

GENERAL REPORT  
ON  
NORWEGIAN ASSISTANCE  
TO THE ENERGY  
SECTOR OF MOZAMBIQUE

PHIL O'KEEFE (EDITOR)  
JENS ERIK TORP



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CENTRE FOR DEVELOPMENT AND TECHNOLOGY  
UNIVERSITY OF TRONDHEIM  
JUNE, 1990

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WILL O'KEEFE (EDITOR)

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UNIVERSITY OF BIRMINGHAM

1971, 1972

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L I S T    O F    A B B R E V I A T I O N S

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GDP	-	gross domestic product
GJ	-	gigajoule ( = 10 <sup>9</sup> joule)
GWh	-	gigawatthour ( = 10 <sup>6</sup> kWh)
km	-	kilometre
km <sup>2</sup>	-	square kilometre
KW (or kW)	-	kilowatt
kWh (or kWh)	-	kilowatthour
m <sup>3</sup>	-	cubic metre
MJ	-	megajoule ( = 10 <sup>6</sup> joule)
MW	-	megawatt ( = 10 <sup>3</sup> kW)
MWh	-	megawatthour ( = 10 <sup>3</sup> kWh)
NARSE	-	New and Renewable Sources of Energy
NOK	-	Norwegian Kroner
SADCC	-	Southern African Development Coordination Conference
t	-	tonne
TWh	-	terawatthour ( = 10 <sup>12</sup> kilowatthour)
US\$	-	U.S. Dollar

L I S T     A     B     R     A     C     I     A     T     I     O     N     S

gross domestic product	-	GD
gigajoule (= 10 <sup>9</sup> joules)	-	GJ
gigawatt-hour (= 10 <sup>9</sup> kWh)	-	GWh
kilometre	-	km
square kilometre	-	km <sup>2</sup>
kilowatt	-	KW (or kW)
kilowatt-hour	-	KWh (or kWh)
cubic metre	-	m <sup>3</sup>
megajoule (= 10 <sup>6</sup> joules)	-	MJ
megawatt (= 10 <sup>3</sup> kW)	-	MW
megawatt-hour (= 10 <sup>6</sup> kWh)	-	MWh
New and Renewable Sources of Energy	-	NRSSE
Norwegian kroner	-	NOK
Southern African Development Coordination Conference	-	SADCC
tonne	-	t
terawatt-hour (= 10 <sup>12</sup> kWh)	-	TWh
U.S. dollar	-	US\$

## INTRODUCTION

The energy sector is an important element in Mozambique's development strategy at both the household-level and the economy as a whole. In macro-perspective, the country looks to commercial energy both as a source of foreign exchange and as a catalyst for industrial progress. At the micro-level, woodfuel is the decisive form of energy. Here, the process of deforestation is creating difficulties for the urban and rural population in accessing energy for domestic consumption and indicates the general need for reforestation as well as for the development of other sources of energy.

The present situation of Mozambique's energy sector reflects the general trends in the country's economy. After a short period of regression following Independence, there was a relatively stable and positive period of development up to 1981, when disruption of economic activity was stepped up. From 1981-86, there has been a continuous decline in economic activity which has also affected the energy sector negatively. Concomitantly, the lack of qualified manpower and shortage of financial resources present obstacles both to normal operations and to policy making and planning. The present armed conflict also creates many obstacles to the efficient operation of the energy sector.

Following the initiation of the Mozambican Government and World Bank sponsored Economic Rehabilitation Programme, in 1987, the sector is at present subject to extensive support programmes from national as well as international development agencies. Within the sector, there are fields that can show a positive development over the last three years.

### 1 The Role of Energy in Overall Development

#### 1.1 Availability and Use of Energy Resources

The total energy consumption of Mozambique, in 1984, by fuel

source and by sector can be seen in Table 1 below. From the table, it is clear that biomass represents about 80 per cent of the total energy consumed in the country, followed by petroleum products (12 per cent) and hydropower (5 per cent). Turning to energy consumption by sector, domestic consumption accounts for about 65 per cent of the total energy consumption in Mozambique. Industry is the second most important sector followed by power generation transport and agriculture.

TABLE 1. ENERGY CONSUMPTION IN MOZAMBIQUE BY SECTOR, 1984. 1,000 TOE\*

Sector	Petroleum Production	Hydropower	Coal	Wood	Charcoal	Total	Per Cent
Industry	56	-	28	414	-	498	17
Agriculture	30	-	6	36	-	72	2
Transport	140	-	2	-	-	142	5
Households	25	-	1	1,900	34	1,960	66
Power generation	18	152	24	-	-	194	7
Others	87	-	-	-	-	87	3
<b>TOTAL</b>	<b>356</b>	<b>152</b>	<b>61</b>	<b>2,350</b>	<b>34</b>	<b>2,954</b>	<b>100</b>
<b>Percent</b>	<b>12</b>	<b>5</b>	<b>2</b>	<b>80</b>	<b>1</b>	<b>100</b>	

\* - Tonnes of oil equivalent

Source: Carla P. Pereira: National Assessment of Biomass/Woodfuel situation in Mozambique (Ministry of Agriculture, Maputo 1989)

The only existing energy consumption projection to the year 2000 suggests that domestic energy consumption based on fuelwood will continue to have the biggest share of total consumption in the foreseeable future (The Beijer Institute and the Scandinavian Institute of African Studies: 1984). Table 2, below, contains more details.

TABLE 2. PROJECTED ENERGY CONSUMPTION FOR MOZAMBIQUE YEAR 2000,  
10<sup>6</sup> GJ

Sector	Petroleum Production	Electricity	Industrial Wood	Fuel wood	Charcoal	Dung*	Coal	Total
Urban Household	3.52	3.43	0.0	15.79	1.75	0.0	0.0	24.5
Rural Household	2.34	2.93	0.0	300.96	15.2	15.2	0.0	321.9
Agriculture	2.35	0.16	0.0	4.11	0.0	0.0	0.0	6.6
Industry	11.54	2.53	5.6	34.81	20.46	0.0	6.3	81.3
Commercial Institution	8.33	0.99	0.0	1.98	0.50	0.0	0.0	11.8
Transport	17.75	0.00	0.0	0.00	0.00	0.0	4.2	21.9
Total Demand	45.83	10.04	5.6	357.65	23.26	15.2	10.5	468.1

\* - Crop residues

Source: Energy and Development in Southern Africa, SADCC Country Studies, part II, Vol. 4 (The Beijer Institute and the Scandinavian Institute of African Studies, 1984).

Two major biomass evaluations have been made in Mozambique. The first was an inventory of forestry resources in Mozambique carried out in 1979-80, with FAO assistance, and was based on satellite imagery and aerial photographs taken in 1972. According to this survey, forests in Mozambique covered about 56.5 million hectares in 1972, equivalent to about 71 per cent of the country's area, with a total growing stock of about 2 billion m<sup>3</sup>. A second biomass assessment, prepared in 1987 by the ETC Foundation based on satellite remote sensing, indicated that Mozambique has 11 biomass classes in its territory, mainly dominated by forests and woodlands (88.5 per cent of the territory). The total growing stock was estimated at about 4

billion m<sup>3</sup>. The major reason for the difference in assessment of total growing stock between the two surveys is that the first survey concentrated on the forests, while the second survey covered all biomass over the whole of Mozambique.

Shortages of energy supplies to urban households are at present the most serious problem in the energy sector. The problems have been manifested by the rising cost of woodfuels as degradation of the natural forests and savanna-land around the towns becomes more acute.

Turning to forms of energy other than woodfuel, Mozambique has a diverse endowment of energy resources but now relies on imported petroleum and petroleum products for 75 per cent of its commercial energy consumption. Hydroelectric potential exceeds 10,000 MW; extensive coal deposits are being mined in modest volumes, gas has been found in several areas of the country and oil exploration is subject to a renewed interest on the part of several international oil companies.

#### Petroleum and Gas

Mozambique has large sedimentary basins, both on-shore and off-shore. Geochemical studies indicate findings of both gas and oil-prone material, with a domination of gas.

Petroleum and gas exploration started in 1948, but was temporarily stopped in 1974. In 1981, the Government's interest in petroleum and gas exploration was revived due to promising findings, and extensive programmes have been launched over the past years.

Petroleum and gas exploration in Mozambique is still at an early stage and available information gives no clear indication of the country's total resources. However, as activity has been concentrated in a few promising areas, some estimates of

proven reserves can be given.

So far the Pande field is the only gas reserve considered for commercial use. Estimates vary from 0.4 to 1.3 TCF (trillion cubic feet). Areas with minor findings have been located in Temane and Buzi.

At present, there is no production of petroleum and gas in Mozambique and all petroleum products are therefore imported. Up to 1984, a refinery called PETROMOC was in operation at Matola, near the capital of Maputo, with a crude oil processing capacity of 17,000 barrels per day. Its shutdown was caused by irregularities in the supply of crude oil, mainly due to lack of foreign exchange. Facilities for unloading and distribution are generally in a poor condition due to lack of spare parts and insufficient maintenance.

Mozambique's favourable location offers a potential for trans-shipment of more than a million tons of products annually to and from land-locked neighbouring countries. At present, a pipeline from the port of Beira is used to supply petroleum products to Zimbabwe. The security situation is the main obstacle for a large scale transit of petroleum products. However, both port capacities and railway facilities need to be further developed in order to create satisfactory conditions.

#### Coal

There are three known major deposits of coal in Mozambique, all located in the Tete province, relatively distant from both the coast and the major consumption centres, (i.e., the southern region):

- Moatize-Minjova, covering about 250 square kilometers.

Estimated coal reserves are:

- proven: 87.1 million tons
- probable: 736.5 million tons

- possible: 1,144.6 million tons
- Senangoe, covering about 550 square kilometers. No estimates are available.
- Muchanha-Vuzi, covering an area of 96 square kilometers. Findings have been promising and indicative estimates are given to be in the range of 3 billion tonnes. However, huge investments are required to establish an infrastructure in the area, including approximately 250 km of railways. This project, is therefore, given lower priority by the Government.

In addition to these known resources, there is reason to believe that coal deposits can be found in the southern part of the country, based on the fact that coal mines are in operation in South Africa, quite close to the border. Mining in this area would have a significant impact, as distance between production and potential consumption would be reduced substantially.

Coal has been exploited, since 1920, but the only existing major mine today is the Moatize underground coal mine in the Tete province. The mine has been operative since the 1940's and had its peak production in 1975 (575,000 tons). In the last decade the production has gradually declined from 535,000 tons in 1981 to virtually nothing in the last couple of years. The dramatic decrease is due to sabotage of the transport system; the railway line to Beira has, practically speaking, been out of operation since 1982.

Considerable amounts of coal have been exported, partly overland to Malawi, partly through the port of Beira to various countries. In 1981, approximately 220,000 tons were exported.

For power production in Mozambique's only coal-fired power plant (Maputo), coal is imported from South Africa.

## Electric Energy Sources

There are three major sources for electric power in Mozambique today:

Production by hydroelectric and thermal power plants owned by the Mozambican state-owned company, Electricidade de Mozambique (EDM).

Acquisition from private companies, the one clearly dominating being Hidroelectrica de Cabora Bassa (HCB). In addition, there are some generating units in connection to industrial plants partly supplying EDM's local network.

Import, basically from the Republic of South Africa but also on a smaller scale from Zimbabwe and Malawi.

In 1981, production covered 41 per cent of Mozambique's total electric energy consumption, acquisition was approximately 6 per cent and import 53 per cent. The total electricity available was approximately 645 GWh. Since then a gradual decrease in energy production within the EDM system, and a corresponding increase in imports from South Africa, has occurred, with total consumption continuing on the same level (EDM: 1987).

In 1988, 18 power stations were in operation with a total generating capacity of about 260 MW. However, due to breakdowns the total available capacity was only about 205 MW. Apart from these, about 15 small stations scattered over the country generate an additional 3 MW, and 4 MW are available through emergency gensets.

The power production units can be subdivided into three main groups:

### Hydropower production

Large scale exploitation of the country's enormous hydroelectric potential started in the mid 1950's with the construction of Mavuzi Power Plant in the Manica Province, for the supply of the city of Beira. Exploitation for export purposes was introduced through the construction of the Cabora Bassa Scheme, established in the mid 1970's to supply the South African network. With its 2075 MW installation, it is one of the biggest hydropower projects ever undertaken in Africa.

Nevertheless, a huge hydroelectrical potential can still be developed, and surveys have been carried out for the last three decades. In 1980, the Norwegian consulting agency NORCONSULT was engaged under the Norwegian Aid Programme to undertake a detailed hydropower study for the whole country, partly based on previous studies carried out by Portuguese and Mozambican agencies.

All major areas of the country are now covered by the study and total hydropower potential is estimated at 12,500 MW, or an annual production of approximately 60,000 GWh. Of this potential, 2,160 MW is developed.

In addition to the Cabora Bassa Scheme at the Zambezi river, (2075 MW), south of the Save river, the construction of the Corumana hydropower plant (15 MW), the Mavuzi and Chicamba hydropower plants at the Revue river (84 MW), and the small hydropower plants at Lichinga and Cuamba.

A major obstacle for a rational utilisation of Mozambique's indigenous hydropower resources is the unfavourable location of the resources in relation to the consumption centres: whereas consumption is largely concentrated in the two southern provinces of Maputo and Gaza, the power resources are most abundant in the central and northern region.

#### Isolated diesel power plants

Throughout the country a number of diesel power plants supply local networks, not being connected to any regional grid. The major diesel plants are located in Nacala (24 MW installed - 7 MW available), Nampula (8-2.8 MW), Quelimane (7-6 MW), Pemba (7-4.5 MW) and Inhambane (3-1.7 MW).

Since the northern main transmission line came into operation in June 1989, the major provincial urban centres of Nacala, Nampula and Quelimane can be supplied from Cabora Bassa.

The diesel power plants generally are in very poor condition due to lack of spare parts, insufficient maintenance and lack of qualified personnel lacking sufficient qualifications. In addition restrictions on fuel has limited the power production.

#### Maputo Thermal Power Station (CTM)

The power station was originally established to supply the capital of Maputo. The main production units are coal-fired, but two gas turbines are installed for supplementary production during peak periods. The station now faces serious maintenance problems and replacement of machinery is crucial to ensure reliable production.

Since the early 1970's, the Maputo area has been connected to the South African grid system through a 120 MW capacity interconnection. The link now constitutes the main supply to the area, leaving CTM as a stand-by unit and for peaking purposes.

#### Electric energy consumption

In spite of an unreliable power supply and generally poor conditions for industrial production, gross electricity consumption in Mozambique has, thanks to imports of electricity, remained on more or less the same level during the last decade, i.e. approximately 600 GWh. A minimum was reached in 1985, but

during recent years a gradual increase again is registered (EDM: 1987).

The power supply system of Mozambique has suffered from various acts of sabotage and destruction over the past decade, seriously affecting the reliability of supply. This, combined with shortage of fuel for the diesel power plants, has largely limited the consumption of electricity over the whole country.

The situation has been most critical in the central region where the imported power supply to the city of Beira is 100 per cent, depending on the transmission lines from the region's hydropower plants. In the year following Independence, production was approximately 175 GWh/year, whereas the corresponding figure for 1986, so far the worst year, was 78 GWh, or approximately one third of the 'normal' level.

The southern region, however, has been affected for short periods by an energy shortage caused by sabotage of the line from South Africa. The capacity of the Maputo Thermal Power Plant is normally sufficient to supply the major part of the load.

No official load forecast on electric power consumption is available from EDM, reflecting the present unpredictability of the consumption.

Three factors weigh against the application of normal forecasting methods:

- the high degree of uncertainty about future economic activity;
- the absence of historic trends based on stable economic conditions;
- the inadequacy of the past records of power system performance.

As long as consumption depends on the availability of power rather than on real demand, the supply situation is decisive for the development of power consumption. Based on this reality, EDM at present produce their demand forecast mainly on a year-to-year basis.

However, to a certain extent, the situation for the Southern Region is somewhat different, as the limit for power supply from South Africa so far has not been reached. The consumption shows a relatively steady growth during 1986-88, at a rate of 7-9 per cent annually and, with the prevailing economic situation, there is reason to believe in continued growth.

Future household demand depends on the prospects for electrification of new areas. As a consequence of deforestation problems in urban areas and with the relatively easy availability of electrical energy, especially in and around Maputo, it is a clear strategy of the authorities to promote a transition from fuelwood to electricity. The major obstacle for this development is the shortage of equipment and material, in addition to the technical problem of electrical installations in traditional houses.

There is, however, no doubt that there exists a substantial hidden demand that will lead to a considerable load growth when, and if, economic situation improves. Enquiries carried out have shown that, even if prices continue to increase, there is a high willingness to pay for the cost of electricity as this energy source is still cheaper than woodfuel.

#### Fuelwood

Fuelwood plays a vital role as the major energy source of the rural and urban population in Mozambique. Almost all the rural population is dependent on wood as an energy source and 70 per cent of the urban population are using woodfuel mainly for

cooking.

In 1987, the total wood consumption was estimated by the Mozambican Ministry of Agriculture to be about 16 million m<sup>3</sup>. The use of wood for fuelwood was dominating with 14 million m<sup>3</sup>, followed by wood for charcoal 1.8 million m<sup>3</sup>, industrial wood 58,000 m<sup>3</sup>, and building poles 5,000 m<sup>3</sup> (Carla R. Pereira: 1989). With a total demand of about 16 million m<sup>3</sup> per year, seen in relation to the annual growing stock, which the Ministry of Agriculture finds is at least double, it appears that the country in general, can be considered to be well endowed with fuelwood resources. Nevertheless, some areas, mainly those surrounding the major urban centres, are facing a fuelwood shortage and suffering environmental degradation. This 'biomass crisis' has its origin in the fast population growth in and around urban centres and, consequently, in the increasing pressure on the environment.

Although there is no generalised information available on rural patterns of woodfuel consumption, several partial surveys indicate the existence of the following features: more than 90 per cent of families use woodfuel exclusively for cooking, and less than 10 per cent use charcoal. Most households use small quantities of kerosene for lighting, but none use it for cooking. In rural areas, the fuelwood supply situation varies from region to region and fuelwood scarcity occurs in spots of stress of different intensity.

In Mozambique, the Ministry of Agriculture is responsible for wood-based energy programmes, while the Ministry of Industry and Energy is focused on commercial fuels. Upto 1985, there was an absence of credible systematic data which prevented the Ministry of Agriculture from quantifying the supply and demand for woodfuels and the effects of the security situation. The first survey was carried out in July 1985, focusing on the woodfuel

situation in urban areas, where it was found that the areas around the major cities have been deforested, especially around Maputo, Beira and Nampula and even around smaller urban centres. The situation around Maputo, a city of about 820,000 people in 1984, is aggravated by the low forestry potential in this region of the savanna land; wood has virtually disappeared within a radius of 50-60 km. Most fuelwood supplies for Maputo originate at 50 km or more from the city. Beira, which is located near a major forest, receives its fuelwood from a distance of 25-30 km. It is reported that the situation around Nampula is similar to that around Maputo.

Based on the forestry reconnaissance mentioned above, a forest biomass balance by province was constructed, in 1980, and projected to 2000. This balance shows that the provinces of Maputo and Nampula are most critical ones with regard to suitable woodfuel supply. Considering only the population growth and its woodfuel needs - since the development of new industries was not taken into account - the Provinces of Maputo, Gaza, Inhambane, Manica and Nampula will all face woodfuel shortages by 2000 (Carla. R. Pereira: 1989).

Firewood collection, together with logging and land clearing for agricultural purposes, has over the past decade lead to a serious deforestation as the demand far exceeds the annual increments of wood growth. A series of ambitious reforestation projects were launched during the last decade, mainly concentrated near the big cities of Maputo, Beira and Nampula. However, results have so far been rather limited, and the goals both in terms of planted areas as well as productivity on the plantations were not reached. The security situation, drought and labour problems appear to be the main causes for the poor performance.

### Other sources of Energy

Agricultural waste is created from the processing of agricultural and forest products, such as cotton, sugar, cashew nuts, rice and wood. The residues from this processing have no commercial interest, but the caloric value allows its use as a valuable source of energy for electricity and steam production. Its share of the national energy balance in 1979 was about 4 per cent but the value during 1981-86 was considerably lower as production in these industries was then at a minimum.

Geothermal energy has so far not been exploited, but a total of 26 thermal springs are reported in Mozambique, with the strong possibility that others exist unreported. The sites are concentrated in the country's central region.

Other renewable sources, such as solar and wind energy, are frequently used on a small-scale basis, but no information is available as to the extent of utilization.

A desk study to investigate the feasibility of using wave power was carried out. However, no concrete measures were taken in order to put the findings into practice.

## 1.2 Institutional Framework, Manpower and Technology

### Power Sector Organisation/Overall Institutional Set-Up

The Ministry of Industry and Energy (MIE) has overall responsibility for setting energy policies. The MIE supervises Electricidade de Mozambique (EDM), the electricity supply company and Petroleos de Mozambique (PETROMOC), the petroleum refining and distribution company. The Minister's cabinet and the senior staff of these two state enterprises are the main policy makers in the sector, under a mandate which is broadly set by the FRELIMO Party and the central government agencies, (i.e. the Ministry of Planning).

Responsibility for coal and hydrocarbons rests with the Ministry of Mineral Resources (MMR), which controls the Empresa Nacional de Hidrocarbonatos (ENH), the hydrocarbons company, and Empresa Nacional de Carcao (ENC), the coal mining company.

The main government Ministry responsible for biomass for energy programmes in Mozambique is the Ministry of Agriculture. It is the central institution with regard to forests, reforestation and logging, and is thus the only Government entity with a formal involvement in fuelwood supply. Within the Ministry of Agriculture, the National Directorate of Forestry and Wild Life (DNFFB) is the focal point for almost all ongoing biomass energy projects. As a national institution, the DNFFB defines the policies and national development strategies for the sector, including supervision of the use of natural forests and the promotion of reforestation programmes.

Many observers stress the point that coordination among the institutions of the energy sector is insufficient and needs to be improved with due regard to the constraints imposed by the limited numbers of qualified staff available. Apparently the FRELIMO Government is moving in this direction by planning to create a National Energy Council at cabinet level.

#### Electricidade de Mozambique (EDM)

In 1977, the Government of Mozambique formed a state-owned company called 'Electricidade de Mozambique' (EDM) to integrate the facilities for generation, transmission and distribution of electricity which, until then, had been in the hands of a large number of governmental, municipal and private undertakings.

EDM is placed under the Ministry of Industry and Energy. The main functions of the company are related to planning, development and implementation of the national electricity supply system, as well as the construction and operation of power plants

and transmission systems.

EDM is headed by a General Director and an advisory board of Directors. The company is divided into 14 operational areas, each responsible for the local power generation and supply. A new organisational structure was elaborated during 1987/88, and has now been implemented.

In addition to EDM, there are other companies dealing with the production and distribution of electricity, the major one being Hidroelectrica de Cabora Bassa (HCB), jointly owned by Portugal (82 per cent) and Mozambique (18 per cent). Many small power stations still exist scattered around the country, owned by municipalities, private or state-owned companies. A few industries also have their own power production from plants fuelled by coal or agricultural waste products.

The National Afforestation Programme (PNR)

In 1977, the Third Congress of Frelimo defined, as part of the Social and Economic Directives, the basis for the country's forestry policy. The objectives can be summarised as follows (Carla R. Pereira: 1989):

- a) to promote the natural and man-made forest cover in depleted areas or areas seriously affected by erosion.
- b) to establish woodlots in communal villages and rural areas to provide the population with wood products and to reduce pressure on nearby natural forests.
- c) to extend the plantations of existing exotic species to provide raw materials for forest industries.
- d) to create forest plantations with fast growing species in the vicinity of urban centres.

Based on these directives, three urban woodfuel plantation projects were created as a measure to increase the woodfuel supply to the major urban centres including Maputo (FO-2) and

Beira (FO-4)). The National Afforestation Programme (PNR) is the entity within the National Directorate of Forestry responsible for supervising the implementation process of these.

#### Choice of Technology

In Mozambique, efforts on fuel switching are very recent. In addition to the examples given above, a pilot project on coal stoves started, in 1987, in order to test the use of coal as a household energy source. Since then, about 1,000 stoves have been installed in Maputo city. In parallel, the Government is increasing the level of petroleum products imported in order to supply the urban population and rural areas with L.P.G. and kerosene. The urban centres are, due to their characteristics, the target group for fuel switching programmes. A major programme to increase the use of electricity within major cities has recently been initiated, with the assistance of the World Bank and other donors, in order to cut down on fuelwood needs.

#### Manpower Development and Training with Special Regard to the EDM/Personal Situation

The manpower situation is today one of the major obstacles for a rational development of Mozambique's power supply. After Independence a substantial part of key personnel within the sector left the country and new personnel had to be recruited and trained.

Another aspect of this problem was, and still is, the question of a general attitude among the staff towards working routines and methods. In particular, within the field of maintenance, experience has shown that lack of conscientiousness regarding elementary aspects, such as cyclic maintenance routines, causes severe problems that can probably only be overcome when the newly recruited staff have had the chance to function for some time.

In 1987, EDM was employing approximately 3,500 staff, of which 40 per cent were unskilled, another 40 per cent semi-skilled, i.e. without any formal technical background, and the remaining 20 per cent were skilled with some kind of technical education. Only 30, or less than 1 per cent, were classified as senior level staff holding engineering, professional, managerial or technical grades.

The lack of qualified Mozambican personnel is presently being relieved through the recruitment of a considerable number of expatriate staff, about 80 in 1985. Expatriates are mainly recruited from Portugal, but various other nationalities are also represented. Lack of qualified counterparts to be trained by the expatriate staff, however, implies that these expatriates will not be substituted by Mozambicans in the short term.

A problem arising from the new economic situation, where privately run companies are supposed to play a more important role in the country's economy, is the probability of EDM losing qualified Mozambican staff because of the considerable higher wages offered outside EDM.

#### Professional Training

The only viable solution to the shortage of qualified manpower is to strengthen the training efforts. Already, from the very start of the Company, the concept of further education and training has been promoted. In 1978, EDM succeeded in establishing its own training centre containing classrooms, laboratories and workshop facilities.

It has been, and still is, the policy of EDM to make extensive use of expatriates to cover major parts of the requirements for high-level personnel, and to concentrate training on mid-level personnel.

There are presently, two major areas of training within EDM;

- Part-time courses for adult workers. These courses are designed for workers who are already employed at EDM and need to upgrade their technical qualifications;
- Full-time courses on basic electricity for younger employees. EDM has started a full-time intensive course for young people who have finished their secondary schools. Basic electricity is taught in order to give the trainees the knowledge, skills and attitudes necessary for practicing their trade.

In addition, different types of specialised courses are offered for certain groups of EDM employees, e.g.

- course for power station technicians,
- course for sub-station technicians,
- course in electronic data processing.

EDM is presently receiving substantial support from Portugal, Italy, Sweden and Norway to pursue its training programme. The training courses are principally run with Portuguese instructors and training material, and are from EDM's point of view, considered to be extremely cost effective. To illustrate this, it has been shown that training of Mozambican personnel to operate the various sub-stations in the transmission network, saves EDM an annual expenditure of approximately US dollars 300,000 compared with running the stations through foreign support.

#### Future Institutional Development

Although organisation itself does not constitute any obstacle for EDM's present power supply, new concepts for the organisational structure are being considered. With Norwegian support, a proposal for a new legal set-up for EDM is about to be worked out where EDM's future position in power supply shall be evaluated. The background for this study is the country's

present and projected political and economic situation where one has seen over the past three years, a clear change from a traditional central economy towards a much more market-oriented economy.

This has already put EDM into a new context, where a new set of requirements have been imposed on the company to run without government economic support. The present institutional framework is not adapted to this new reality and, in order to have an efficient and rational operation of the company, basic changes are needed.

Productivity requirements, combined with the new economic situation, may also involve a much more extensive use of local contracts for construction tasks. Services of this kind within the fields of civil construction and power line erection were not available when EDM was founded; these services had to be established and maintained within the company. As the private sector is foreseen to have a somewhat greater role, the policy of EDM will be to concentrate on operation and maintenance of the power supply system and, to a much higher degree, leave the construction to private contracts. A likely consequence will be a further reduction in the staff of EDM.

#### Manpower Development and Training with Special regard to the wood energy sector

Although the forestry sector has a lack of skilled personnel, efforts have been made to assign technical staff to the biomass based energy projects and, in general terms, the wood energy sector involves: nearly 50 technicians directly involved with biomass energy programmes, either at central level within the State administration or within the projects. They are responsible for the administration of about 2,000 workers and an annual plantation target of nearly 1,500 ha of woodfuel plantations and woodlots.

In general, the existing forestry technical staff have been trained in the forestry technical schools at different levels and at University.

The main forestry training institutions existing within Mozambique are:

- Five agrarian schools (Namaacha, Chokwe, Bilibiza, Fonta Boa and Mocuba) for the elementary level which administer two year courses in agriculture and livestock production (Certificate);
- One technical agrarian institute (I.A.C.), which administers a three year forestry course (Diploma);
- The forestry department at University which administers a five year forestry course (Degree);

An average, 10 students per year graduate with Diploma course and about 7 with a Degree in forestry. All institutions are facing a shortage of lecturers and teaching materials. At the same time, the technical staff are involved in technical matters of implementing, tending and utilising man-made forests as well as the general administration of projects. Little attention has been given to the other fields of biomass programmes such as fuel conservation, energy surveys and consumption patterns, community involvement in reforestation programmes and agroforestry schemes.

#### Awareness Programmes

The general awareness in Mozambique for the need to preserve the existing natural forests, to avoid environmental degradation and to participate in tree planting programmes, are considered by the Mozambican Ministry of Agriculture to be at a very low level. (Carla R. Pereira: 1989).

Some attempts have been made to raise the awareness of people to take responsibility for the protection of their natural environmental such as;

- a national campaign against indiscriminate forest fires was launched, in 1978, through public meetings, audio-visual materials, posters and pamphlets in order to raise the people's consciousness about the need to control the forest fires;
- a national tree planting campaign of 1 million seedlings was launched, in 1982, in order to increase the people's awareness of the need to plant trees and preserve the natural forests resources;
- an awareness programme with the urban and semi-urban population of Maputo city was started, in 1986, in order to raise the urban dwellers' consciousness of the need to protect and care about the city's ornamental trees.

However, the Ministry of Agriculture finds that the national awareness campaigns have had little impact in raising the people's consciousness of the need to preserve the forestry's natural resources mainly due to the fact that the national campaigns targets were too ambitious compared with the existing human, financial and material resources at their disposal. (Carla R. Pereira: 1989).

### 1.3 The Role of Energy in Economic Development with Particular Emphasis on Industry, Transport and Agriculture and Balance of Payment Problems.

When Mozambique gained Independence in 1975, the Frelimo Government took over a retarded and misdirected economy. During colonial times, the country was developed primarily as a service economy for neighbouring countries and for the Portuguese settlers. Income from transit services and remittances from migrant workers in South Africa helped to offset a persistent deficit on external trade. In agriculture, the major export crops came from the Portuguese-owned plantations and estates, while the traditional African smallholders were largely neglected. The peasantry on the other hand, was subjected to

enormous pressures to supply its labour power to neighbouring countries, to the expanding plantations and settler farms, to the public sector for road building and the construction of railways as well as to the ports for cargo handling. The industrial sector was characterised by high cost production, geared partly towards the needs of the Portuguese settlers and partly towards the needs of Portugal itself. Data from the World Bank indicated that the literacy rate (7 per cent) and the average life expectancy (41 years), was extremely low, even compared to the general levels of Sub-Saharan Africa (World Bank: 1988a).

The exclusion in the colonial period of most of the African population from education and training as well as trading activities, meant that Mozambicans were almost totally absent in the modern sector of the economy. This colonial legacy was further aggravated by the mass exodus of 90 per cent of the Portuguese settlers at the time of Independence, including most of the plantation and factory owners, settler farmers, transport and industry workers, traders, administrators and professionals.

#### Early Policies for Economic Development

An authoritative statement by the new Frelimo Government for the future development of Mozambique can be found in the 'Economic and Social Directives' adopted by the Third Party Congress, held in February 1977. It outlined the first coherent policy for the economy and for the new State apparatus.

These guidelines present the phase of development in Mozambique as one of building a Popular Democracy, in which the foundation for passing to the stage of a Socialist Revolution was to be created. In this process, "agriculture is seen as the basis and industry as the dynamic and decisive factor".

With regard to agriculture, two fundamental principles were outlined: concentration of the rural population in communal villages where basic social facilities (schools, medical care,

drinking water, etc.) would be made available, and modernisation of the rural areas through State farms and producers' cooperatives. These two principles were seen to be interlinked; the labour force for the State farms and the cooperatives was to come from the communal villages. Simultaneously, improved land productivity through mechanisation was seen to be necessary in order to be able to concentrate the rural population. Without mechanisation, concentration would only lead to super-exploitation of the land with concomitant soil depletion and erosion. By introducing improved, mechanised farming, productivity would be increased, the peasants would gradually become wage-earning labourers, and the rural areas would move up the ladder of modernisation, finally approaching the stage of socialism.

The construction of heavy industry was considered to be of decisive importance, and active participation of the workers in the decisions of the factories and in the organisation of work was strongly underlined. The role of the industrial sector was first of all to supply basic necessities to the people such as; processed agricultural commodities, clothes, fuel, household utensils, construction materials, etc. The industry would also supply agriculture with tools and other means of production, process domestically available raw materials and create export earnings.

In the late 1970's and early 1980's, priority in the allocation of resources was given to implementing projects envisaged in the Prospective Indicative Plan 1981-90. Notably, the Frelimo Government's policy was to create the infrastructure which was expected to stimulate investment in productive capacity. Hence, the major transmission line of electricity from Cabora Bassa, the Centre-North line, was decided upon on this basis. The major electrification works are now almost complete, but the envisaged associated agricultural and industrial developments have not

taken place. Since the late 1970's investments in the energy sector (including fuelwood), amounted to 20 per cent of total investment expenditures (World Bank: 1987).

The consequences of these kinds of unrealistic forecasts have been fully shown through the construction of the Centre-North line from Cabora Bassa to Nampula and Zambezia provinces. A decisive precondition for the implementation of the project was the construction of an energy intensive aluminium plant in the Zambezia province which would facilitate the export of energy intensive products. The project was abandoned due to economic conditions, but still the line was constructed with a present and projected load that could not repay the enormous investment.

#### Adjusting Concepts of Economic Development

During the preparation of the ten year prospective plan document in 1980/81, the economic problems facing Mozambique turned from grave to worse, while high hopes of joining the CMEA - and hence obtaining substantial financing for the implementation of the plan - failed to materialise. The plan-document itself was adopted by the National People's Assembly but was never published, while political interest changed from dreams of making a big leap forward to the practical attempts at confronting mounting economic and political problems. A series of factors combined to deform and retard what could otherwise have been an economic recuperation with good prospects for real increases in the general standard of living. During 1975-81, Global Social Product was on the increase. However, from 1981, Mozambique began to pay the economic costs of South African destabilisation, natural disasters and mistakes in Party and Government policies.

The Fourth Party Congress of April, 1983, recognised that adjustments in economic policy were badly needed. The Congress, as well as the preparatory discussions which led up to it, was characterised by wide ranging and sharp criticisms against the

economic policy pursued by the party after the Third Congress. More specifically, the neglect of family agriculture and of the cooperative sector, the question of the place of private enterprise in economic development and the over concentration on the State sector were raised as major problems. The preoccupation of the planning system with big projects, and the consequent neglect of the role of small projects in sustaining and expanding the production of basic necessities, was raised as a major issue.

As a result, the economic policy of the party was adjusted. The State sector would need to consolidate itself before it could engage in any further expansion. Family agriculture, as well as the cooperatives, were to be supported in terms of material resources. The role of private enterprises was to be increased and incorporated into the development effort. Small projects geared towards production for the immediate needs of the people were to be promoted vigorously.

Following the guidelines of the Fourth Congress, the first attempt to reverse the economic decline was made during the period 1984-86 with the so-called Economic Action Programme. This included the introduction of an export retention scheme, of new labour legislation giving more autonomy to enterprises to manage their labour force, increases in the fixed prices of commodities and services, the abolition of price control of a few farm products, and the introduction of a new foreign investment code. However, these measures did not address the major economic distortions (in the exchange rate, pricing system, investment pattern, etc.) and proved too marginal to stop economic decline.

#### 1981-86: A Period of Economic Decline

Between 1981 and 1986, the Mozambicans experienced a marked and sustained decline in output, combined with an aggravation of economic distortions and financial imbalances. As shortages of

goods increased, barter and, parallel markets, usually with highly inflated prices, became widespread. According to a World Bank estimate, the official exchange rate was, by the end of 1986, grossly overvalued at 40 times the unofficial (black market) rate (World Bank: 1988a). According to official statistics (Governo de Mozambique: 1987a), overall production fell by 30 per cent between 1980 and 1986, and consumption per capita dropped by 45 per cent. Erosion of the tax base, due to the decline in marketed production and a shift towards parallel markets, combined with continued increases in public expenditure, caused the State budget to move from a small surplus to increasing deficits on the current account, amounting to as much as 50 per cent of current expenditure in 1986. Due to the unconstrained bank financing of large fiscal deficits and State enterprise losses, the money stock tripled despite shrinking output.

The pressure of excessive nominal domestic demand, together with the drying up of foreign medium and long-term loans, contributed to external imbalances. These were financed by the rapid accumulation of arrears, amounting to US dollars 711 million by the end of 1986, according to the World Bank estimates (World Bank: 1988a). Domestically, as production fell, a ration system established at the time of Independence became of increasing importance in providing urban consumers with essential goods at subsidised prices.

During the first five years of Independence, energy played a much larger role within the economy and in the country's foreign trade than what came to be the pattern of the period 1981-86. Power production and exports from the Cabora Bassa hydroelectric complex initiated in April 1975, were reduced in 1981 and halted in 1984 due to sabotage to the transmission lines. National coal production is a fraction of its level in the late 1970's, due to the severance of transport links from the coal mines.

TABLE 3. Annual Changes in Global Social Product (1) of Mozambique 1981-86 (Constant Prices of 1980) %

	1981	1982	1983	1984	1985	1986
	- Annual changes in percentage (2) -					
Agriculture	1.0	- 1.0	-22.1	1.7	0.8	1.6
Manufacturing	3.1	-13.7	-20.0	-21.1	-18.6	-0.7
Construction	-2.1	4.3	2.0	-10.0	- 4.4	44.2
Transport and Communications	11.1	- 7.8	-22.5	-22.7	-11.8	2.2
Trade etc.	-1-7	0.0	- 5.2	7.3	6.8	1.8
<b>TOTAL GSP</b>	<b>2.4</b>	<b>- 4.0</b>	<b>-18.3</b>	<b>- 9.6</b>	<b>- 7.4</b>	<b>4.3</b>

Note:

- (1) The concept of Global Social Product (GSP) is not identical to that of Gross Domestic product (GDP). The concept of GSP is more frequently used in centrally planned economies and indicates the gross value of production as distinct from the gross value added of GDP. In more technical terms, in aggregating GSP the value of the productive consumption of raw and auxiliary materials as well as intermediary products is not netted out. The object of the concept does not consist in arriving at a measure of national income, but at a measure of the gross value of all commodities produced.
- (2) Indicates for any given year, say 1981, the changes from 1980 to 1981 as a percentage of performance in 1980.

Source: Calculated on the basis of Governo de Mozambique: 1987a, p.17.

Former imports of crude oil to the PETROMOC refinery have been replaced by imports of refined products and the total volume and value of imported petroleum has declined substantially from 1981 onwards. With the closure of the petroleum refinery in Maputo, excess refined products ceased to be exported during 1984 (World Bank: 1987).

Similarly, with regard to production and consumption of electricity, the period 1981-86 is a turning point: In 1978 and 1980, energy from Cabora Bassa was made available to the network

of southern Mozambique. Imports were reduced considerably during these three years. Since then there has been a fairly constant consumption level of electricity, but for the southern part of the country it has increasingly been satisfied by imports from South Africa (EDM: 1987).

#### Economic Policies - Searing for New Grounds

##### The PRE-Programme

Recognising the scale of decline, the Mozambican Government in January 1987, launched its Economic Rehabilitation Programme, (the so called PRE-Programme). Its overall objectives as stated in the report prepared by the Government for a Paris Club meeting in June 1987 (Government of Mozambique: 1987, p. 14) are: (1) to reverse the decline in production and restore a minimum level of consumption and income for all the population, particularly in rural areas; (2) to substantially reduce domestic financial imbalances and strengthen the external accounts and reserves; (3) to enhance efficiency and establish the conditions for a return to higher levels of economic growth, once the security situation and other exogenous constraints have eased; (4) to reintegrate official and parallel markets; and (5) to restore orderly relationships with trading partners and creditors.

These objectives are to be achieved through major reforms in economic management. Over the course of 1987-90, the Government will (Government of Mozambique: 1987, p. 15): (1) progressively reduce centralised administrative controls in the economy and encourage private sector participation; (2) allow resource allocation based more on market determined prices, credit policies and other indirect means of guiding the economy, rather than on direct administrative intervention; (3) establish more direct links between income and performance of economic units and individuals; and (4) improve the quality of planning and policy making, and ensure that the public expenditure programme focuses on the priority requirements of the economy.

The Government strategy depends on the recovery of agriculture, especially the family sector, where the potential for an immediate supply response is highest. Devaluation, coupled with price decontrol and adjustment of fixed prices to more appropriate levels will shift the internal terms of trade in favour of agriculture, provide incentives for the restoration of marketable production and exports, and raise rural income. These warranted changes rely upon the provision of incentive goods (consumer goods and tools) to agricultural producers in exchange for their production, and establishment of appropriate marketing facilities.

The relative price changes will also support a recovery of domestic industrial production, by increasing its competitiveness and enhancing the incentive to production. Industrial recovery will, however, require a restructuring of existing capacity away from import-intensive and inefficient enterprises, to those based on local resources or efficient import substitution. Restoration of industrial production requires, in turn, that agricultural inputs and imports will be available. Because the pace of agricultural recovery is partly conditioned by the security situation and because such restructuring is necessarily a long-haul effort, international support through this transitional period is a key factor in the potential success of the strategy.

With regard to energy, the Mozambican Government emphasizes that one of the primary goals of planned energy investments is to restore Mozambique to its previous position as an exporter of electricity. In addition, it is anticipated that rehabilitation of facilities damaged as a result of the security situation will allow a reduction in electricity imports by 1990. To this end, special attention will be paid to the repair of transmission lines from the Cabora Bassa hydroelectric facility. Also, investments will be made in sub-stations and additional

transmission lines. Other investments foreseen include power stations in Inhambane and Beira, and oil depot facilities. In addition the Government has secured adequate funding for commencing the Urban Household Energy Programme, aimed at rationalising energy supply and demand, and at lessening the burden of household energy costs for segments of the urban population (Government of Mozambique: 1989).

With regard to imports of energy during the four years of the PRE-Programme, 1987-1990, the largest requirements relate to petroleum imports. (See Table 4)

TABLE 4. Energy Import Requirements of Mozambique 1987-90  
Million U.S. Dollars

	1987	1988	1989	1990
Petroleum	64.3	81.3	88.6	100.8
Electricity	7.8	10.5	12.5	15.5
Investment	30.1	19.3	8.6	3.4
Rehabilitation	(10.3)	(6.8)	(2.8)	(2.8)
Ongoing	(19.8)	(12.5)	(5.8)	(0.6)
<b>TOTAL</b>	<b>102.1</b>	<b>111.1</b>	<b>109.7</b>	<b>119.7</b>

Source: Government of Mozambique: 1987

Some important policy measures taken during 1987 - 1989. The following are some of the most important policy measures taken during 1987 - 1989:

- \* The metical was devalued in several steps to make it reflect its real value, and to ensure that a new set of domestic prices were established. In little more than two and a half years, the exchange rate increased from 40 MT to 800 MT per US dollar. Simultaneously, the black market rate is reported to have decreased from 1,500 - 2,000 MT per US

Dollar in December 1986 to 1,200 MT per US dollar in February 1989, i.e. from 40-50 times to only 2 times the official rate. For a number of reasons, and especially the illegal but efficient circuits established by Maputo traders with neighbouring South Africa, it is very unlikely that a black market rate can be totally eliminated in present day Mozambique but it appears that the gap between the official and the black market rate can be stabilised.

- \* The State budget deficit was restricted, especially by cutting subsidies to consumers, by limiting the financing of State firms' losses, and by forcing State firms to finance investments through the banks. In fact, subsidies to State firms amounted to 33 per cent of current government spending in 1986, while by 1988 estimates showed a reduction to 7 per cent. Likewise, the subsidy element of the food basket ration system was greatly reduced at the beginning of 1988, constituting a decrease from 6 to 2 per cent of current spending from 1987 to 1988.
- \* The number of fixed prices was greatly reduced and trade was partially liberalized.
- \* Investments increased at the expense of consumption in the government budget, as well as the economy as a whole.

These are only the first phases of the Economic Rehabilitation Programme. A full picture will become clearer when the next phase of the programme comes into force during 1990. A presentation of the policies to be implemented can be found in official Mozambican documents (see e.g. Government of Mozambique: 1989) as well as in reports of the World Bank (World Bank: 1987, World Bank: 1988a, and World Bank: 1989). They envisage that, during 1990, the Mozambican Government will review and modify existing tariff structures, further adjust the exchange rate of

the metical, select a number of products to be imported without administrative allocation of foreign exchange and establish a mechanism to this purpose, reduce the number of products subject to fixed and conditioned prices, and initiate minimum producer price system for some crops, possibly starting with cashew nuts.

In spite of the fact that the World Bank and the IMF consider the Rehabilitation Programme to be "a structural adjustment programme", the PRE, in fact, does not imply structural transformation in the strict sense of the word. PRE is seen as a traditional programme of demand management by reducing government spending, coupled with overall liberalisation. The programme aims to transfer resources and initiatives from the public to the private sector, including the peasant family sector, and to encourage exports.

Frelimo's fifth congress, which took place from 24th - 31st July, 1989, envisaged a broad continuation along the path embarked on with the introduction of the Economic Rehabilitation programme in 1987. The report of the outgoing Central Committee defended the PRE as a necessary, but difficult, course which had to be followed to overcome national decline. At the same time it spoke of the party's preoccupation with maintaining the living standards and purchasing power of workers, preserving social achievements, preventing illegal accumulation of wealth and defending the party's socialist heritage.

The social and economic directives approved by the congress reaffirmed that priority would continue to be given to agriculture and particularly to family (peasant) agriculture. Increasing food production was identified as the main short term objective in the agricultural sector. Unlike those adopted at previous Frelimo congresses, the latest directives did not specify quantitative targets but the government was called upon to prepare a medium-term development programme by the end of

1990.

#### The Impact of the Economic Rehabilitation Programme.

In connection with programmes such as PRE, it might be asked whether the market will be responsive to price incentives and whether it is possible (and sometimes advisable) to transfer resources from meeting domestic needs to supplying export markets. In the case of Mozambique, such preoccupations are reinforced by the fact that PRE is being carried out in a situation of war. This not only limits the scope of redirection of government activities from defence to other spheres, but it also makes it extremely difficult to ensure a market response from peasants isolated by war and disruption. Similarly, the war situation restricts the market outlets for the domestic consumption industry and impedes the establishment of a rural/urban exchange.

TABLE 5. ECONOMIC INDICATORS OF MOZAMBIQUE FOR 1987 AND 1988

Annual percentage changes

	1987	1988(1)
GSP(2) (Constant prices of 1985)	3.6	4.2
Industrial output (Constant prices of 1985)	5.9	5.1
Agricultural output (Quantities)	6.8	2.6
Export of goods (Value in US dollars)	22.6	4.1

Notes: (1) Forecast as of December 1988.

(2) For a definition of GSP see Note (1), Table 3.

Sources: Governo do Mozambique:1988, Government of Mozambique: 1988, World Bank:1988b, and EIU-Country Reports: 1/89.

In spite of these considerations, however, it appears from Table 5 that the PRE programme has been able to reverse the negative trend of previous years and restore economic growth. However, compared to the rate of decline during 1981-86 documented above,

there is still a long way to go before the 1980-81 production levels will be reached.

In 1987, a modest recovery in GSP of 3.6 per cent was recorded. This reflects largely an increase in light industry as a result of increased imports of raw materials and spare parts financed by World Bank loans. In agriculture, there was a substantial rise in the production of some family sector crops. Cotton production more than doubled, but there was a poorer cashew crop (Governo do Mozambique: 1988). For 1988, however, preliminary indications are that there may be a doubling in marketed production of cashew nuts.

Exports measured in US dollars increased by close to 25 per cent from 1986-87, especially as a result of increases in exports of cotton, copra and cashew nuts (Governo do Mozambique: 1988).

Even if there is positive change towards growth in the basic indicators offered in Table 5, it should be noted that the preliminary results of the PRE appear modest, compared to initial expectations and targets set, especially for 1988, taking into account the devastating decline of production during 1981-86. The growth recorded in Table 5 was achieved through a massive injection of external resources - spare parts and inputs to industry, consumer goods to promote peasant sales of cash crops, etc., which initially met a favourable response from the peasants and other producers in Mozambique. However, based on the preliminary data for 1988, it appears that three essential areas are meeting difficulties already in the second year of the PRE: industrial production, peasant marketing and exports in general have all stagnated.

As argued by Kenneth Hermele (SIDA:1988), the implications of this seems to be a question mark as to the sequencing of the components of the PRE. Bearing in mind the effects of the war,

it should come as no surprise that market responses are much weaker than in "normal" circumstances. Likewise, rehabilitation of existing industries managed initially to increase output, but outlets were subsequently blocked either because of the war and concomitant transport breakdowns or because effective demand was less than anticipated.

The limit to effective demand (i.e. demand backed up by purchasing power) is partly a direct effect of the policies of the PRE. As a consequence of the devaluations, coupled with the restraints on the government budget, drastic increases in the price of basic necessities, housing, education, medical care, etc., were introduced. In a remarkably short time, these price increases limited the urban market and hence put a restraint on the demand for industrial consumer goods, which were now being priced to reflect their real value. As the war simultaneously blocks access to the rural areas, industries find themselves with several months of production volumes in stock.

#### The Impact of the PRE Programme on Energy

For several years price levels on electrical energy were artificially low, as a result of the Government's foreign exchange policy. Following the devaluations of the local currency from 1987 onwards, energy prices have changed dramatically. Although measures were taken to prevent an enormous price escalation for domestic consumption, the household tariff was increased by approximately 250 per cent during 1987.

For industrial tariffs, the increase was approximately 550 per cent during 1987 but the most dramatic change occurred in the so-called 'General' tariff, dependent on the commodity assistance of the international relief organisations.

## 1.4 The Role of Energy in the Household Economy

### Rural

Although there is no generalised information available on rural patterns of woodfuel consumption, several partial surveys summarised by the World Bank indicate the existence of the following features (World Bank: 1987):

- (a) more than 90 per cent of families use fuelwood exclusively for cooking, and less than 10 per cent use charcoal (mostly those families that produce charcoal as a major activity);
- (b) most households use small quantities of kerosene for lighting, but none use it for cooking (some use kerosene for igniting charcoal, which is sometimes used in small quantities for ironing clothes);
- (c) consumption of fuelwood rarely exceeds 70kg/week; 50 per cent of families use less than 50 kg/week and consequently they could be experiencing social hardship; in areas of pronounced shortage, about two-thirds of families use only 30 kg/week and consequently are obliged to restrict fuelwood consuming activities to only those that are vital for survival';
- (d) responsibility for timely supply of fuelwood rests largely with women, who spend 8-14 hours weekly on fuelwood gathering. In a typical village situation in fuelwood deficit areas, it has been estimated that villagers (mostly women) roam for six to eight kilometers in search of firewood;
- (e) kerosene has been available only in the larger communities and purchasers have had to spend a considerable amount of time (4-5 hours/week) to obtain supplies. Under the present circumstances, restrictions on availability, effectively rule out kerosene as an option for rural household energy.

### Urban

The full impact of the recent price changes cannot be clearly identified as they were introduced along with a series of

measures that involved great improvement of conditions for industry production but so far they seem to have caused a change in consumption patterns.

The level of household consumption has been relatively constant over the last three years, indicating the non-appearance of projected load growth in this sector rather than a virtual zero growth. Even though no specific study has been carried out to verify this, it seems quite obvious that the low income group of consumers have reduced their consumption of electrical power as a result of the price increases.

Industrial consumption, however, and in particular the consumption in the Maputo area, has increased substantially, despite the considerable price escalation. Increases in industry tariffs were more than twice that of household tariff. Nevertheless, industrial consumption has made a growth of 40-50 per cent over the last two years, increasing its share of the total consumption from approximately 40 per cent in 1986 to approximately 50 per cent in 1988.

Both domestic and industrial consumption are strongly dependent on the country's economic situation and electrical power consumption is considered to be a good indicator of general economic activity.

The considerable growth in industry consumption referred to above can only be explained by improved conditions for industry production following the Economic Rehabilitation Programme introduced in 1987. Extensive import support was offered by international financing institutions and raw materials for industrial production were again available after several years of almost total absence.

It should be emphasized, however, that the effects of PRE so far are felt primarily in the major cities of the country, especially in Maputo, while many provincial towns are still hardly serviced. Technical and financial support has been obtained to begin implementing the programme of domestic energy for urban areas before the end of 1989. The programme, which is to run for six years, will have access to 65 million US dollars concessionary credit from the World Bank, the Arab Bank for African development (Badea), Norway and Denmark. The equivalent of 5 million US dollars will be provided by the Mozambican government. The new programme envisages spending 25 million US dollars on promoting the use of gas, paraffin and coal for domestic use. A major project of electrification is to be undertaken by a new entity, Prolec, which will employ about 500 people to electrify 40,000 houses in Maputo, Beira, Nampula, Nacala, Tete and Quelimane during the next five years. This will bring the total number of electricity consumers in the country to around 100,000. The promotion of alternative fuels commenced in some suburbs of Maputo last year on a trial basis and the sales of paraffin oil increased from 8,200 tons in 1987 to 10,300 tons in 1988.

Beyond the immediate scope of the domestic programme, the district headquarters of Zobue and Mandimba, in the border areas of Tete and Niassa respectively, began to receive electricity from Malawi in September 1989. This was part of a SADCC programme benefiting from a grant provided from Norway. The first phase of this programme, which began two years ago in cooperation with Escopm of Malawi, saw the towns of Ulongue and Milange supplied with electricity from Malawi.

## 2 Review of MDC-Funded Projects and Other MDC Assistance to the Energy Sector, 1980-89.

### 2.1 MDC Assisted Investments by Size and Type of Project

The Norwegian power sector support comprises a list of projects

varying in contents as well as size. The major part of the projects are accomplished through the bilateral cooperation programme. However, over the past years an increasing part of the support has also been channelled through multilateral programmes, in particular through SADCC cooperation projects.

The Norwegian engagement with Mozambique on a bilateral basis started with personnel support and hydropower studies in 1979. Since then it has developed into a sector engagement, with a formal Sector Agreement entered into in 1987, in which all bilateral cooperation projects are included.

The following projects have been included in the bilateral support up to 1989:

Hydropower Studies (MOZ 018)

- An assessment of Mozambique's hydropower resources carried out by the Norwegian consultant Norconsult.
- First agreement entered into in 1980, project still ongoing.  
Spending up to 1989: NOK 31.6 million.

Equipment for Power Development (MOZ 021)

- Import support for equipment and spare parts for EDM.
- Originally included in the general commodity assistance to Mozambique, from 1983 identified as a separate project.
- Spending up to 1989: NOK 119 million.

Lichinga Hydropower Project (MOZ 028)

- Construction of a small-scale hydropower plant at Lichinga, in the Niassa province.
- Construction work started 1981, plant commissioned 1983.
- Total Norwegian support: NOK 19 million.

Impregnation Plant (MOZ 029)

- Erection of an impregnation plant for wooden poles for power lines at Marracuene, approximately 30 km. north of Maputo. The plant utilises local forest resources, and supplies EDM with poles for expansion and maintenance of the distribution network.

- The plant was constructed during 1982.
- Total Norwegian support: (NOK 6 million)

Institutional Cooperation (MOZ 030)

- Personnel support to EDM
- Project started 1980, still ongoing.
- Spendings up to 1989: NOK 19.1 million.

Cuamba Hydropower Project (MOZ 035)

- Construction of a small-scale hydropower plant at Cuamba, in the Niassa province.
- Construction work started 1984, plant commissioned 1988.
- Total Norwegian support: NOK 60 million.

Training and Personnel Fund (MOZ 048)

- Assist EDM in training activities and give support to necessary expatriate personnel (foreign exchange component).
- Up to 1987 included in the Institutional Cooperation, from 1987 identified as a separate project.
- Spendings up to 1989: NOK 6 million.

Mbahu (Lucheringo) hydropower project (MOZ 049)

- Construction of a second small-scale hydropower plant at Lichinga, in the Niassa province.
- Still pending a final decision on implementation.
- Total budget: (NOK 83.2 million.

Electricity supply Beira (MOZ 052)

- Purchase of equipment to improve the reliability of the electricity supply to Beira town. The improved reliability is to be obtained by strengthening EDM's capability to undertake necessary repair work in case of supply interruptions.
- Equipment purchased in 1988.
- Total Norwegian support: NOK 6 million.

Special Support to Cuamba (MOZ 053)

- Allocation of funds for transport and radio communication to overcome problems in the construction of the Cuamba hydropower plant related to the transport as well as the security situation.

- Funds utilised in 1988.
- Total Norwegian support: NOK 1 million.

Turning to Norwegian support for the regional development of energy, the following SADCC projects are funded by MDC:

Interconnection Mozambique - Zimbabwe, Phase I (REF 014)

- Rehabilitation of existing interconnection between the two countries, and a study of the feasibility of constructing a new power line with higher capacity.
- Study performed in 1987, rehabilitation work expected to be terminated in 1989.
- Total Norwegian support: NOK 12.5 million.

Electrification of Border Areas, Mozambique - Malawi (REF 034)

- Power supply to Mozambican and Malawian communities along the border from the Malawian distribution network, including training of Mozambican personnel in Malawi.
- Preparatory work started in 1987, construction work expected to be terminated in 1990.
- Total Norwegian support: NOK 20 million.

Mavuzi Hydropower Plant Study (REF 035)

- Investigation of the potential and feasibility of exporting hydropower from Mozambique to Zimbabwe with special reference to an extension of the installed capacity of Mavuzi hydropower plant.
- Study was performed during 1987 and 1988.
- Total Norwegian support: NOK 6 million.

Corumana Hydropower Project (REG 042)

- Construction of a hydropower plant in Southern Mozambique.
- Feasibility study and tender documents were produced under the Hydropower Studies in 1986. The plant is planned to be commissioned in 1989.
- Total Norwegian support: NOK 72.5 million.

### 3 Energy Sector Policies

#### 3.1 Review of Mozambique's policy

During the first years after Independence, Mozambique's energy policy was marked by an optimistic confidence in the ability to achieve a high degree of self-sufficiency within the sector. It was considered to be essential to reduce the import of petroleum products. Even though it represented only 12 per cent of energy needs (1979), they constitute a heavy portion of the National Hard Currency Budget. Therefore, exploration of indigenous energy resources was promoted in order to meet the requirements of large industrial and agricultural schemes.

Based on this, the objectives of Mozambican energy policy were summarized through a series of measures:

- \* intensifying the survey of existing energy resources, giving priority to hydropower;
- \* profiting from the large existing hydropower potential in order to meet new energy requirements by developing larger hydropower schemes, and simultaneously erecting a National Electrical Network;
- \* developing a rural energy policy in areas far from the National Electrical Network based on reforestation programmes, small scale hydropower projects, the use of windmills and watermills for irrigation and solar energy for cooking and heating;
- \* rationalizing the use of oil, primarily by implementing a series of measures in the transport sector, such as improved maintenance, control of purchase and imports, promotion of public transport etc.
- \* giving constant attention to technology evolution of new and renewable sources of energy (geothermal, wind, waves, solar, etc).

According to interviews with a high ranking official in early June 1989, Mozambique's energy policy has not changed over the past decade. Top priority is still given to exploitation and

utilization of indigenous hydropower resources, both for inland consumption, as well as for export to neighbouring countries. The pace of development has not been as high as originally foreseen and the aims identified in the first years after Independence have not been reached.

However, a new element has been introduced as a central element in the country's energy policy, namely The regional aspect, which was not included in the original concept when efforts were largely concentrated on self-sufficiency. Traditionally, the role of Mozambique in an overall regional context has been linked to:

- exporting labour,
- rendering services, i.e. harbour/railway facilities and energy trade.

Regional cooperation has been largely stimulated through the SADCC cooperation and in the energy sector it is now a clear policy to give high priority to power exchange projects. In principal, the Mozambican authorities are promoting the use of existing facilities as well as the exploitation of new hydropower projects involving power export, to find a market for its huge resources. In addition, projects where Mozambique actually imports power are under consideration when this is feasible both from a national and regional viewpoint.

There has, however, been a change in priorities regarding hydropower exploitation. More emphasis is placed on small-scale projects and the big projects, dominating the picture during the first period after Independence, are temporarily put aside. This is more a result of the development process, rather than a change in policy. The huge investments laid down in projects like the northern and southern transmission systems should be considered as basic investments to create a foundation for future electrical power development in Mozambique. Now the time has

come for a second phase, involving the establishment of infrastructure, to create conditions for utilisation of the power resources made available, implying small-scale projects, but still requiring high investments.

On the other hand, one should also bear in mind that these huge investments have not, so far, given the projected results. One example is the Centre-North line which for various reasons has not been in operation throughout its full length for more than six months, despite the fact that construction work started in the early 1980's. Another example is the investment and mobilisation of efforts in order to prepare large hydropower projects like Cabora Bassa II and corresponding projects in the Zambezi basin, based on the availability of a power market outside the country. None of these efforts have been vested but, as the benefits so far do not correspond to the costs, they are likely to have created a certain amount of reservation against large-scale projects, not only within Mozambique, but also among the supporting donor agencies.

### 3.2 Review of principal objectives of Norwegian development assistance. 1980 - 89.

When bilateral cooperation with Mozambique was initiated, in 1977, Norway was requested to give assistance within the power sector. A sector study was carried out in 1978, and following the study the power sector was considered to be one of the main areas for bilateral cooperation.

In official Norwegian project documents, the development of Mozambique's power sector is considered to be a condition in order to meet with its long term social and economic goals, according to the country's own policy. The strategy to achieve this is referred to as being:

- a) to utilise its huge hydropower potential for export of electric energy, hence obtaining foreign currency income

- that could stimulate the economy in general;
- b) to employ hydropower to replace diesel power production, reducing consumption of diesel and thus foreign currency spending;
  - c) to stimulate the development of agriculture and local industry through an energy supply based on cheap hydropower. (Ylvisàker, 1989)

From a Norwegian point of view and as a guideline for Norwegian support of the power sector, points (b) and (c) in the above strategy are particularly emphasised.

As for the broad Norwegian engagement within this sector, the following aspects should be highlighted:

1. As Norwegian power supply is based only on hydropower, it follows therefore that Norway is well qualified to provide a high standard of assistance within this field.
2. Over the past few years, the Norwegian power industry has been facing a considerable reduction in activity, creating spare capacity within this field. Thus, Mozambique's need for support coincides with the Norwegian ability to provide this support.
3. It has been a major goal for Norwegian support to southern Africa to reduce the region's dependency on South Africa. In the present situation, approximately 70 per cent of electrical energy consumed in Mozambique originates from South Africa (power import and coal for power production). Support to power production schemes is, therefore, a valuable contribution in achieving this. Accordingly, support to power cooperation projects with neighbouring countries is also considered to be a counterbalance to the South African dominating role in the region.

List of Persons Interviewed

Mr. Fernando Ramos Juliao, General Director, EDM (Maputo)  
Mr. Eduardo Teodorico Franca, Head of Finance, EDM (Maputo)  
Mr. José Nicolau, Head of Planning Department, EDM (Maputo)  
Mr. Arne Disch, Attaché, NORAD (Maputo)  
Ms. Ellinor Melbye, Energy Attache, NORAD (Maputo)  
Mr. Odd Haugland, NVE Advisor in EDM (Maputo)  
Mr. Per Magnar Gildseth, NVE Advisor in EDM (Maputo)  
Mr. A. Vinjar, NVE Director (Oslo)  
Mr. Steinar Grongstad, NVE Officer (Oslo)  
Mr. Egil Skoftoland, NVE Officer (Oslo)  
Mr. Knut Kayser, Energy Section, NORAD (Oslo)  
Mr. Hans Terje Ylvisaker, former NVE Advisor in EDM (Maputo)  
Mr. Odd K. Ystgaard, Vice President, Norconsult, (Oslo)  
Mr. Roar Gjestvang, Assistant Vice President, Norconsult, (Oslo)

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Mr. Arne Dachs, Attaché, NORAD (Maputo)  
Ms. Elfinor Melbye, Energy Attaché, NORAD (Maputo)  
Mr. Odd Haugland, WVE Advisor in EDM (Maputo)  
Mr. Per Ragnar Gildseth, WVE Advisor in EDM (Maputo)  
Mr. A. Vinjar, WVE Director (Oslo)  
Mr. Steinar Gronstad, WVE Officer (Oslo)  
Mr. Egil Skotteland, WVE Officer (Oslo)  
Mr. Arne Kyster, Energy Section, NORAD (Oslo)  
Mr. Hans Terje Yivasker, former WVE Advisor in EDM (Maputo)  
Mr. Odd K. Ystebard, Vice President, Norconanid (Oslo)  
Mr. Roar Gjestavag, Assistant Vice President, Norconanid (Oslo)

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