electric power meters
- Data acquisition equipment and computers
- Energy audit vehicles

Building Energy Management Systems

Time clocks, temperature or light induced controls, and computers.

DESCRIPTION OF EQUIPMENT AND COMMODITIES

Energy Conservation/Fuel Conversion Equipment

Energy efficient equipment will play a major role in achieving Morocco's energy conservation and increased productivity goals. The categories below describe the equipment that has been identified to-date for this activity.

Initially, all of the equipment will be imported. Eventually some of it will be manufactured in Morocco.

- Waste Heat Recovery Equipment

  Several million tons of oil equivalent (MTOE) per year of waste heat is discharged from furnaces and boilers in Morocco's industrial sector. Heat recovery technology allows cost effective recovery and use of this heat. Heat exchangers are the primary component of a heat recovery system, enabling heat to be transferred from the reject stock gas to useful circulation streams. These heat sinks may consist of boiler makeup water, domestic water, combustion air, or ventilation air.

- Instrumentation and Monitoring Systems

  Instrumentation and control systems in this study refer to automatic actuated valves, stack gas characterization and burner control equipment, physical measurement instrumentation and data acquisition systems. Automatic actuated valves are controlled by temperature and pressure transmitters either mechanically or electrically actuated. Automatic actuation enables more accurate and uniform control enabling higher production capacities per unit of energy consumption. Stack gas characterization equipment consists of CO_2 or O_2 analyzers and temperature indicators. Continuous monitoring of the stack gas enables burner control at maximum efficiency. Advanced versions compute efficiency based on stack temperature and O_2 concentration. The systems are also available with feedback mechanisms to control combustion air changes in the burner. Physical measurement and data acquisition systems enable parameters to be measured and stored. Examples of these paremeters are pressure and energy consumption and production rates. This information can lead to optimum energy use for a given plant.

- Insulation Materials

  Insulation materials consist of low thermal conduction materials to cover the outside of pipes, ducts, vessels, furnace and boiler walls to minimize heat conduction losses. High temperature materials also need to be fire resistant. The materials are available in rolls, sheets or brick form. Materials include fiberglass, mineral work, magnisite, zirconia, and other refractory brick.

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- Steam Generation Equipment

  Steam generation equipment includes upgrade equipment such as dearators, water treatment systems, steam traps; high efficiency oil, gas or coal fired boilers; waste fuel boilers including pith, bagasse, paper waste; and high efficiency and multifuel burners.

  Upgrade equipment focuses on improving boiler water quality and effective steam distribution. Existing boilers with efficiencies below 70% that are over 25-30 years should be replaced with new package boilers which can fire on multiple fuels with fuel to steam efficiencies of 83-84%.

  Inefficient boilers that are too young to retire can be retrofitted with new gas and oil fired high efficiency burners. The high efficiency burners are forced draft and are made for gas, or liquid fuels. Liquid fuel burners can be pressure or steam atomized. Coal fired boilers consist of stoker, pulverized fuel, or fluidized bed. In stoker fired boilers, solid fuel burns on a grate. Pulverized fuel fired boilers use a forced draft burner to burn pulverized coal. Fluidized bed boilers burn solid fuels in a churning bed of hot sand/limestone set in motion by upward flowing air through the bed.

- Furnaces and Direct Heating Equipment

  Furnaces and direct fired heating equipment include all fuel fired operations that are not related to steam generation. The generic type of equipment for Morocco includes electric arc furnaces, fuel fired melting operations, fuel processing equipment, high efficiency furnaces and multiple fuel furnaces. Melting furnaces are designed to heat metal scrap to 2200-3000°F range, indirect heat of oil in the refinery (250-600°F); and direct or indirect drying of solids (100-300°F).

- High Efficiency Motors and Power Factor Connection Equipment

  Recent developments in electric motor technology have allowed higher efficiencies to be achieved. Improvements in motor efficiency are achieved by reducing losses from friction and windage, core, static, rotor and stray load. High efficiency motors optimize reduction in each of these losses to improve efficiency by 5-10%.

- Coal Handling Equipment

  Coal handling equipment refers to all equipment used to transport, grind and store coal during the time between delivery and plant use. Coal requires special care in transport and storage. The coal can lose a significant portion of its volatile matter content and there is a constant danger of spontaneous oxidation during the transportation and storage. Coal must be blanketed in an inert environment to minimize particle breakage and attrition during transport.

- Cogeneration Systems

  Cogeneration systems produce electricity expanding hot high pressure gas either in an engine cylinder, gas or steam turbine to produce shaft power. Only about one-third of the energy consumed by the system is converted to electricity. The exhausts from these electrical production systems contain electricity. The exhausts from these electrical production systems contain substantial amounts of heat. The system uses this reject heat to raise steam.

- High Efficiency Lighting

  Relamping with more efficient lamps can increase lighting efficiency without the need to modify lighting fixtures or ballasts. Changes in fixtures and ballasts can provide further energy savings at substantially higher capital costs. Electricity savings of 15-25 percent for high efficiency bulb reduces 40-100 watt range are common. Although the high efficiency bulb reduces operating costs the bulb life is less than that of standard bulbs.

Building Energy Management Systems

An energy management system (EMS) is composed of microprocessor-based devices that control and optimize energy use in a building or facility, and is capable of on-site programming by building operating personnel. In general, the cost of an EMS, and the energy savings achievable with its use, increase with the capability of the system. Some specific uses for EMSs are:

- Optimum start/stop. By monitoring indoor and outdoor conditions, an EMS will start equipment as late as possible and shut down equipment as early as possible while still allowing comfortable conditions to be maintained in the spaces served by building HVAC equipment.

- Time-of-day duty cycling with temperature compensation will help to reduce building peak demand and electric energy use. This

strategy is most effective where air conditioning is not needed for humidity control.

- Peak electric demand control by load shedding or cycling. This option, while not necessarily cost effective under present utility rate schedules (which tend to have low demand charges), will become more attractive as utility rates increase and/or rates are restructured to include higher demand charges.

APPENDIX G: JAMAICA -- ENERGY MANAGEMENT LOAN

F. INSTITUTIONAL ANALYSIS

(i) The National Development Bank

The following information on the National Development Bank of Jamaica Ltd. is provided in accordance with the USAID Handbook of Instructions (Appendix 4A - Intermediate Credit Institutions):

Official Name of Institution and Address:

National Development Bank of Jamaica Limited (NDB)
11a - 15 Oxford Road, P. O. Box 8309
Kingston 5, Jamaica W.I.

Telephone - (809) 92-94000
Cable/Telex - NDBJAM KINGSTON

Nature of Present Financial Operations

NDB is a secondary development banking institution for Jamaica, which will provide medium and long-term fixed interest rate funding assistance to local commercial lending institutions for on-lending to eligible projects that meet developmental objectives of Jamaica. The attached statements on Policies and Strategy, and Operating Criteria (Annex J) further elaborate on NDB's mode of operation. NDB's program is designed to ensure availability of term financing for industry which has been lacking in recent years.

Legal Status of NDB

The NDB was formed as a limited liability company in 1981, and is wholly owned by the Government of Jamaica. Registered Articles of Association are available in Annex J.

NDB Policy Statements and Operations Rationale

As noted earlier, NDB will not normally lend directly to projects. Instead, NDB will lend to Approved Financial Institutions for onlending to project sponsors. The basic policies of NDB are summarized in the following attachments available in Annex J: Policies and Strategy; Operating Criteria; and Operating Procedures. The rationale for operating as a secondary financial institution is to encourage private sector innovation and risk-taking and simultaneously minimize NDB portfolio risk. NDB will be insulated from the commercial project credit risk borne by the Affiliated Financial Institutions.

Initial lending operations of NDB will be carried out through intermediary financial institutions (AFIs) approved by NDB for participation in the program. To meet NDB criteria each institution has to be properly registered, and designate at least one senior executive with an appropriate background to be responsible for project evaluation and coordination with NDB. At present there are 9 commercial and 6 merchant banks that could participate in the proposed project. Three merchant banks are associated with commercial banks and three are independent. As a safety precaution NDB has an exposure limit not to exceed two times the net worth of each AFI except when an AFI presents a separate guarantee satisfactory to NDB. This limit may be changed as more experience is gained, particularly with merchant banks. The Jamaica Co-operative Credit Union League is also a participant in the NDB program and acts as an AFI for the small business sector.

Participating AFIs will assume the entire commercial risk for their subloans and will be expected to participate in subproject financing, providing at least the necessary short-term working capital. They will be primarily responsible for appraisal and supervision of subprojects they finance. Each AFI will be obliged to repay NDB according to an agreed schedule irrespective of whether the sub-borrower meets his repayment obligations. Rescheduling of subloans would be subject to NDB prior concurrence.

For their services and risk-taking AFIs will receive an interest spread of 3% p.a. This spread has been found acceptable by potential AFIs (see Annex K) but may be revised as experience is gained regarding the performance of individual AFIs. As an inducement to term lending by commercial banks, their loan portfolios financed by NDB will be exempted from reserve requirements.

Each AFI will be required to send to NDB semi-annually their financial statements, annual estimates of their lending activities, and copies of subproject supervision reports. NDB will review annually the performance of each AFI, make appropriate recommendations and, as needed, provide appropriate staff training facilities.

A current status report on AFIs (Memo dated May 16, 1983 from H. Abrikian, Treasurer of NDB) is included in Annex J.

There will be a limit on the size of a sub-loan, but sub-loan Borrowers will have to comply with a maximum debt to equity ratio of 4:1 in the case of sub-loan projects having net fixed assets below J$300,000. Projects are expected to have a minimum Debt Service Coverage Ratio of 1:5 and a minimum Internal Rate of Return of 12%.

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All subprojects will be appraised and approved by AFIs. AFIs will have responsibility for supervision of their subprojects. NDB will ensure through staff visits and other means that proper supervision is being carried out.

Commercial banks, who dominate the Jamaican financial markets, are mainly locally owned, but still retain strong ties with their present or past parent institutions in Canada, England and USA. They generally follow the traditional banking principles of safety and liquidity, making mostly well secured short-term loans which can be rolled over subject to yearly reviews. About 10 percent of their portfolios is in mortgage loans to selected clients secured either by residential properties valued at least 25 percent above the loan amount, or by tangible business assets valued 50 percent or more over the loan. In addition, commercial banks usually establish a "ceiling" for each borrower above which they will not lend irrespective of additional collateral or activity to be financed. In 1982, the commercial banks' outstanding loans for manufacturing activities amounted to over J$320 million, representing over 20 percent of their overall loan portfolios.

NDB's exposure limit to AFIs of 2 times an AFI's net worth, bank lending practices, plus NDB review of projects submitted for funding will all help to ensure that proper program risk management exists.

Description of Capitalization

The share capital of NDB is J$20 million of which J$10,051,569 is presently subscribed and paid in by the Government of Jamaica. Attachments in Annex J describe the equity and debt capitalization sources to date for the NDB.

Financial Statements

The audited financial statements for the year ending September 30, 1982 along with interim financial statements as of March 31, 1983 are available in Annex J.

Organization Structure

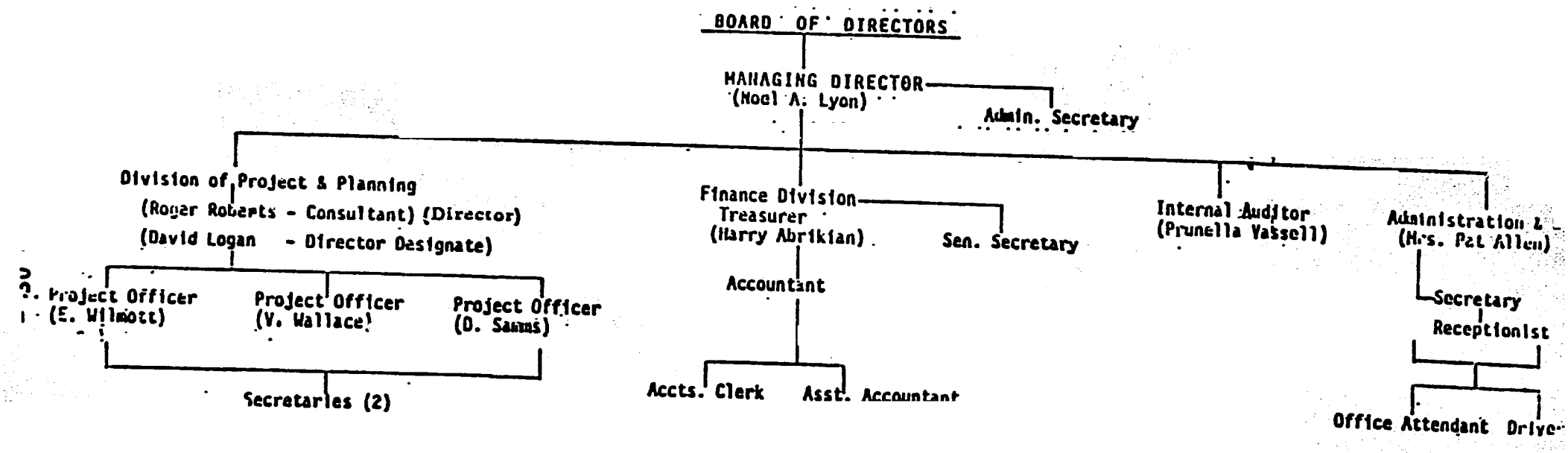
The organization structure of NDB is detailed below.

Background Data on Directors and Management

A Directors' List and the Curriculum Vitae of NDB's management is included as a part of Annex J.

NATIONAL DEVELOPMENT BANK OF JAMAICA LIMITED

ORGANISATION CHART.



Loan Application Procedures

It is anticipated that the Energy Credit Fund program will operate basically in the same way as the existing NDB loan assistance program. A project promoter will apply directly to an AFI who will be responsible for evaluating the application from a financial and credit point of view and making a decision whether or not to finance the project. The AFI in turn, will apply to NDB for funding the loan.

The loans will be disbursed in accordance with an agreed project disbursement schedule with overseas suppliers paid by means of a letter of credit. The letter of credit will serve to collect the necessary documents to permit A.I.D. reimbursement and NDB drawdown under the Energy Credit Fund facility. The AFI will have a continuing responsibility to monitor project and collect loan payments. The AFI repayment responsibility to NDB is independent of the repayment of the sub-loan project borrower. That is to say the AFI will repay its loan to NDB regardless of its loan experience with the project borrower. It is not expected, therefore, that NDB will be involved in the loan collection process with sub-loan project borrowers.

The AFIs will make their best efforts possible to reduce the collateral requirements and eligibility criteria for small and medium size borrowers.

Details of NDB's existing operating and loan processing procedures are contained in the Operating Procedures in Annex J.

Training Program at NDB

Under a separate contract, NDB is being provided the services of a U.S. consultant to provide on-the-job training for NDB staff and institution building at NDB.

(ii) The Energy Division, Ministry of Mining and Energy

To implement Phase I of the Energy Sector Assistance Project, the Energy Division has been building institutional capability for the past two years in the areas of Energy Conservation and Alternative Energy. The Public Education Program of the Energy Division has been particularly aggressive in trying to educate and raise the awareness level of Jamaica's citizenry towards the need for and benefits from energy conservation and alternative energy opportunities.

Hence, the institutional needs to implement Phase II, as far as the Energy Division-MME is concerned, are already in place. The areas for which the Phase II project will look to the Energy Division for inputs are the (a) identification of a Project Officer for Phase II, (b) promotion of the Phase II project by the Public Education Unit so that it is widely advertised and the private sector is knowledgeable about the loan opportunities under the project (c) documentation of energy saving data for use as

verifiable indicators for project evaluation and (d) guidelines for undertaking audits (formats, calculations) payback and return on investment ranges and types of projects attractive for funding. In addition, a listing of certified auditors and technical specialists for referral through the financial intermediaries to the ultimate users.

G. ADMINISTRATIVE ANALYSIS

(i) Resources - The Energy Credit Fund (ECF)

The initial funding of the ECF will consist of a loan from USAID in the amount of US$1,600,000 and a loan from the GOJ in local currency equivalent (at the official exchange rate) of US$400,000. These resources may be augmented by new lines of credit or allocations of other NDB resources as may be determined by NDB Board of Directors. The recommended breakdown of resources by subfund activity is indicated in the section on Cost Estimate and Financial Plan.

The commercial banks will be authorized to approve loan applications for each applicant of up to a maximum of US$200,000. For loans exceeding US$200,000 and up to a limit of US$500,000, USAID/Jamaica's prior approval will be required; the sub-loan ceiling of $200,000 will be waived only on an exceptional basis.

(ii) Eligibility Criteria

ECF credit will be granted to private sector enterprises in the commercial, distributive, manufacturing, industrial, tourism and service sectors of the Jamaican economy. The ECF is intended to support projects which, in addition to being technically, economically, and financially sound, will:

- reduce the consumption of energy per unit of output, thus lowering the amount of imported petroleum and by-products;

- substitute renewable energy sources for non-renewable ones, similarly lowering the amount of imported petroleum and by-products;

- support the development of domestic industries to provide alternative energy and energy conservation equipment and services, both for local consumption and export; and

- identify specific energy conservation opportunities to interested firms in the private sector, which may be implemented without need for substantial capital expenditures.

The Project does not preclude energy companies interested in purchasing conservation equipment under the ECF and leasing the equipment to potential users in the public or private sector.

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The resources of the ECF may not be used to finance:

- refunding of debts to third parties, partners, or owners of the enterprise benefited by the credit;
- leasing or purchase of lands or of commercial buildings;
- used machinery and equipment;
- payment of dividends or recovery of invested capital;
- purchase of shares, bonds or other securities;
- payment of salaries and other administrative expenses.
- industries which are not economically viable in the absence of tariff protection

(iii) Approval of Subloans

A uniform application form should be used by all subloan applicants, which will be submitted to the financial intermediary. Approval of the loan by the commercial banks should be based on a thorough financial analysis and a technical evaluation of the proposal. It should also constitute a determination that the project meets ECF program objectives and criteria, that the project is technically, economically and financially sound and that there exists reasonable assurance of repayment.

(iv) Eligible Applicants

Applicants eligible for ECF consideration may be new or established business firms. Ownership may be Jamaican, mixed or foreign provided the company is established in Jamaica. The form of business may be a corporation, partnership or proprietorship.

(v) Loan Application Process

The MME working closely with NDB will provide the commercial banks with (a) a list of qualified energy auditors in Jamaica and (b) a list of energy conservation opportunities that have attractive payback periods, marked savings in energy consumption and are supportive of the National Energy Plan. This list will be updated as national priorities for conservation and alternative energy projects change. NDB should provide the commercial banks with criteria for evaluating the technical, economic and financial soundness of the projects which will be used to select viable projects.

A borrower, considered a potential client by the commercial bank, will be encouraged to utilize the services of anyone on the list of energy auditors to conduct an energy audit. While evaluating a borrower as a potential client, the commercial banks will make best efforts possible to reduce the collateral requirements for small and medium-sized firms.

The commercial banks will furnish 90 percent of the energy audit costs in J$ from the ECF and the client will be required to furnish the balance or J$250 which ever is lower. If the energy audit develop into an energy conservation or alternative energy project, the 90 percent contribution by the commercial banks from ECF will be rolled over into the total loan package for the project. In cases where the energy audit does not result in a project, the funds advanced for the audit will be charged to NDB.

Copies of all energy audits, funded by the commercial banks, whether the audit developed into a loan or not, will be sent to NDB.

The loan application for projects funded by ECF will require the borrower to record monthly energy consumption data for one year after installation of the energy conservation devices or retrofits. The data should be furnished to MME on a monthly basis for one year.

The borrower also agrees to maintain the operation and maintenance schedules for the newly installed retrofits.

(vi) Responsibilities for Approved Loans

Once the loan is approved, the financial intermediary will be responsible for:

- bearing the risk of nonpayment under the subloan;

- monitoring subloans in accordance with the terms and conditions of the subloan;

- notifying the NDB of any serious problems and taking any other steps necessary to assure proper administration of the subloan; and

- submitting such documentation and reports and verification, inspection, and subloan status to the NDB and MME as may be required.

(vii) Interest Rates

The interest rate for the loan will be guided by the prevailing market rate. Various fees and charges will be paid out of the interest rate, as follows:

- 1 percent to cover the exchange risk assumed by the Government of Jamaica;

- 2 percent to be paid to NDB to cover administrative fees;

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- 3 percent to be paid to the financial intermediaries for services and repayment risk (for analysis refer Annex K);

- the balance to be used to meet the debt service requirements of USAID and to augment the ECF resources.

There will be a preliminary review of the project six months after disbursement of the first loan from ECF or the depletion of the first tranche to the ECF whichever occurs sooner. The evaluation team will assess:

- the impact of the excise tax, customs duty and consumption tax as incentives/disincentives on the utilization of the ECF resources;

- the rate of depletion of the US$ component of the ECF;

- the reasons why energy audits conducted under the Project did not evolve into loan projects. Did the commercial banks seek high levels of collateral that deterred small and medium sized firms from utilizing the funds?

- the rate of interest charged;

- the level of energy savings that can be anticipated from the conservation or alternative energy projects approved by the commercial banks;

- the procedure for the expeditious execution of all the necessary authorization and clearances for the importation of equipment and materials by sub-borrowers; and

- the procedure for the review and approval of loans by the commercial banks.

The evaluation team will identify bottlenecks in the process and recommend approaches to streamlining the process.

The recommendations of the evaluation team would be discussed by USAID and GOJ representatives and a course of action agreed upon for the continued operation of the Project. The second tranche from USAID will be disbursed after agreement on a course of action is reached and the necessary modifications in the implementation of the Project are instituted.

(viii) Disbursements

The ECF will be set up as a revolving fund under which advances will be made from USAID to the NDB. In the case of subloans requiring foreign exchange for imported goods, the NDB will authorize the opening of a letter of credit covering purchases by the ultimate beneficiary. On receipt of adequate documentation as may be required by NDB, (including a declaration that the expenditures were incurred solely for the project financing under the subloan) funds will be released to the financial intermediary for payment through a U.S. commercial bank direct to the overseas supplier. As drawdowns are made, NDB will provide the necessary documentation as required by USAID to verify the disbursement.

Disbursements of the entire amount of the local currency part of the loan will be made by NDB to the financial intermediary as soon as a loan is approved. The financial intermediary must submit to NDB a banker's report of payment and a prescribed request for reimbursement together with such documentation as may be required by USAID and NDB including, but not limited to, cash receipts, receipted invoices, prepaid bills of lading, and/or any other customarily accepted instruments including the declaration that these expenditures were incurred solely for the project financing under the subloan. Disbursement of funds from the financial intermediary will be made directly to the supplier of goods and services on the ultimate beneficiaries behalf.

(ix) Repayment

All subloans are to be denominated and repayable in Jamaican dollars equivalent to the amount of local and foreign currency disbursed. In the case of imports financed under the subloan, disbursements shall be charged against the subloan note at the parallel rate of exchange prevailing on the date of disbursement.

Repayment periods for all subloans will vary with the size of the project, with subloans repayable over a maximum term of five years.

(x) Reflow of Funds

After the initial disbursement of U.S. dollars through the Energy Credit Fund, local currency repayment will be made to the National Development Bank. These funds will be relent over the first five years to finance energy related activity as set forth in the Project Paper Supplement. Should a need for further foreign exchange be evident, the GOJ will make best efforts to make necessary foreign exchange resources available. The use of ECF reflows will be reviewed by GOJ and AID after five years and may, at that time, be folded into NDB's general resources for relending to a variety of activities, including energy, deemed eligible by NDB's operating criteria.

(xi) Role of MME

Since MME is committed to updating the National Energy Plan annually, it is in a unique position to determine the type of energy conservation opportunities that will yield the greatest savings in energy consumption and marked savings in the oil import bill. Further, MME staff members have completed several energy audits and energy retrofits in the public sector. MME has also trained groups of private energy consultants to conduct energy audits. For Phase II, the Project Officer from MME will provide the financial intermediaries with the following:

- A prequalified list of consultants who are capable of conducting reliable energy audits and whose work is acceptable to MME.

- In cooperation with NDB, MME will prepare a list of energy conservation opportunities that have attractive payback periods, marked savings in energy consumption, good internal rate of return and are supportive of the National Energy Plan. This list will be updated as changes in National Energy Plan and Policies are introduced.

The financial intermediaries will provide the Project Officer, MME, with copies of all the energy audits conducted for ECF loan applicants. In the case of ECF funded projects, the borrower will also furnish MME with energy consumption data on a monthly basis for one year. This data gathering will start immediately after the retrofits have been installed.

VIII. Cost Estimate and Financial Plan

The financial plan calls for $5,900,000 of A.I.D. funds and a GOJ contribution of $5,600,000, $600,000 of which may be composed of in kind services. The Energy Credit Fund will be capitalized with $5,700,000 of A.I.D. funds and $5,600,000 of GOJ funds, $8,000,000 of which will be allocated to retrofitting and alternative energy systems, $2,500,000 to the energy product service industry, and $800,000 for TA, all as shown in the following table.

COST ESTIMATE AND FINANCIAL PLAN

	AID (US$000 FX)	GOJ (US$000 LC)
A. Establishment of Energy Credit Fund**	5,700	5,600
1. Loans to Industrial/ Commercial enterprises for energy audits, retrofits and alternative energy systems	4,000	4,00

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	AID (US$000 FX)	GOJ (US$000 LC)
2. Loans to Energy Development Products and Energy Services Firms	1,500	1.000
(a) Upgrading Alternative Energy Industry	100	400*
(b) Upgrading Energy Conservation Industry	100	200*
Evaluations	200	0
Total	5,900	5,600

* GOJ Contribution will consist of in-kind provisions

** Although the funds are divided into various loan activities, the credit fund will actually function and be administered as a single fund. Funds may, with the approval of USAID/J, be moved from one loan activity to another depending on the progress of the various activities.