Sida Evaluation 01/21

Swedish Support to the Power Sector in Mozambique

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Abbreviations

A	Administrative Losses
CNELEC	National Electricity Council
CTM	Central thermal power station of Maputo, *Central Térmica de Maputo*
Danida	Danish International Development Assistance
DER	Transmission and Distribution Department, EDM
DIPLA	Corporate Planning Department, EDM
DNE	National Directorate of Energy
EDM	Mozambique's Electricity Board, *Electricidade de Moçambique*
EIA	Environmental Impact Assessment
ESKOM	Electricity Utility of the Republic of South Africa
FIRR	Financial Internal Rate of Return
FUNAE	National Energy Fund
GIS	Geographical Information System
GOM	Government of Mozambique
GWh	Giga Watt hour
HCB	Hidroelectrica de Cahora Bassa
HV	High Voltage
IRR	Internal Rate of Return
KfW	German Development Bank
KTS	Contract-financed Technical Cooperation
kV	kilo Volt
kW	kilo Watt
LFA	Logical Framework Approach
MIREME	Ministry of Mineral Resources and Energy
MMTS	million *Meticais*
MOTRACO	Mozambique Transmission Company
MW	Mega Watt
MZM	Mozambican *Meticais*
NOK	Norwegian *Krone*
NORAD	Norwegian Agency for Development Cooperation
NPW	Net Present Worth

OH	Overhead distribution lines
PE	Public Enterprise
RBM	Results-Based Management
REP	Rural Electrification Projects
RSA	Republic of South Africa
RTA	Resident Training Advisor
SADC	Southern African Development Community
SAPP	Southern Africa Power Pool
SEB	Swaziland Electricity Board
SEK	Swedish *Krona*
Sida	Swedish International Development Cooperation Agency
T/NT	Technical and Non-technical
TA	Technical Assistance
TC	Training Centre
USc	United States Cents
USD	United States Dollar
UTIP	Technical Unit for Implementation of Hydropower Projects
ZESA	Zimbabwe Electricity Supply Authority

Executive summary

A. Brief Overview of Sida's Support

Sida has supported energy activities in Mozambique since the late 1970s with most support directed to EDM. Early attention was on the main transmission facilities. From the mid 1980s the cooperation also included advisors for operation and maintenance of the national power system and training. Since the beginning of the 1990s focus has shifted to power distribution, including commercial and administrative issues.

In 1997, a three-year phasing out of support to the energy sector started. But Sida has at the same time begun supporting the development of rural electrification as well as advisory services for EDM related to the Southern African Power Pool (SAPP).

Total Sida funding during this period is around SEK 500 million of which SEK 140 million has been allocated since 1995.

B. Purpose and Focus of the Evaluation

The main *objective* of this evaluation is to provide relevant information as a basis for discussions and decisions on the potential future Swedish assistance to the energy sector.

The *purpose* of this evaluation is to summarise the programme results and sector impact of the Swedish power sector support and to assess if the sector strategy has led to the anticipated results. The evaluation should also assess the effectiveness and efficiency of the utilisation of development assistance funds. This evaluation only covers projects that have been in operation since 1995.

C. Main Findings

1. Technical Assistance on Transmission and Distribution

Technical assistance to the maintenance, operation and planning of EDM's transmission and distribution networks has shown considerable flexibility and adaptation to changes which has resulted in the project in some areas developing beyond the plans. The close relationship between the Swedish consultant and EDM may have caused relaxation with respect to cost-effectiveness in implementation.

The **efficiency** increased during the period as permanent advisers were replaced by visiting experts. The **effectiveness** seems satisfactory with regard to achievement of project objectives, though for some of the activities this is difficult to ascertain as these were either not completed or changed in the course of implementation.

The **impact** has been good as EDM personnel are now capable of handling normal planning, operation and maintenance of technical facilities. The long-term relationship between EDM and Swedpower produced a high degree of trust which in this field strengthened the long-term impact of the support.

The **relevance** of the project remains high as it has contributed to developing the technical dimensions of EDM, which is a pre-condition for it becoming a commercially viable company.The *technical/organisational* foundation for **sustainability** has thus been laid , but the *financial* sustainability remains a challenge that senior EDM management has to address more forcefully.

2. Training Centre Activities

Support to EDM's Training Centre (TC) is one of the most successful cases of organisational development in Mozambique. The TC has been enabled to fully develop and consolidate the structure, contents and materials for all its core courses; train national instructors in most of the areas; upgrade and maintain its training facilities; and run the required courses at a standard that seems to correspond to the needs of the organisation.

The **efficiency** has been good when compared with alternative training arrangements, and has reduced per-trainee costs over time. The **effectiveness** has been good with respect to the stated Immediate Objectives, and the **impact** similarly was good measured against the Development Objective. These objectives themselves, however, were not the most adequate given the larger transformations of the sector and EDM that were apparent at the time the final contract was entered into.

The **relevance** of the project remains very high both in terms of national and EDM's own goals and objectives, but the **sustainability** is the weak point, where EDM's willingness and prioritisation of continued TC development requires more internally allocated resources. But donors may consider supporting those TC's activities relevant to the restructuring and transformation of EDM as a more competitive firm. These are extraordinary costs that EDM cannot be expected to be able to fully fund itself.

3. Loss Reduction Project

The loss reduction project is a highly successful project. The support from Sida has included both technical assistance and procurement.

The **efficiency** of the support from Sida has been outstanding. Distribution losses in 1999 were 24% compared to over 40% in 1995, so the resulting benefit in 1999 was about SEK 120 million, representing five times total project costs. The **effectiveness** is good with respect to the stated project objectives, and the **impact** is certainly positive both with regard to the physical conditions of the distribution networks, the approach and attitude of EDM's personnel as well as the results for subscribers and the public in general.

The **relevance** of the project with regards to EDM's priorities remains high as it is key to transforming EDM into a commercially viable company. The **sustainability** appears very good both in technical/organisational and financial terms, as this project forms the basis for EDM's *Nova Imagem* programme which is now part of EDM' normal operation. This has resulted in a new approach to the handling of commercial matters.

4. Advisory Services, SAPP

International co-operation in the power sector is becoming increasingly important, so strengthening EDM's capacity within the SAPP is important.

The **efficiency** is satisfactory. Total project costs are about SEK 5.5 million for the five-year period 1998 through 2001, and the TA during regional negotiations has resulted in better contract conditions and thereby financial benefits for EDM.

The **effectiveness** with regard to project objectives and expected results are in general satisfactory, but the project objectives could have been more focused on international cooperation and less on the operation of the EDM grid. The **impact** on EDM's key personnel is positive in those areas where activities are undertaken while other impacts are limited due to the comparatively short period of time since the project started.

The **relevance** of this project is high and will increase as regional power co-operation develops in the future. S**ustainability** should be attainable in terms of EDM being able to handle normal operation and international co-operation, and on its own can decide for which purposes external assistance is required.

5. Rural Electrification Projects

Sweden supported rural electrification in the Ribáue-Iapala and Memba districts of Nampula Province with a little over SEK 50 million during the 1998-2000 period. The **efficiency** was reasonable as project implementation has been subject to competitive bidding in Sweden and no severe cost overruns occurred. This might even have been better if international competitive bidding had been used. The **effectiveness** of the project is satisfactory on the basis of implementation time and number of consumers connected approximately half a year after commissioning.

The impact of this project is too early to assess. It was, however, found that the improved supply of electricity has increased commercial activities. The expected environmental benefit of switching to modern sources of energy and relief of workload of women for collection of wood was non-existent.

With regard to **relevance** the need for investments in infrastructure in the Nampula province is evident. Experience from the Memba project, however, points to the need for proper feasibility studies prior to project implementation. The **sustainability** of the project is satisfactory but merits close monitoring over time. The progress with regard to connection of new consumers and EDM' ability to maintain and operate the project is good, but while the projects are likely to generate an operating surplus the problem is if EDM will earn a proper return on capital.

D. Impact on the Power Sector in Mozambique

The projects have largely made substantive contributions towards their objectives. For some projects, however, the objectives were not the most relevant with regard to the development of the sector. The relevance, timing and mix of Sida-funded projects are considered appropriate and relevant. Performance of the power sector has improved, as shown below, and the Sida support has certainly contributed to this.

Technical Matters

Power generation has increased from 965 GWh in 1995 to 1,328 GWh in 1999, an average annual increase of about 8%, which is high for a developing country. Distribution losses have been reduced by approximately 20% of the power supplied. *Reliability* is less clear as the statistical basis is weak.

Access to electricity has been increasing during recent years.

Economic Matters

The Sida funded activities have been critical to the improvements in EDM's financial situation: the early transmission and distribution projects allowed the physical network for power distribution to survive and continue as the fulcrum for EDM's income generation; the loss-reduction project has generated major savings; the inter-connection to Zimbabwe is an important revenue source. Performance could have been even better through a more commercial orientation such as a more aggressive pursuit of revenue-enhancing activities like the *Nova Imagem* program.

Environmental Impact

An improved power sector has led to important environmental improvements. Most important has been the decommissioning of the thermal power station in Maputo, which was an obsolete, coal-fired power station that was a major source of SO_2, NOx and particle pollution in Maputo. A number of diesel-powered generation sets have also been taken out of service as the power grid has been extended.

The substitution of hydropower for thermal power has been in line with the strategy to replace as much of local power production as possible with low-cost and clean indigenous hydropower from Cahora Bassa. This strategy, however, was more a result of economic considerations rather than environmental concern

Gender Impact

In 1997 EDM started a process with Sida support to elaborate a Gender Policy. The aim of this is to improve gender awareness and increase the number of females in higher posts at EDM. So far the impact is limited, but more due to the general gender attitude in Mozambique than poor implementation of the policy.

The support to rural electrification has by some been expected to reduce the drudgery for women by switching from fuelwood to electricity. This is not happening as power is largely used for lighting and minor appliances, and then only among the better-off households.

Poverty Impact

The early justification for support to the power sector was for overall economic growth and development, and poverty reduction was not dealt with in a consistent way before 1997. With the shift towards rural electrification more consideration has been given to poverty reduction. The impact will be indirect and through two channels. The first is that Sida will focus on the poorer and central northern regions, and the second is to focus on getting power to rural areas where labour-intensive activities are higher. Health and educational facilities as well as security should be improved, but the effect on poverty reduction from this is debatable and need further assessment. Although the project has resulted in some increased economic activity and improved security it is too early to note any impacts on poverty reduction only some few months after project completion.

E. Options for the Future

Sweden's decision in 1996 to phase out its support to the energy sector formally remains in place. However, financial resources available to Mozambique are set to rise considerably during the coming years. Sida has decided to give priority to the road sector as far as its own management and technical skills are concerned, but Sida could develop a "win-win" situation by also supporting investment projects in the power sector. The objective should be to identify investments that are

used for highly productive activities that are necessary pre-requisites for sustainable growth and hence sustainable poverty reduction. By focusing the power sector engagement on such projects, Sida's own administration can be kept to a minimum.

EDM's Rural Electrification Projects are the most logical candidates for such financing. But the quality of EDM's current program and project preparations is not satisfactory. The economic and financial analyses should provide a basis for more rigorous comparisons and priorities. There is also the lack of participatory planning, so it is not always clear what stakeholders themselves prefer. This is particularly relevant if Sida wants these projects to address poverty and livelihood issues. More consistent and comprehensive socio-economic benchmark studies that permit results and impact assessments as well as contribute to more general monitoring of trends is required.

Rural electrification projects that are primarily addressing political priorities and not EDM's own commercial concerns should entail that on-lending agreements contain renegotiable conditions regarding interest rate, grace period and repayment horizons, depending on how the actual demand for energy develops.

If Sida wishes to finance such projects, it should also provide for a consultancy fund for feasibility and benchmark studies to ensure better investment choices and project monitoring. Another or complementary possibility is a more general fund that actors in the power sector could apply for, to cover costs that are considered extra-ordinary in connection with the transformation of the energy sector. In order to minimise the administrative costs and policy involvement of such fund/s, Sida should consider ways of handing management responsibilities to an external actor.

1 Background and Introduction

Sida has provided support to the power sector in Mozambique for over 20 years. In 1996, the Swedish Government took the decision that support to the sector was to be phased out over a three-year period.

During the subsequent period the on-going technical assistance support to transmission and distribution and training activities has largely been terminated. Some limited technical assistance related to loss reduction, activities in connection with the Southern Africa Power Pool (SAPP) and general project management still remains. At the same time, however, Sida has begun supporting rural electrification projects.

In connection with the on-going work of developing a new country strategy for Sweden's co-operation with Mozambique, Sida's Infrastructure Division therefore commissioned an evaluation to review projects that were in operation in 1995 or that had been introduced later on.

1.1 Objectives of Evaluation

The main *objective* of this evaluation is to provide relevant information as a basis for discussions and decisions on the potential future Swedish assistance to the energy sector.

The *purpose* of this evaluation is to summarise the programme results and sector impact of the Swedish power sector support and to assess if the sector strategy has led to the anticipated results. The evaluation should also assess the effectiveness and efficiency of the utilisation of development assistance funds.

1.2 Method

In order to carry out the evaluation, a four-person team was put together that included competencies in the fields of power systems, environment, economics, gender and poverty reduction. The work has largely consisted of three activities:

- A careful *review of documents* both at Sida head office in Stockholm and in the field. This included documentation from Mozambique's Electricity Board *Electricidade de Moçambique* and other relevant agencies. Appendix C provides the Bibliography for this study.
- A two-week field visit during the period November 26–December 8 by the entire team was used to *interview* key informants both on the Mozambican and Swedish sides.
- The field visit was also used to make *on-site visits* to activities that had received Sida support, in order to make own assessments of achievements and issues.

On this basis a Draft Final Report was completed and submitted to Sida in February 2001. Thereafter it was presented at a seminar in Mozambique in February 2001, and comments from Sida and EdM have been taken into consideration for the preparation of this Final Report.

The questions posed have been in relation to the issues raised in section 3, "Scope and Focus", in the Terms of Reference, which are attached as Appendix A.

The evaluation has focused on the results and effects of projects that were in operation in 1995 or that have been introduced later on. For each project, an assessment is made of achievements using the five standard OECD/DAC evaluation criteria, where appropriate:

- **Efficiency** or cost-effectiveness – the relationship between inputs and outputs,
- **Effectiveness** or efficacy – the extent to which the immediate objectives have been attained as a function of the results produced,
- **Impact** – the changes and effects, whether negative or positive, foreseen or unexpected with regards to the target groups,
- **Relevance** – the degree to which the project is justified in relation to EDM and national development priorities, and
- **Sustainability** – an assessment of the extent to which the positive effects of the project will continue after Sida's support ended.

1.3 Structure of the Report

The report contains four chapters in addition to the Executive Summary and this Introductory chapter. Chapter 2 gives a short overview of the power sector in Mozambique and Sweden's support to it over the last several years. A more complete picture of the power sector is provided in Appendix E.

Chapter 3 presents all the projects that have received Swedish support, with the team's assessment of achievements and shortcomings. Chapter 4 then looks at the cross-cutting dimensions of poverty reduction, gender, environmental impact and economic and financial sustainability, while Chapter 5 looks at the programme as whole with regards to achievements and sustainability. The questions posed in the Terms of Reference are addressed, before final conclusions and recommendations are made.

A series of appendices provide additional information. Appendix A gives the Terms of Reference for the evaluation. Appendix B lists the persons met. Appendix C provides the documentation consulted, including the numbering scheme used for the references in the text. Appendix D gives the full LFA matrices for the project activities undertaken during the 1995–1999 period. Appendix E gives an overview of the energy sector in Mozambique, including the organisational structure of the public sector and EDM, and Appendix F is a list of business relations handled by DIPLA.

1.4 The Evaluation Team

The contract for this assignment was awarded to SPM Consultants/Stockholm in association with Norconsult/Oslo. The evaluation team consisted of Mr. Trond Westeren, power engineer (Norconsult – team leader), Mr. Anders Ellegård, environmental expert (Bioquest/Gothenburg), Mr. Arne Disch, economist (Scanteam/Oslo), and Ms. Alexandra Silfverstolpe, development management consultant (SPM consultants).

1.5 Acknowledgements and Disclaimer

The evaluation team had to rely extensively on the assistance and support of Sida staff in Stockholm and the Embassy in Maputo. During the field visit, the team was given full support by

EDM and its staff. The full co-operation and willingness to "go the extra mile" by both Mozambican and Swedish officials is very much appreciated.

The evaluation team is responsible for the analyses and conclusions of this report, as well as for any remaining errors contained herein. The opinions expressed here are those of the Evaluation team alone, and should not be attributed to Sida or EDM or any of their staff, or to any of the collaborating governments and organisations.

2 The Power sector and Sida support

The power sector in Mozambique is dominated by two entities. The Cahora Bassa power scheme, *Hidroelectrica de Cahora Bassa* (HCB) has a capacity of about 2,000 MW. Of this, South Africa's electricity company ESKOM has a right to purchase 90% while the remaining 10% belongs to Mozambique and is used to feed the national power grid. HCB is owned 80% by Portugal while the remaining 20% is owned by the Government of Mozambique (GOM).

Mozambique's power company *Electricidade de Moçambique* (EDM) owns the national transmission system and is also the dominant actor on the distribution side. The power grid essentially consists of three lines: the southern one that is fed via South Africa; and the central and northern lines both fed from HCB. In 1999, in the EDM system, total production including import was 1,328 GWh, which is an increase by 38% since 1995. The peak load in 1998 was 237 MW, where the southern system dominated with a peak load of 134 MW.

2.1 The Public Sector

The Government's energy strategy of 1998 (#33) focuses both on increasing the availability of energy for domestic uses and on provision of power for so called mega-projects. These large-scale projects such as the recently opened aluminium smelter MOZAL, are based on new cheap power generated in Mozambique and are considered key to the economic and export growth of the country.

Within the Ministry of Mineral Resources and Energy (MIREME), the National Directorate of Energy (DNE) is the body responsible for power issues including policy formulation and implementation, project definition and promotion, initiation and formulation of regulations and energy planning, management and conservation. DNE has in addition special functions in areas such as rural electrification and distribution of petroleum products.

Three other government institutions in the power sector are important:

- The National Energy Fund (FUNAE) was established as a result of the new Electricity Act of 1997 as a financially and administrative autonomous body that is to assist low-income groups access to low-cost energy. It should also promote conservation and a rational and sustainable management of energy sources. FUNAE will be financed through fees, licenses and concessions. There is a board of five members from different ministries, and a director has been appointed. So far, very limited resources have been allocated through the existing financial mechanisms.

- The National Electricity Council (CNELEC) was also created in 1997. Its current mandate is as an arbiter in the power sector, though it also has some functions pointing towards a future role as regulator. CNELEC is not yet staffed.

- The Technical Unit for Implementation of Hydropower Projects (UTIP) is to act as a facilitator for new hydropower projects. Exploitation of potential hydropower in the country is a prioritised issue in the national energy strategy.

DNE is responsible for setting the power tariffs. There is currently a unified national tariff system, so that rural consumers are in fact being subsidised as costs of supply are higher in such areas.

2.2 Electricidade de Moçambique

EDM was a state body till it was transformed into a public enterprise (PE) in 1995. The Electricity Act opens up the power market to competition both on the generation, transmission and distribution sides, and among other things requires that EDM provide access to the national grid, which it currently owns and manages. While some new actors have entered the sector (see next section), EDM remains a quasi-monopolist in both transmission and distribution. The transformation into a PE has forced EDM to focus more on its financial performance, and in 1998 it achieved an operating surplus for the first time. EDM is currently acting under a performance contract with the government.

Many donors have provided EDM with technical assistance, grants and soft loans for operational expenditures and investments, among them Sida, Danida, NORAD and KfW. Today most funds to the power sector are provided to GOM, which then on-lends to EDM on terms that are negotiated between the parties.

EDM does not have any substantial power generation capacity itself. There are a number of smaller generating facilities, both hydropower stations and gas and diesel powered generators (see Annex E). There are interconnections to with South Africa, Zimbabwe and Swaziland plus some minor local connections with Malawi. EDM is furthermore part of the South African Power Pool (SAPP).

The Maputo area has the largest concentration of consumers, and about 27% of the population has access to electricity, whereas the corresponding figure for the whole country is around 4%.

2.3 Private and Non-governmental Involvement in the Power Sector

With the new Electricity Act, new actors have entered the sector. The Mozambique Transmission Company (MOTRACO) is to construct and operate two 400 kV transmission lines, primarily for the MOZAL aluminium smelter. Management contracts have been given to private companies for off-grid power systems in the Vilanculos area (gas-based) and in Montepuez (diesel-generator based). These systems have about 400 consumers each. Such isolated grids are considered by DNE as possible solutions for the supply of electricity to remote areas, for which grid extension is not feasible in the near future.

If the new large-scale power project at Mepanda-Uncua comes on-line, that will have to be largely private-sector funded. It will also require new transmission capacity, which will have to be private sector financed as well.

As elsewhere in developing economies, the structure of the power sector is thus changing, albeit slowly. The legal framework for a more competitive, efficient power sector has improved considerably with the Electricity Act, though the changes flowing from this will clearly take some time to develop.

2.4 Overview of Sida's Support to the Energy Sector in Mozambique

Sweden has supported energy sector activities in Mozambique since the late 1970s. Up until 1995, about SEK 400 million of country frame resources were used. In addition come SEK 110 million over Sida's regional SADC funds, largely to co-finance the hydropower plant at Corumana with

Norway, and the gas turbine outside Beira town. Finally, Sida also provided Mozambique with SEK 50 million of import support for energy equipment.

Sida's energy sector support has largely gone to EDM. During the 1980s support was provided in the form of consultancy services for the development of the grid to the central and northern parts of the country, and to supervision of the power network in some areas in the south of the country. From 1985/86 the co-operation was widened to include advisors for the operation and maintenance of the transmission systems of EDM, training of EDM personnel, and a pilot project for household energy provision. During 1988/89 support was further expanded to include consultancy services for the development of a master plan for power distribution in Maputo and Beira as well as equipment related to this.

In 1991 the need for support to EDM's administrative and commercial entities became evident. From 1992 and onwards the support focused on administrative development, including personal training in transmission and distribution areas and loss reduction. A first agreement was signed covering activities for the period 1992/93–1994/95 (SEK 90 million). The agreement was thereafter extended at two occasions providing an additional SEK 35,5 million until 1996. During this period, Swedpower was the main Swedish firm involved.

2.4.1 Swedish Support during the Period after 1995

Since 1995 the main objective of Sida's support to the energy sector has been to assist EDM create the capacity to plan, operate and maintain its power plants, substations and network. The rationale for the support has been the importance of a developed electricity sector as a basis for economic and productive development of Mozambique. The assistance has therefore focused on EDM's internal training in relevant fields as well as to assist EDM to reduce energy losses in relation to power distribution.

In 1997, a three-year phasing out agreement of the support to the energy sector was signed in line with the country strategy for Mozambique for the period 1996–2001. The agreement covered continued support to the transmission and distribution department, the training centre, and loss reduction projects. The main reason for phasing out the support to the energy sector was to reduce the number of sectors in which Sida was involved. But it was also assumed that by the end of 1999 EDM would have the required skills and capacity to manage the planning, operation and maintenance of its power plants and transmission and distribution facilities. Whatever technical assistance EDM would need in specific areas it was assumed EDM could finance with its own funds (# 20).

Table 1 Sida Agreements from 1995 and Onwards (SEK million)

Agreements	1992/93	1993/945	1994/95	1996	1997	1998	1999	2000	2001
Energy Sector Co-operation 1992/93–1994/95		MSEK 90	MSEK 25 Extension	MSEK 10.5					
Energy Sector Co-operation 1997–1999					MSEK 40			Ext.	
Energy Sector Co-operation 2000–2001								MSEK 8	
Adviser Services EDM (SAPP)						MSEK 3.3			
Rural Electrification Ribáue-Iapala					MSEK 35			Ext.	
Addendum Rural Electrification Memba						MSEK 16			

Despite the decision to phase out, Sida has continued to support the energy sector through various projects. A two-year agreement for advisory services to EDM in relation with SAPP was signed covering the period 1998–1999. Sida has also supported the development of rural electrification in the northern and central parts of Mozambique. A project for support to rural electrification in Ribáue and Iapala in the Nampula province was entered into in 1997. In 1998, an addendum was made to include rural electrification of the Memba district. Currently a consultancy contract for support to the energy sector during 2000–2001 is financed with Contract-financed Technical Cooperation (KTS) funds totalling SEK 8 million. This agreement includes continued technical assistance to EDM, advisory services to EDM in relation with SAPP, as well as continued support for loss reduction projects in Tete and Chimoio. In all, Sida has supported the energy sector with approximately SEK 140 million since 1995.

The justifications for Sida's continued assistance is partly based on the changing situation in the energy sector, and partly changes to Sida's own assistance strategy. Sida's assessment memo notes that the SAPP co-operation poses an increased demand for effective organisation and increased workload of EDM. EDM needs therefore to strengthen its organisation and competence to work in line with set goals for grid operation, economic demand and exchange of energy in order to ultimately optimise the regional production and transmission capacity. The current country strategy for Mozambique underlines the importance to increase the poverty orientation of the development co-operation through support to deprived areas in the northern and central parts of the country. The promotion of a well functioning electricity network is according to Sida assumed to indirectly reduce poverty through increased employment in industry and commerce and also improvement of social services such as hospitals, schools and water supply. Some measure of direct poverty reduction is expected through improvements in electricity supply to the population lacking a secure and efficient energy supply. The investments required for the extensions of the national grid and local distribution networks are beyond what Mozambique and EDM alone can fund, and therefore donor financing is required for this more balanced regional development.

3 Sida-Supported Activities 1995–2000

Technical assistance (TA) to the Mozambique power sector during the period comprises three different areas of support: (i) Technical assistance to transmission and distribution; (ii) EDM centre training activities; (iii) Energy loss reduction. These activities were different in structure and purpose, and since each one was quite important in its own right, they are treated as three different projects below. The loss reduction project is foreseen to continue to 2001.

The fourth project is the extension and continuation of the original TA transmission and distribution project, but where the rationale is Mozambique's participation in SAPP. This is a project that is currently foreseen to continue through 2001. The first rural electrification projects in the Ribáue-Iapala and Memba areas are looked at next.

Early in the period, Sida supported the renovation and extension of the substations in the Beira and Maputo areas. These are looked at briefly, before two projects that were funded over the regional SADC allocation are discussed.

Finally, Sida has signalled that it will support a couple of new activities in the rural electrification area. The first is the extension of the national grid up to the Niassa province, while the other is electrification of the Morrumbala area in the Zambézia province. These are looked at for possible lessons for the future.

3.1 Technical Assistance on Transmission and Distribution

Sida has provided support to EDM in the form of TA to the Transmission and Distribution Department (DER) of EDM for many years. In a review of the Sida and NORAD support in 1995 (#49), one of the major recommendations was that continued support be focussed on activities related to the global objectives for EDM, and that results should be measurable against predetermined targets and time schedules. In the following period, all projects were therefore designed using the Logical Framework Approach (LFA) including LFA-matrices. Annex D provides an overview of these matrices for all the projects, including the reported achievements against planned outputs and objectives.

3.1.1 Project Objectives

The project objectives are presented in Table 2 below. Analysis of the objectives, intervention logic and verifiable indicators show that it is sometimes difficult to assess project achievements from the indicators, since some are very general and depend also on a number of other factors. For instance, the observation that EDM is a commercially viable company, as shown by financial instruments such as balance sheets, etc. depends to a large extent on other factors, e.g. export of power. The deficit in 2000 due to the flooding in southern Mozambique does not imply that EDM has not reached the goal of independent management and planning.

Similarly, the project objective that the Department of Distribution and Transmission (DER) shall supervise all plants and networks is not directly related to the indicator of increased availability of power in Mozambique. Increased availability of power might also be the result of substantial input of expatriate personnel, specific donor projects, etc.

Table 2 LFA Matrix for the Technical Assistance (TA) Support to EDM 1997–1999

	Intervention logic	**Verifiable indicators**
Development objective	EDM shall be able to manage, plan, operate and maintain its transmission plants and networks.	EDM is an economically and viable company.
Project objective	DER shall supervise planning, operation and maintenance of EDM plants and networks, while undergoing transformation into a commercially oriented company.	Increased availability of power within Mozambique
Expected results	**1. Maintenance:** The Maintenance dept. is supervising the maintenance of all transmission (switching) equipment within EDM.	The maintenance of the switching equipment follows DER's Annual Maintenance Work Plan.
	2. Operation/protection The Operation/Protection dep. is supervising EDM's work with protection equipment. Operational management routines are implemented within EDM.	Reduced interruption frequency.
	3. Distribution Planning Guidelines for planning are implemented within EDM. Routines for continuously upgrading and analysing of the distribution networks are implemented.	Distribution planning procedures include economic/viability analysis. Alterations in the networks

3.1.2 Efficiency

The budget for the period after 1995 is shown in Table 3. Before 1997 the TA was based largely on resident advisors. This was changed to visiting advisors during the phasing out of the support to the sector during the years 1997–99. Projects in the first period and in the second period were essentially the same, with the exception that support to telecommunication was terminated.

Table 3 Budget for the Technical Assistance Projects 1995–2001 (SEK Million)

Project	**95–96**	**97–99**	**00–01**
Technical Assistance	41.7	16.7	
Extended TA		3.1	1.3

The efficiency of the support should preferably be gauged against achievement of project objectives. At the end of the 1997–99 project period it is stated that project objectives have been essentially reached in the major areas, i.e. maintenance, protection and operation. This was also confirmed by the project coordinator. The focus of support was therefore changed more to system planning, power economy and management.

It is the opinion of the evaluation team that the change from resident to visiting advisors appears to have increased the efficiency of the support. This was questioned both by Sida and EDM during the seminar in February and such statements by the evaluation team are of course subjective. In this case it is, however, based on descriptions of activities and results as given in relevant project documents and progress reports. Analysis of these documents revealed that several activities were not completed during the early part of the period with resident advisors and had to be continued. In the latter part of the project period they were largely completed and at the same time visiting advisors undertook the work. This indicates increased efficiency per se in the way the term is defined for the purpose of this report. It does, however, not imply that the evaluation team questions the choice of resident advisors during the early part of the project period.

Using the same Swedish consulting company throughout the period without setting the contracts out to bid may have resulted in a relaxed attitude towards cost-effective implementation. It is however difficult to imagine that the trust and confidence between the advisors and the client that was actually built through the projects, would have been possible to achieve with competitive bidding leading to possibly frequent change of people. On the other hand, the repeated delays in designing guidelines and standards, and the apparent lack of implementation, are negative with regard to efficiency.

3.1.3 Effectiveness

In as much as the verifiable indicators are considered, it is probably fair to say that project objectives have been attained:

- There is increased availability of power in Mozambique compared to the situation before the project. This is substantiated by the development of power consumption in general which averaged annual increases of more than 7% during the period. Another indicator is access to electricity. Consistent figures for this exist for 1998 and 1999 and there is a small increase during this period.
- The maintenance work follows the work plan. But while the maintenance schemes are in place, in some areas the resources to implement the maintenance is not forthcoming.
- Planning procedures include viability analysis from 1995 through 1999.

An indicator for operation/protection is according to the LFA matrix "reduced interruption frequency". Consistent figures for the whole transmission network, i.e. 66 kV–275 kV, only exist for 1999. For the period 1995 through 1999/2000 outage statistics are available for the 275 kV network in the south and the 220 kV network from Cahora Bassa to the northern part of the country. Figures for the northern network also exist for the period 1990 through 1995, but they are not reliable. Another important consideration with regard to quality of supply is the duration of the outages for which historical records are not complete.

Outages in the 275kV southern network show an increase in the order of 40% from 1995 to 1999 whereas the result for year 2000 is considerably better, i.e. below 50% of the 1995 level. This is explained by insufficient maintenance during the 1995–1999 period and introduction of earth wires for protection in year 2000.

The outage statistics for the northern grid show a result for 1999 at the same level as for 1995. There were, however, higher levels of outages both in 1997 and particularly in 1998. This is explained by the operation situation in the north where the voltage level at Cahora Bassa had to be increased when power export to Zimbabwe commenced. A consequence of this was an increased number of outages in the northern network due to overvoltages.

The above discussion shows that "reduced interruption frequency" is not a good indicator for the expected results of the TA. One reason is that outage duration also is important in relation with quality of supply. It is obvious that factors outside the influence of the TA also have significant influence on the interruption frequency or outages.

Although all activities have been reported in rather great detail, it is difficult in several areas to quantify achievements since the objectives are rarely quantified. In many cases the activities appear not to have been completed, or their objectives or content changed during the implementation. Hence the effectiveness has not been very high in such cases.

Table 4 Summary of TA Activities and Performance as Stated in Annual Reports

Maintenance	
The expected result of this program was that the Maintenance Department should be supervising the maintenance of all transmission equipment within EDM. That this has been achieved is verifiable through the Annual Maintenance work plan. This plan is followed in as much as documentation and recommendations are concerned. However, with the reduction of the technical assistance, the resources to implement the measures suggest by the plan have eroded. Thus recommendations for maintenance according to plan may be delayed or cancelled due to lack of resources. Internal allocation of funds for this purpose was perceived a serious problem by DER.	
Preparation of guidelines	Partly implemented. Transmission guidelines completed in 1998, short-circuit in 1999. In use in the organization.
Specification for equipment for > 60 kV tension	Completed in May 1998. Currently in use especially in the transmission network.
Training of transformer expert	Project finalisation delayed by one year.
Preparation of work plans	Work stated to be "in progress".
Investigations on transmission equipment	Undertaken "as required".
Creation of Distribution Management Organisation	One training session and one seminar in the first year.
Training course for heavy maintenance team	Objective shifted from day-to day training and into training courses in RSA.
Preparation of interchangeability standards for >60 kV	Only partly implemented. Down-prioritised without clearly stated motive. According to interviews due to lack of funds.
Support from home (Swedpower) office	Support from the home office was carried out during all the years.
Remaining activities from previous period	Documentation of all transformers in the Central region, and gas analysis of remaining transformers. At the end it was noted that little gas analysis was actually carried out, which could result in very costly faults in the future.

Operation/Protection.	
The expected result of this activity was that the Operation/Protection Department should be supervising EDM's work with protection equipment, and that operational management routines should be implemented within EDM. This appears to have been achieved. The verifiable indicator by which to judge this achievement was said to be reduced Interruption frequency which was discussed before.	
Support to EDM in Operation and Protection	No statement whether operation manuals were completed, although project was listed as "finalized"
Collection of data in all regions	Completed to 80% first year, 90% second year. Inconclusive reporting.
Negotiations in SAPP	See section 3.4
Follow up on transmission net	Same objective and achievement was listed for all years. Inconclusive reporting.
Improve the load flow	"Many studies done". Inconclusive reporting.
Improve fault current calculation	Completed 1998
Follow up yearly work	No reporting

Distribution Planning	
The expected output for distribution planning was that guidelines for planning should be implemented within EDM and routines for continuously upgrading and analysing the distribution networks should be implemented. Verifiable indicators would be that planning procedures include economic viability analysis, and that alterations are made in the networks. Reading from the overall objectives, it appears that the initial approach was more reactive than proactive, i.e. that planning should focus on existing infrastructure. In reality it turns out that planning has been much more proactive, including planning for a sizeable number of extension projects. The planning procedure now routinely includes economic viability analysis, which is not to say that priorities are set based upon this criterion exclusively. Instead, the support criteria from various donors have to be taken into account, so that the whole planning exercise is somewhat erratic. Seven activities were initially listed under this program, of which the planning activity itself appears to have been by far the most productive.	
Inventory of medium voltage networks	Slow progress, change of approach. Not completed. due to lack of staff.
Upgrading of medium voltage networks	Objective was to continue upgrading the MV networks applying the Swednet system. This is still not operational in the Northern Region.
Load flow studies and analysis	The report on load flow studies refer to the previous (Swednet) activity in all years
Guidelines	Planning guidelines completed. Quality guidelines shifted to SAPP project
Plans	Focus shifted from planning for existing network to expansion of network.
Training for Planning Department team	Several courses arranged.
Co-operation with city planning unit in Maputo.	No activity first two years. Inconclusive reporting.

Outcomes of the planning activity during years 1997–99 illustrate the shift of focus from planning for the existing network, to plans to extend the network. Two of the projects subsequently funded by Sida and part of this evaluation appear as plans from the planning department in 1997 and 1998. An important note, that is being made year after year, is the continued understaffing at the planning department that puts a heavy workload on the remaining team. Proposals to EDM to employ more personnel have until now apparently gone unheeded.

3.1.4 Impact

The impact of TA project activities on the operation of EDM as a functional commercial utility has been considerable. In general the skills of personnel and the procedures in maintenance, operation and planning have been greatly improved. It is also obvious that the project has contributed to creating an awareness of the importance of proper operation and maintenance and strengthening the positions of these functions within EDM. One aspect of the impact is that personnel trained at the DER have been promoted to important posts outside the department. The downside of this has, obviously, been the loss of the skilled persons at the department.

3.1.5 Relevance

The relevance of technical assistance to distribution/maintenance and operation remains high. The skills focussed on are necessary for any utility in order to be able to operate in a sustainable and cost-efficient way.

A long-running problem of the installation of the Swednet computer planning tool raises a question of the relevance of continuing this exercise over the years (this is discussed further under section 3.3.3). The team is of the opinion that tender specifications and contract obligations for Swednet should have been differently designed, or more closely followed up. This could have reduced or at best avoided this serious situation.

3.1.6 Sustainability

The programmes and activities implemented have been designed to enable EDM to become independent and thus a sustainable firm in terms of being able to handle normal planning, operation and maintenance with its own personnel resources. The long-term presence of Swedpower was undoubtedly important in systematically building this kind of local capacity and thus important for attaining the level of sustainability that EDM has attained.

While the skills situation is such that EDM can be said to have reached the objectives set out, actual performance falls short of desired, as not enough resources are in fact allocated to maintenance and surveys. This lack of maintenance has already resulted in some potentially problematic situations. This, however, is more a management issue and is not caused by lack of competent personnel.

3.1.7 Summary

Technical assistance to the maintenance, operation and planning programmes of EDM have followed and developed further the support provided previously. There has furthermore been considerable flexibility and adaptation to changes, which has resulted in the project in some areas developing beyond the plans. On the other hand, the close relationships may also have caused a certain relaxation with respect to focus on cost-effectiveness in implementation and achievement of objectives.

- The **efficiency** increased during the period as permanent advisers were replaced by visiting experts. Further cost efficiency gains may have been achieved if an element of competition had been introduced into the contracts. This, on the other hand, could have weakened the longer-term impact (see below).
- The **effectiveness** is satisfactory with regard to achievement of project objectives. For some of the activities, however, it is questionable as these were either not completed or changed in the course of implementation.
- The **impact** has been strong as EDM personnel at present in principle are capable of handling normal planning, operation and maintenance of technical facilities. The long-term continuous relationship between EDM and Swedpower produced a high degree of trust to develop that strengthened the long-term impact of the support.
- The **relevance** of the project remains high as it has contributed to developing the technical dimensions of EDM, which is a pre-condition for it becoming a commercially viable company.
- The *technical/organisational* foundation for **sustainability** has been laid through the project, but the *financial* sustainability remains a challenge that senior EDM management has to address more forcefully.

3.2 Training Centre Activities

EDM has always accorded training and human resources development high priority. Over the last years, concerns over labour productivity have become more important. EDM has pursued a three-pronged strategy to improve efficiency of its human resources:

- While EDM down-sized its labour force by about 20% during the 1987–1992 period, during the last five years the employment level has remained constant. But EDM has restructured

internally as staffing levels in the engineering and general technical areas have been reduced in favour of the commercial and management sections.

- EDM has upgraded the average skills level of its staff through recruiting more qualified employees, replacing less skilled with better trained personnel.
- Finally, EDM has improved the quality of its staff through internal training provided by its Training Centre (TC).

3.2.1 Sida Support to EDM's Training Centre

Sida has supported EDM's TC since 1981 with funding for facilities, teachers, didactic materials and running costs for the courses. The contract was with Swedpower, which either used own expertise or sub-contracted other firms depending on the topics to be taught. As of 1987 a Resident Training Advisor (RTA) was permanently based in Maputo.

NORAD also provided training support, but had contracted a Portuguese firm to carry out the actual training. But the co-ordination between the actors was poor. During the early 1990s, this created inefficiencies in terms of the two donors funding largely similar kinds of training, but using different approaches and methodologies. As of mid-1993, an agreement was reached whereby Sida would focus on technical training and NORAD would finance the non-technical courses. A few years later, Norway phased out its support to training altogether.

As of around 1990, teaching responsibilities began being handed over to local trainers. The role of the RTA changed to focus on the "training of trainers" and improve management through courses abroad, study tours and seminars. Sida's support was phased out in 1999.

3.2.2 Project Objectives

In 1994, Results-Based Management (RBM) was introduced, where one long-term objective was defined with a series of immediate project objectives. The subsequent contracts have contained detailed agreements laying out expected results with budgets and annual work plans. For the phasing out period 1997–99, objectives and results were modified somewhat, in line with the diminishing role that Swedpower was to play and the re-orientation of EDM towards becoming a more commercial entity:

Table 5 LFA Matrix for the EDM Training Centre, 1997–1999

	Intervention logic	Verifiable indicators
Development objective	EDM shall be able to manage, plan, operate and maintain its transmission plants and networks.	The official yearly report from EDM
Project objective	EDM shall have the competence to handle its internal training in the fields of generation, transmission and distribution, while undergoing transformation into a commercially oriented company	Degree of fulfilment of the demand specification of the training needs for the three year period presented by the regions and the central functions. All management tasks executed by own staff.
Expected results	1. EDM Training Centre is able to plan, develop, implement and follow-up decided training activities.	Degree of implemented programmes
	2. Concluded training programmes for EDM generation department and power stations' staff facilitate the management, planning, operation and maintenance of EDM's power system.	Eight courses implemented.
	3. An elaborated Gender Policy for EDM.	The Gender Policy Document

3.2.3 Efficiency of Sida Support

The TC has developed a coherent training programme covering core competencies in the fields of electricity and mechanics, plus courses in administration, commercial training, and management. Curricula and training materials have been developed for all courses, and most of them are now taught by local instructors. Both the development of the training program and the contents of the courses have clearly benefited from Sida's support. Expenditures during the period 1 July 1992 through 31 December 1996 was about SEK 25.2 million while the budget for the following three-year phasing out period was SEK 8.5 million.

The efficiency or cost-effectiveness can be looked at from two angles: whether *per trainee*-costs have decreased, or if there were less costly alternatives available to in-house training.

There are no institutions within Mozambique that could have taken on the training in EDM's core skill areas. While the regional training centre in Kafue in Zambia can provide training in certain areas, it does not have the capacity and is not set up to carry out the kind of intensive long-term training that the TC provides. South Africa may have capacity to take on the kinds of numbers that Mozambique would require but politically this was not possible before 1992, and the costs of doing so today would be prohibitive. The language barrier would also make such training inefficient. Just during the last five-year period 1995–1999, almost 2,000 participants have been provided training through a little over 210 courses offered[1].

[1] It should be noted that number of participants is not the same as number of staff who have been trained. In the electricity field, training is provided at four levels, with work periods from six months up to a couple of years between each level. An employee who starts off with basic training will therefore require four to five years to complete all the four levels – and might therefore be registered four times in the table above if s/he took the basic course in 1995 and the highest-level course in 1999.

Table 6: EDM Training Centre, Courses and Participants, 1995–1999

	1995		1996		1997		1998		1999	
	No. (1)	*Part. (2)*	*No. (1)*	*Part. (2)*	*No. (1)*	*Part. (2)*	*No. (1)*	*Part. (2)*	*No. (1)*	*Part. (2)*
Electricity	7	65	21	194	13	126	17	117	21	163
Mechanics	2	12	-	-	2	18	5	11	2	26
Commercial	3	44	3	53	4	65	4	57	10	140
Administrative	3	24	1	13	-	-	2	35	1	20
Management	4	62	2	60	2	31	1	14	1	8
Various other (3)	12	125	23	152	12	140	13	48	26	132
Total	31	332	50	472	33	380	42	282	61	489

(1) Number of courses given
(2) Total number of participants
(3) Includes English language training, information technology, and specialist courses, workshops, training of trainers, etc.

Source: Various EDM Reports

On the TC cost-side, national instructors have replaced the foreign teachers. This has reduced teaching costs per course dramatically. The student:teacher ratio in most courses has remained the same. The course materials are largely similar, and the feed-back from the students does not indicate significant quality difference between the courses offered by national versus expatriate teachers. This means the cost-effectiveness improvements in teaching costs is a net gain to the TC. Training at the first two course levels had been taken over by local instructors by 1995, and by the end of the phasing out period, training at the two highest course levels were also now done by Mozambican instructors.

The efficiency of teaching has also improved through the establishment of the regional training centre in Chimoio, and the more recent training activities in Nampula. EDM needs to train a workforce that is spread throughout the country. The Maputo TC in the extreme south of the country means travel and housing costs are high. The TC does not have its own accommodation, so trainees from outside Maputo must stay in hotels. In 1997, of the TC local budget of 325,400 mill meticais (MMTS), only 39,830 MMTS (12.3%) was for salaries. Lodging took 220,000 MMTS (67.6%) while travel took the remaining 20%. Reducing these non-productive costs is a major challenge to the TC.

Most of the staff who have been trained as instructors remain with EDM. Most of the course instructors work in their own fields and are only brought in when needed to run the courses. This increases the cost-effectiveness of the training, both because there is no "dead-time" for teaching staff, but also because their technical knowledge of what happens in the field is constantly updated.

Could the contract with Swedpower have been less costly? The training contract was never put out to international tender, though the Portuguese firm under the NORAD-contract was less costly than Swedpower. It brought in didactic material written in Portuguese, and the instructors could interact with the students more freely in that language. The downside seems to have been that their pedagogical approach was seen as less modern than Swedpower's. The long continuity of Swedpower was an advantage in terms of the "institutional memory" on the TA being offered. This was strengthened by Swedpower also working with EDM on core activities in the field, thus seeing what kinds of skills were required and changes required over time. The downside was the lack of competitive pressures on Swedpower to improve cost-effectiveness where feasible.

3.2.4 Effectiveness

To what extent did project results contribute to the project reaching its objectives? The handing over of teaching, programming and management responsibilities has been successful, with current management not exhibiting any major concerns. Interviews with management in various parts of EDM revealed satisfaction with the training being provided, particularly in the core areas of power generation, transmission and distribution. The fourth high-level course on project evaluation and finances was run in 1999 so a total of 46 EDM managers have taken the course. The financial director of EDM noted that due to these courses, EDM now carries out financial analyses of all its projects, which it previously did not, and that the general understanding of financial thinking had improved throughout the organisation.

In 1997, Swedpower introduced structured feed-back on the activities. For some activities the instructors were assessing participants' performance and need for further training, but in most courses it was the participants who assessed course contents and the instructors. The feed-back from the participants has on average been very positive, where most felt that the courses were highly relevant for their jobs, and that the course contents and presentation was good or very good. Many of the courses are characterised by laboratory work or practical exercises, and this clearly is assisting in the assimilation of the material.

While Sida support helped EDM get a good *programme* in place in the technical/electricity field, the same cannot be said for non-technical areas. The courses in administration and particularly in management do not support professional upgrading and lay the foundations for career development and promotion in the same way as in the technical fields. This is largely because EDM does not yet have a human resources policy based on a vision of EDM as a service delivery organisation rather than an engineering outfit.

In terms of effectiveness, Sida support has thus been good given the stated objectives. But in a wider perspective this could have been even better if the overall transformations of EDM had been taken as the point of departure when defining the project's own Immediate Objectives.

3.2.5 Impact

The skills composition of EDM's overall labour force has improved dramatically over the last dozen years, as shown in the two tables below. The number of unskilled workers has fallen from more than 1,400 to just under 500, while number of high-level technicians has increased more than seven times. Looking at the 1992 to 1999 period, unskilled and semi-skilled workers have fallen by around 27% while the category of "very skilled" has increased by 80% and "high level technicians" almost tripled. Together, these last two categories now make up about 16% of EDM's workforce compared with only 7.4% seven years earlier.

Table 7: Composition of EDM Workforce, 1992–1999

	1987	1992	1993	1994	1995	1996	1997	1998	1999
Unskilled	1422	711	649	574	570	570	486	507	496
Semi-skilled	1619	1412	1278	1246	1229	1229	1139	1115	1046
Skilled	385	736	646	770	776	779	761	798	862
Very skilled	113	185	206	217	219	219	232	264	333
High-level technicians	17	42	60	82	101	101	110	115	123
Total staff	3556	3086	2839	2889	2895	2895	2728	2799	2860

Source: Various EDM annual reports, #98

This leap in skills levels is as much due to recruitment as internal training. But particularly in the areas of skilled and very skilled workers, internal upgrading of skills has been important. And this qualitative improvement in the skills pool available to the organisation clearly improves EDM's ability to "manage, plan, operate and maintain its plants and networks".

Table 8: Changes to EDM Workforce Composition, 1987-1992-1999

	1987		1992		1999		
	No.	Share	No.	Share	No.	Share	Change, 1992–99
Unskilled	1422	40.0%	711	23.0%	496	17.3%	-13.0%
Semi-skilled	1619	45.5%	1412	45.8%	1046	36.6%	-14.9%
Skilled	385	10.8%	736	23.8%	862	30.1%	11.1%
Very skilled	113	3.2%	185	6.0%	333	11.6%	52.1%
High-level techn'ns	17	0.5%	42	1.4%	123	4.3%	21.8%
Total staff	3556	100%	2895	100%	2860	100%	-7.3%

Source: Various EDM annual reports, #98

The transformation to a more commercial enterprise is still some ways off, however. EDM needs to focus more on productivity and overall cost-effectiveness issues. This would have been reflected in faster down-scaling of staff and more efficient use of internal resources. One Swedpower instructor noted that while they had trained EDM personnel to work in small and more effective line-maintenance groups of three where each person had his own tools, when they were sent back to the field they were put back into 12–15 person work groups with a joint tool kit that EDM has traditionally used. That is, *management* training needs to be developed along with the technical training – the corporate culture is not changing very fast, and mid-level and senior management does not seem to be results-focused enough. Here the lack of a more business-driven partner may have been a factor, since Swedpower's strength clearly has been on the engineering side as well.

The Development Objective is thus still concerned with transmission plants and networks rather than the development of EDM as a competitive supplier of services to client groups. On its own terms, impact seems to be quite good – but the goalposts were perhaps not the best.

3.2.6 Relevance

The *relevance* of the project with regards to both EDM's and Mozambique's priorities remains high. Whether EDM is always focusing on the right issues and is pursuing them in the most cost-effective manner is one thing, but the need for the nation to develop its considerable hydro-potential and make it available to national and international clients is beyond doubt. In order for EDM to become and remain a competitive actor, the need for continuous upgrading and updating of skills is paramount.

3.2.7 Sustainability

The *sustainability* of project results depends on the *financial* sustainability of the TC in order to continue training, and the *organisational* or *skills* basis for the continued training.

On the financial side, the TC is facing problems. Management believes that the current budget is about half of what is required. It does not run the full complement of courses, it cannot buy all the didactic materials needed such as cables for the cabling course. Upgrading of course contents that require changes to the course manuals is a problem. The major challenge is the more advanced

courses where ability to stay abreast of technological developments in the field is important in order for course contents to remain relevant.

On the organisational side, the TC seems well enough equipped in terms of management and course instructors – today. But financial constraints mean that skill levels may deteriorate in comparison with needs over time. The area that is of most concern is business-based management. Corporate culture is still physical/engineering based, and transforming this towards client-oriented service-quality will take time and requires consistent and persistent training. This is an area where resources are a major factor since many of the required skills have to be hired from outside the organisation. While the TC may be good at what it was originally set up to do – answer EDM's needs for technical skills – it may have less capacity to do what it ought to, namely be a facilitator and catalyst in the transformation of EDM. It may therefore end up doing the things right, but not doing the right things!

3.2.8 Summing Up and Findings

Support to EDM's Training Centre must be said to be one of the most successful cases of organisational development in Mozambique. The TC has been enabled to fully develop and consolidate the structure, contents and materials for all its core courses; train national instructors in most of the areas; upgrade and maintain its training facilities; and run the required courses at a standard that seems to correspond to the needs of the organisation.

- The **efficiency** of Sida support has been good when compared with alternative training arrangements and has reduced per-trainee costs over time, though putting the training contracts out to bid could have enhanced the cost-effectiveness further.
- The **effectiveness** has been good with respect to the stated Immediate Objectives, though the objectives themselves do not seem to have been the most adequate given the larger transformations of the sector and EDM that were apparent at the time the phasing-out contract for the 1997–99 period was entered into.
- The **impact** similarly was good measured against the Development Objective – but not against what would be more logical goals for Swedish assistance during the period.
- The **relevance** of the project remains very high both in terms of national and EDM's own goals and objectives.
- The **sustainability** is the weak point, where EDM's willingness and prioritisation of continued TC development requires more internally allocated resources. But donors may consider supporting the TC's activities relevant to the restructuring and transformation of EDM as a more competitive firm. These are extraordinary costs that EDM cannot be expected to be able to fully fund itself.

3.3 Loss Reduction Project

Emphasis was given to the development of transmission facilities in Mozambique's power system during the first years after independence. This was followed by a period with focus on development of the power distribution for which Sida provided both technical assistance and investment in physical equipment. During work with the distribution system it was found that total losses in the EDM network were around 40% before 1995. This is extremely high as power system losses in developed countries normally are around 10%.

Loss reduction therefore became a high priority to EDM. The first loss-reduction project was agreed to between Swedpower and EDM in March 1994. This included an initial assessment of distribution losses as well as selection of Maputo as the first area for specific interventions. Technical assistance and procurement in relation to the areas of Nampula, Nacala and Beira were subject to the Energy Sector Cooperation Agreement of 1977. A special agreement with the purpose of extending the project to Quelimane and also to include Chimoio and Tete was concluded in 1999.

Based on this loss reduction project, EDM developed its *Nova Imagem* ("New Image") programme which is receiving support also from other donors such as KfW.

3.3.1 Sida Support to Loss Reduction in EDM

Following the initial support to loss reduction in the Maputo area, technical assistance and procurement has also been provided to Nampula, Nacala and Beira through the Energy Sector Cooperation Agreement of 1997. A special agreement with the purpose of extending the project to Quelimane, Chimoio and Tete was concluded in 1999 (# 52). The technical assistance has been related to consumer statistics, data collection, technical calculations and assistance of EDM personnel in the field. The procurement has included transport equipment, computers, meters and tools as well as renovation of office facilities.

3.3.2 Objectives

The objective of the initial contract was to determine the *level* and *type* of losses and to propose activities to reduce the losses within the EDM grid. The first assessment revealed that technical losses were approximately 10%, commercial losses approximately 22% and administrative losses approximately 8%.

The objective as expressed in 1995 for the Maputo area was to reduce losses by 14% within four years. The objectives for the period 1997–99 as defined in the Energy Sector co-operation agreement of 1997 are given in Table 9 below.

Table 9 LFA Matrix Loss Reduction Project 1997–1999

	Intervention Logic	Verifiable Indicators
Development objective	EDM shall be able to manage, plan, operate and maintain its transmission plants and networks.	EDM is an economically and viable company.
Project objective	Reducing the energy losses by 3% in Nampula and Nacala (by December 1998) and in Beira (by December 1999).	Monthly statistics from the billing system compared with distributed energy.
Expected results	Reduced losses (within the test areas) due to 1.Non-technical losses: 1.1 energy theft from 9 to 5% 1.2 substandard meters from 5 to 3% 1.3 substandard mounting from 3 to 1% 1.4 meter reading problems from 4 to 2%	
	2. Administrative losses 2.1 administrative losses from 8 to 4%	
	3. Technical losses. 3.1 Established and maintained level of losses.	Actual losses in %
	4. Follow up 4.1 Loss reduction activities in Maputo followed up, knowledge transferred in Nampula and Nacala 1997. 4.2 Loss reduction activities in Nampula, Nacala and Beira 1998–1999 followed up.	
	5. Loss reduction offices constructed and materials produced.	Degree of completion

3.3.3 Efficiency

The support to loss reduction during the period 1995 through 1999 was SEK 22.3 million while the allocation for year 2000 is SEK 1.05 million. The resulting total allocation becomes consequently SEK 23.35 million.

Statistics for losses and sales in the EDM grid are shown in the subsequent paragraph. These indicate that total distribution losses in the EDM network in 1999 was 289 GWh corresponding to 24% of the supply. If the losses had remained at 43%, the level in 1995, this would have been 518 GWh. The difference of 228 GWh can be considered as the benefit of the project. Given the average sales price of 886 MZM/kWh in 1999 these gains correspond to USD 12 million or SEK 120 million. The direct benefits during only one year are thus equivalent to five times the project cost over the six year period.

The effect on the EDM's financial performance is thus outstanding. There are, however, some comments on the procurement for the project that are worth mentioning:

- Sida funds included procurement of a Swednet software package intended for filing purposes and calculations and design of future expansions of distribution networks. This had hardly been working at all in Nampula and Nacala. The contractor should normally be supervised by the consultant or client in this case to fulfil the contractual obligations.
- Motorbikes were procured for use in Nampula and Nacala for the fieldwork. Because non-standard bikes had been purchased, none of them worked due to lack of spare parts at the time of the visit of the evaluation team.

- The specifications on a considerable number of the meters were not appropriate for domestic consumers who normally have small loads. These meters have, however, been transferred to other districts in EDM and used for larger consumers there.

3.3.4 Effectiveness

The objectives of the initial contract were to determine the level and types of losses and propose activities to reduce them. The first assessment was concluded in 1995 and provided the basis for concrete actions. Work then commenced in the Maputo area to reduce losses there.

After this initial assessment all further objectives refer to reduction of losses in specific geographic areas. Statistics on losses for the areas where loss reduction activities were supported by Sida are shown in Table 10 below.

Table 10 Distribution in the EDM Power Grid (% of power supplied)

	Maputo			Beira			Nampula			Nacala			Quelimane			Total EDM Grid		
Year	*NT*	*A*	*T*	*NT*	*A*	*T*	*NT*	*A*	*T*	*NT*	*A*	*T*	*NT*	*A*	*T*	*NT*	*A*	*T*
1995	**24**	**20**	**44**	**15**	**12**	**27**							**32**	**16**	**48**	**21**	**20**	**41**
1996	**28**	**8**	**36**	**25**	**4**	**29**							**32**	**9**	**41**	**25**	**9**	**34**
1997	**18**	**4**	**23**	**25**	**6**	**31**	**26**	**22**	**48**	**23**	**10**	**33**	**27**	**8**	**35**	**19**	**7**	**26**
1998	**12**	**8**	**20**	**21**	**4**	**25**	**27**	**16**	**43**	**22**	**15**	**37**	**23**	**9**	**32**	**15**	**8**	**23**
1999	**10**	**9**	**19**	**26**	**4**	**30**	**27**	**8**	**35**	**13**	**11**	**24**	**20**	**8**	**28**	**14**	**8**	**22**

- ***"NT"*** *represents technical and non-technical losses as percentages of total energy distributed in the respective areas.*
- ***"A"*** *represents administrative losses, i. e. the difference between the value of the energy invoiced and the energy actually paid for. Another term for this is "collection rate". In the EDM statistics these percentages are based on values invoiced, i. e. in terms of money. In this table the corresponding percentages are related to energy and the figures are therefore different.*
- ***"T"*** *represents total losses in the distribution network excluding public lighting.*
- *The data basis in Nampula and Nacala prior to 1997 is weak, but losses are assumed to be in the order of 40 to 50%.*

The objective as expressed in 1995 for the Maputo areas was to reduce losses with 14% within four years. This was easily achieved as the losses in Maputo were reduced from 44% in 1995 to 19% in 1999. The objective as expressed in 1997 for Nampula and Nacala was to reduce losses with 3% by December 1998. In Nampula losses were reduced from 48% in 1997 to 43% in 1998 while in Nacala losses increased from 33% to 37% , which are still very high. By 1999, however, figures both for Nampula and Nacala show reductions of losses of more than 10% from year 1997 to 1999. This indicates that a reduction of losses by 14%, for which a definitive time has not been given, may be reached within one or two years from now. There are ongoing activities in this area which make this assumption realistic (see also 3.3.7).

The objective of reducing losses in Beira with 3% in 1999 was not achieved since there was a reduction from 1997 to 1998 of 6% but an increase from 1998 to 1999. Quelimane, however, achieved the target as the reduction from 1998 to 1999 was 4%.

3.3.5 Impact

The project has contributed to major impacts in a number of important areas: losses have been substantially reduced, the physical condition of the distribution networks has improved, the

approach and attitude of EDM's personnel has changed as reflected in the *Nova Imagem* project, and this has had as end result that the service to subscribers and the public in general has improved.

With regard to the distribution networks isolated conductors are being used to avoid illegal connections or theft of electricity. Prepayment meters have been introduced to improve the collection rate and reduce administrative losses. Further extensions of distribution networks are being planned with more emphasis on project economy which will result in reduction also of technical losses.

The commercial staff in EDM is being strengthened both in numbers and training, new electricians have been recruited to create teams for disconnecting illegal consumers and consumers with debts. The Mozambican Parliament recently approved a law that permits arresting illegal consumers. EDM personnel now work with the police during inspections at nights and weekends. EDM personnel is now giving priority to customers and serving these efficiently. A new attitude towards the economic value of electricity is consequently developing also among the public in general.

3.3.6 Relevance

The relevance of this project with regards to EDM's priorities remains extremely high. The project is critical for turning EDM into a customer oriented service institution that is commercially viable and looks for technically and financially superior solutions. It is becoming even more important for EDM to become an efficient actor, both within Mozambique but also in the context of the power sector in southern Africa, as this will become increasingly competitive in the future.

3.3.7 Sustainability

The support from Sida in the early phases of the project formed the basis for the EDM *Nova Imagem* programme, which contains the elements noted above: strengthening the commercial department; the establishment of special teams that work with the authorities to eliminate fraud and theft; installation of pre-payment meters; rehabilitation of low-voltage networks. Together, these steps have made critical contributions to making EDM as a firm and the *Nova Imagem* programme itself sustainable in all senses of the term. For these reasons, the project must be seen to be a major success. More can, however, be done. The loss figures for Maputo has levelled off at around 20% while the remain considerably higher in other parts of the country. Observers have noted that EDM's performance contract with the Government is in fact quite lax and that much more ambitious targets could and ought to have been set. Getting distribution losses down to 10% ought ultimately to be an achievable goal.

3.3.8 Summing Up and Findings

The loss reduction project is a highly successful project. The support from Sida has included both technical assistance and procurement.

- The **efficiency** of the support from Sida has been outstanding. EDM statistics show that distribution losses in 1999 was 24% compared to over 40% in 1995 when the project started. The resulting benefit in 1999 alone was on the order of SEK 120 million, representing five times total project costs.
- The **effectiveness** is also good with respect to the stated project objectives. It should, however, also be kept in mind that these first improvements are compared with a level which was very poor.

- The **impact** is certainly positive both with regard to the physical conditions of the distribution networks, the approach and attitude of EDM's personnel as well as the results for subscribers and the public in general.
- The **relevance** of the project with regards to EDM's priorities remains high as it is key to transforming EDM into a commercially viable company.
- The **sustainability** of the project also appears very good , both in technical/organisational and financial terms. The reason is that the support from Sida in the early phases of the project formed the basis for EDM's *Nova Imagem* programme, which is now established as a part of EDM' normal operation. This has resulted in a new approach to the handling of commercial matters.

3.4 Advisory Services, SAPP

International co-operation in the power sector is becoming increasingly important both in industrialised and in developing countries. Co-operation in the energy sector within the Southern Africa Development Community (SADC) began in the early 1980s. This has gradually developed and now the Southern African Power Pool (SAPP) has been established. The South African power company ESKOM, which is one of the largest power utilities in the world, has an important role in SAPP due to the size of its power grid and the economy of RSA.

SAPP is not a power pool with free trading of power in the way NordPool operates in Scandinavia, but is at present more an organisation to assist the co-operation in the power sector in the region. Mozambique has at present power interconnections with RSA, Zimbabwe and Swaziland and international co-operation in the power sector will become more important in the future (a list of contract agreements and other documents presently handled by the Planning Department (DIPLA) in EDM is given in Appendix F).

To strengthen EDM's capacity and capability in relation to international co-operation, Sida supported activities specifically for this purpose started in 1998. In this report the project is referred to as the "SAPP project".

3.4.1 Sida Support to the SAPP Project

The activities envisaged for the years 1998 and 1999 are described in the project document "Advisory Services, EDM, Special Purpose for System Planning and Operation, Interconnected Grids (SAPP)" (#13). The activities for the years 2000 and 2001 are described in the Energy Sector Cooperation 2000–2001 agreement (#52). The project document included services of three experts from Swedpower: a planning engineer, a power economist, and a power system operation specialist. A total of 1.5 man-years evenly distributed among these three experts was to be used on visits to Mozambique. All three experts undertook visits during 1999 and this also continued in year 2000.

3.4.2 Objectives

The objectives as described in the project document for the period of 1998 and 1999 are given in Table 11 below.

Table 11 LFA Matrix of Advisory Services SAPP

	Intervention logic	Verifiable indicators
Develop't objective	To improve the reliability and quality of supply to the entire EDM grid. Further more, it is required to improve the system reliability and operation in the regional grid under the SAPP. EDM's institution shall be capable in terms of staff and capacity to fulfil requirements of the SAPP for system planning and operation of the existing and future interconnected grids.	Increased power supply reliability and quality will promote GDP Growth. Reduced costs for system operation and increased sales due to less interruptions.
Project objective and expected results	1.Consulting services to provide qualified advisers for training and guidance to EDM staff to create and build the planned new System Planning section and Operation depart't. Establish routines within Economic and Financial Depart's for economic and financial evaluation of project proposals. Establish routines within Commercial Department for Load Demand, Forecasting, Tariff constructions and Power Purchase Agreements. Build a section for Transmission and Generation System Planning and train a section head responsible for the section Build a section for Operation and train a section head. Plan for and set the criteria for a new national Control Centre.	

The development and project objectives in the LFA Matrix for the years 2000–2001 do not specify matters related to international co-operation or SAPP directly. With regard to expected results it is, however, stated that the Corporate Planning Department (DIPLA) shall attain improved capability to handle contractual matters related to purchase/supply of electricity. Furthermore, EDM's Southern Region shall have improved capability to operate the south grid for optimal performance. This includes the creation of a new Operation Department and initiation of new Control Centre facilities with resultant reduced interruption frequency.

3.4.3 Efficiency

The cost for the first three years was SEK 3.3 million from Sida and MZM 92 million from EDM. For the subsequent period 2000–2001 the budget is SEK 2.2 million.

DIPLA is involved in negotiations and discussions on several contracts related to power sales and sector co-operation. EDM notes that the technical assistance from Swedpower during such negotiations had resulted in better contract conditions for EDM and the evaluation team received a report from EDM with more specific information in this regard after the seminar in Maputo. Details will not be referred here as the information is confidential. Indications of benefits from EDM were, however, provided both in relation with the MOTRACO Agreements and with regard to sales of excess power from Cahora Bassa to utilities in neighbouring countries. These benefits result from contract negotiations with other utilities and organizations and the TA is considered important in this process.

The evaluation team is of the opinion that the principle of short-term technical assistance as it is being applied in this case is appropriate, especially if experience from NordPool or previous Nordel co-operation is used. The efficiency might have been even better if international co-operation was given higher priority as compared to operation of the national network *per se*.

3.4.4 Effectiveness

The development objective basically comprises two purposes:

- Improvement of reliability and quality of supply of the national EDM grid.
- Improvement of system reliability and operation in the regional context under SAPP.

The first of these purposes could be considered a continuation of the technical assistance that has previously been undertaken in relation to the national EDM grid, but with this project is more focused on operation. The second purpose is more related to international co-operation and SAPP. The project objectives and expected results are, however, more related to the national grid. It is obvious that a proper functioning of a national grid is a prerequisite also for international exchange and trade of power. However, if the development objective is facilitating EDM's co-operation within SAPP, this should have been more emphasised in the project design.

The verifiable indicators are defined as "increased power supply reliability and quality will promote GDP growth" and "Reduced costs for system operation and increased sales due to less interruptions". The indicators considered for this evaluation could be outage statistics in the main grid, and GDP in Mozambique. The limitations with regard to use of interruption frequency or outages as an indicator were discussed in Paragraph 3.1.3 and are relevant also for this project for the same reasons. With regard to GDP, the link between improved power supply and growth in the national economy is obvious, but also trivial. The *marginal* contribution of the project is impossible to ascertain as no better specified link was given. Power consumption and production has continuously increased during recent years, so given the existing indicators this objective is considered achieved.

With regard to the project objectives and expected results, activities have in principle been undertaken as planned and properly reported in the progress reports. These are in general satisfactory, but activities related to the "south grid operation" were not found at this point in time and should be more emphasised in the near future. One constraint to successful project implementation has been lack of relevant EDM personnel on some occasions.

It is worth mentioning that only a limited number of the project objectives and expected results are related to the SAPP co-operation per se and thereby the second purpose of the development objective.

3.4.5 Impact

The beneficiaries of this SAPP project should be all existing and future infrastructures connected to the EDM grid including co-operating utilities through grid interconnections. This impact is at present limited due to the comparatively short period of time since the project started.

The impact on EDM's key personnel in the areas of planning, operation and legal and contractual matters seems positive given the activities undertaken. But so far these have been limited to meetings within the SAPP co-operation and also to internal work in EDM regarding demand forecasting, load flow studies, tariffs studies, feasibility studies, etc.

The benefits indicated for certain agreements between EDM and neighbouring utilities indicate a positive impact on the commercial operation of EDM, which is of high importance.

3.4.6 Relevance

The relevance of this project remains high due to the general co-operation within SAPP, the present power interconnections with RSA, Zimbabwe and Swaziland and the increase in the importance of the regional market to Mozambique's power sector for the exploitation of hydro-thermal complementarities, mutual assistance in case of disturbances and maintenance, reduced requirements for reserve capacity, economies of scale in new generation capacity, etc.

The fact that the most important hydropower plant in southern Africa, Cahora Bassa, is located in Mozambique should also be considered. Other vast hydropower resources in Mozambique, with considerable potential for power export, may also be developed in the near future, and knowledge of international co-operation will be of high importance in this regard.

3.4.7 Sustainability

The sustainability of this project is more difficult to evaluate for this project than for the previous TA support. The reason is that it is different both with regard to volume and nature. The volume is considerably less and includes only three foreign experts mainly as short-term visitors. The character of the services is also different as this project primarily is focused on co-operation and advice related to planning, operation and legal issues at a very high level. For these reasons sustainability will most likely be lower than for the previous TA support.

It is important to keep in mind that power utilities in industrialised countries also use external expertise for specific tasks such as in this project: complicated legal and commercial matters related to development of international generation projects and power interconnections and trade. This project should therefore be considered successful if EDM after project completion is able to handle normal operation and international co-operation with its own resources and then is able to properly decide for which purposes external assistance is required. The ability to manage such assistance is also of high importance. The constraint with regard to the availability of EDM personnel needs to be addressed during the remaining project period.

3.4.8 Summing Up and Findings

International co-operation in the power sector is becoming increasingly important both in industrialised and in developing countries. Strengthening EDM's capacity and capability within the SAPP is important for the company's future.

- The **efficiency** of this project is satisfactory. Total project costs are limited to about SEK 5.5 million for the five-year period 1998 through 2001 and figures provided by EDM, related to specific contracts, indicate significant benefits.
- The **effectiveness** with regard to project objectives and expected results are in general satisfactory. One constraint has been availability of EDM personnel. It is, however, the opinion of the evaluation team that the project objectives should have been more focused on international cooperation and less on the operation of the EDM grid even if it a proper functioning of a national grid is a prerequisite also for international trade of power.
- The **impact** on EDM's key personnel in the areas of planning, operation and legal and contractual matters is positive in those areas where activities are undertaken. Another positive effect is the improved commercial operation of EDM.
- The **relevance** of this project is high and will increase as regional power co-operation develops in the future.
- The **sustainability** of this project may be lower than for the previous TA, but should be attainable in terms of EDM being able to handle normal operation and international co-operation, and on its own can decide for which purposes external assistance is required.

3.5 Rural Electrification Ribáue-Iapala and Memba district

Sweden has supported rural electrification in the Ribáue--Iapala and Memba districts in Nampula Province in northern Mozambique. Both projects comprise the construction of 33 kV overhead lines, distribution transformers, low voltage distribution networks and meters for connection of consumers.

The first line stretches from Nampula city through the villages of Rapale, Mutivasee, Namina, Naminconha to Ribáue and Iapala. The Ribáue district has an estimated population of 126,000 inhabitants. The construction of the Ribáue-Iapala line started early 1999 and the first consumers were connected in March 2000.

The second line stretches from Nacala to Memba through a village called "Seventh of April" where there is a connection to Geba. The population of Memba is 50,000 and that of "Seventh of April" 7,000. The construction of the line to Memba started in 1999 and was completed in June 2000.

A turn-key contract for the construction of the project was given to the Swedish company Transelectric on the basis of competitive bidding in Sweden. Transelectric subcontracted a part of their work to a South-African contractor. EDM was responsible for land acquisition and connection of consumers. Internal house installations is the responsibility of the consumers and are being controlled by EDM prior to connection.

Project documents for the two project were prepared by EDM in August 1997 for the Ribáue-Iapala area (#54) and in April 1998 for the Memba area (#74) Ribáue

3.5.1 Project Objectives

The development objective of the rural electrification projects Ribáue is to promote overall economic development in the region. Electricity is expected to support the growth of local industries, promote local trade and employment opportunities as well as social welfare for the population in the area through electrification of health and educational facilities. An important reason for Sida's support to rural electrification is its expected impact on poverty reduction in line with the current country strategy for Mozambique. In the long term, the project is expected to make a positive contribution to EDM's commercial operation. The construction of the distribution network is further assumed to have a positive environmental impact by replacing diesel-operated facilities such as generators, mills and pumps by hydropower based electricity. Positive gender impact may be expected due to improved adult education and household facilities. Women are assumed to spend less time on collecting water and fuel.

The project objective of the Ribáue-Iapala project is to promote infrastructure development through the implementation of rural electrification allowing approximately 1,000 domestic, five medium and 20 small industrial and a number of commercial consumers to be connected to the existing EDM grid. The objective of the Memba project is to connect approximately 300 domestic and 25 industrial and public consumers in the Memba district.

Table 12: LFA Matrix Rural Electrification Ribáue-Iapala Areas and Memba District 1997–1999

	Intervention logic	Verifiable indicators
Develop't objective	Overall macroeconomic development in the proposed areas through growth of local industries and creation of employment opportunities as well as social and environmental development.	Increased regional GDP growth. Number of new industrial and social amenities. Increased agricultural production, processing and marketing facilities. Extended time available for work, teaching and adult education.
Project objective	Ribáue-Iapala: 1000 domestic, 5 medium, and 20 small industrial and a number of commercial consumers to be connected to EDM existing grid fed from Cahora Bassa. Memba district: 300 new domestic, 2 medium and 5 small industrial and a number of commercial consumers to be connected to EDM existing grid fed from Cahora Bassa.	Numbers of new consumers. Energy sales and maximum demand. EDM financial results.
Expected results	Ribaue-Iapala:1. Construction of 160 km 33 kV OH system from Nampula 33/11 kV sub-station to Ribáue and Iapala. 2.Construction of distribution transfer centres. 3.Construction of 46 km low voltage grid. Memba district: 1.Construction of a 33 kV OH system from Nacala a Velha existing 33 kV grid to Memba and Geba. 2.The construction of a number of distribution transformer centres. 3.Construction of a low voltage grid.	Km of installed 33 kV lines. Km of installed low voltage lines. Installed distribution transformer capacity. The final date of the project i.e. commissioning and hand over of the project.

Source: EDM Project documents

3.5.2 Efficiency

Sida's support was SEK 35 million for the Ribáue-Iapala project and SEK 16 million for the Memba project. There were delays of about half a year for the main distribution lines, commented on later. No severe cost overruns occurred.

There are two matters to be discussed in relation to cost-effectiveness. The first is whether grid extension is the appropriate or relevant way of supply compared to other alternatives, which is discussed in section 3.5.5. The next question is if the project based on grid extension has been implemented in a cost-effective way. This is basically the case as the project has been subject to competitive bidding in Sweden. There would certainly have been a possibility for further cost savings if the project had been subject to international competitive bidding. The reason for this is that South African contractors are considered competitive for such projects.

There was one change compared with the assumptions in the project document. This relates to the use of local resources. The construction of the distribution lines was of a technically complicated nature, which would require international tendering for the projects. EDM hence suggested that a Consultant with long experience of similar work in Mozambique should prepare tender documents for the project. It was believed that this would create a possibility for local contractors to participate in the competition. The evaluation team does not share the opinion that the project was technically complicated. The project components are "proven technology" and EDM is well acquainted with all components comprising the project.

The Swedish turnkey contractor subcontracted a South-African contractor for parts of the work. Local labour was only used to a very limited extent. The team was informed that the financial capability and other contractual formalities prevented the use of local contractors. Considerations regarding efficiency and time may justify a turnkey type of contract, but it should definitely have been possible to use local resources to a higher extent even if this might have required more co-ordination work from EDM or the consultant.

3.5.3 Effectiveness

The work on the Ribáue-Iapala line started early 1999 with a planned completion by the end of that year. A delay of about half a year occurred because of custom problems in connection with import of the equipment, the breakdown of a machine for erection of poles, and transport problems during the rainy seasons.

A part of the 33 kV line – a T-off from the rural centre in "Seventh of April" to Geba – had not been commissioned by early December 2000. This was due to technical problems with voltage transformers and the destruction by floods of a part of the line with a length of approximately 300 m. This is the obligation of the turnkey contractor to complete and should be corrected as soon as possible.

Apart from these incidents, the construction of the distribution lines, the transformers and low voltage networks has been satisfactory and completed according to plans.

Until the end of November 2000, 314 consumers had been connected along the line between Nampula and Iapala, i.e. one third of the expected total so far. The consumers are divided as follows with regard to geographical area and consumer's category:

Table 13: Distribution of Consumers Connected to the Ribáue-Iapala Project

Clients\Village	Natikiri	Rapale	Namina	Naminconha	Ribáue	Iapala	Total
Domestic	4	13	42	11	124	49	**243**
Commercial	1	2	11	14	11	8	**47**
Public Admin		6			10	2	**18**
Health Clinics		1			1	1	**3**
Schools.		1			1		**2**
Church					1		**1**
Total	**5**	**23**	**53**	**25**	**148**	**60**	**314**

The largest number of connected consumers along the Ribáue-Iapala line is domestic. Still only about 25% of the expected number of households have been connected. The connected commercial industries include a cotton factory in Ribáue, an agricultural farm in Natikiri, a cement block factory in Rapale, four maize mills in Rapale, Namina and Naminconha, two restaurants in Natikiri and one in Ribáue. In addition, a number of small-scale business activities such as local stores, bars, small cinemas, etc. have been connected. So far two schools have been connected, in Rapale and Ribáue, and three health clinics in Iapala, Ribáue and Rapale. Twelve public administration buildings, including administration offices, police stations, etc., have also been connected. The number of connections at this point in time is considered satisfactory by the evaluation team given the experiences from similar projects.

As of November 2000 a total of 82 consumers had been connected on the Memba line, representing approximately 25% of the expected total number of consumers. The consumers are divided as follows:

Table 14: Distribution of Consumers Connected to the Memba Project

Clients \ Village	Memba	Seventh of April	Geba	Total
Domestic	55	7	-	**62**
Commercial	12	5	-	**17**
Schools	1			**1**
Hospital	1			**1**
Public Admin	2			**2**
Total	**71**	**12**	**0**	**83**

In Memba a primary school and a hospital together with a police station and district administration office have been connected. In addition a few smaller shops had been electrified. In "Seventh of April" there is one school that so far had not been connected.

No consumers have so far been connected in Geba. The most important consumer in Geba is a cashew nut, salt and sisal factory employing about 1,000 people. It is important that the connection of the factory in Memba is completed in the near future, as the main reason for extending the distribution line to Geba was its supply. The factory is currently supplied by a diesel generator and has a peak load of about 300 kW.

It should be noted that an important district hospital along the road between Nacala and Memba, located only 10 km from the main road, was not included in the project. The hospital, which contains a maternity ward, is important servicing a total of 100,000 people in the area. A technical boarding school with 200 students situated in the same area was also not included in the project. The evaluation team regards this as serious and emphasises the importance of proper feasibility studies of rural electrification projects prior to project implementation.

3.5.4 Impact

It is too early to assess the impact of the project. The evaluation team did visit Natikiri, Rapale and Namina to obtain a first indication of the effect of the rural electrification project both for private, commercial and administrative consumers.

Economic activity: The improved supply of electricity has increased commercial activities in all places. Some of the visited local industries had been established before and were previously supplied by diesel generators. The availability of reliable electricity seemed, however, to have increased the willingness and possibility to expand economic activities. An agricultural farm in Natikiri had recently been connected. This farm produces agricultural products and breeds cattle and employs around 100 people. The electrification allowed it to expand its activities and also include the establishment of a restaurant. In Rapale a quarry and cement block factory employing about 20 people has recently been connected. The owner had recently moved wood working equipment from his premises in Nampula and had plans to expand the business considerably in the future. Several small-scale businesses, including local shops, bars and several cinemas, had been connected in Namina and Rapale. The bars and shops were able to keep longer opening hours and also diversify their products with the use of refrigerators after electrification. New maize mills had been established in Rapale and in Namina as a result of the electrification. The customers, mostly women, had previously ground the maize manually.

Social services: Three hospitals and two schools had been connected at the time of the field visit. The evaluation team visited the newly connected missionary hospital in Rapale, which accommodates about 1,000 patients a month. This was previously supplied by a diesel generator. Benefits of the electrification included better preservation of vaccines, as these were previously kept in Nampula,

the possibility to sterilise medical equipment as well as improved lighting in the maternity ward. It was indicated that the number of births at the hospital has increased from 50 to 70 per month as a result of the electrification. It was understood that funds for purchase of equipment that now could be applied as a result of the electrification was considered as a constraint. The public school and health clinic in Namina had so far not been connected due to lack of local government funds.

Improved standard of living: If the total number of people in the Ribáue district is considered, about 5% of the population in the area is expected to benefit directly from the electrification project. The number of domestic connections is limited due to the relatively high costs for installation and connection. The households visited mainly used the electricity for lighting, which had improved the possibility to read at night and also provided increased security. None of the households used the electricity for any purpose other than lighting. It is questionable if the electrification will yield the expected benefit of use of electricity for cooking and other electrical appliances at least in the short run. The expected environmental benefit of switching to modern sources of energy and relieving the workload of women for collection of wood is effectively non-existent.

3.5.5 Relevance

The need for investments in infrastructure in the Nampula province is evident. The province was destroyed during the war and investments in the region have been marginal during the 1990s. EDM and the Government of Mozambique have expressed their intentions and desires for donors to invest in electrification projects in the area.

A socio-economic study related to the Ribáue-Iapala rural electrification project was carried out by a Swedish consultant prior to the project. The study showed that several positive economic and social benefits could be expected from the electrification of the area. As mentioned in the previous paragraph there are indications of such benefits, but a more comprehensive study has to be made at a later point in time to fully evaluate this impact. No comparative study with regard to poverty reduction was, however, done.

An important consideration is whether grid extension is the appropriate or most relevant supply. Alternatives could be small-scale hydro schemes or diesel generators. Solar energy is not compatible with the peak loads required and this is also the case with regard to wind energy due to reliability of supply. The project documents do not discuss alternatives to grid extensions, but in Nampula there are to our knowledge no suitable sites for small-scale hydropower schemes. The only alternative is therefore increased supply by diesel generators. Supply of diesel and spare parts is a serious constraint in these areas, and the environmental impact is negative. Another consideration is foreign exchange required for import of diesel compared to indigenous hydropower generation, which is the basis for the grid extension. The conclusion is therefore that extension from the national grid is the correct solution even if this is not properly described and substantiated in the project documents.

3.5.6 Sustainability

Project sustainability in the short run is judged to be satisfactory as EDM management believes the projects will generate an operating surplus. The connection rate of consumers is promising at this point in time just a few months after commissioning of the main distribution lines and new consumers are expected to be continuously connected in the near future. EDM were also in the process of organising local representations at all rural centres for the purpose of administration of commercial matters related to new and existing consumers. The issue remains whether EDM will earn enough to get a decent return on capital. With the current load this does not seem likely but if

there is a continuous increase in the number of subscribers above what is currently foreseen, this picture may change, though this may take several years.

With regard to technical operation and maintenance of the project components, well known technology has been used and EDM can at present maintain and construct new 33 kV lines with their own personnel. Routines for control of house installations also seemed to have been satisfactorily established. The tariff structure, however, is seen as complicated for people in the area. The division between commercial and domestic tariffs also appears to be somewhat artificial, particularly examples observed during the field visit pointed to combinations of domestic and commercial uses. A simplification of the tariff structure for rural areas might perhaps improve rural people's understanding of these matters, their willingness to pay and thereby also project sustainability.

3.5.7 Summing up and Findings

Sweden has supported rural electrification in the Ribáue-Iapala areas and Memba district of the Nampula Province in northern Mozambique with a little over SEK 50 million during the 1998–2000 period. Ribáue

- The **efficiency** is considered reasonable as project implementation has been subject to competitive bidding in Sweden and no severe cost overruns occurred. This might even have been better if international competitive bidding had been used.
- The **effectiveness** of the project is satisfactory on the basis of implementation time and number of consumers connected approximately half a year after commissioning.
- The **impact** of the is too early to assess. It was, however, found that the improved supply of electricity has increased commercial activities. The main benefits of the electrification for a hospital visited included better preservation of vaccines and improved lightning in the maternity ward. About 5% of the population in the Ribáué area is expected to benefit directly from the electrification and the households visited only used the electricity for lighting. The expected environmental benefit of switching to modern sources of energy and relief of workload of women for collection of wood was non-existent.
- With regard to **relevance** the need for investments in infrastructure in the Nampula province is evident. Experience from the Memba project indicates the necessity of proper feasibility studies prior to project implementation.
- The **sustainability** of the project is satisfactory but merits close monitoring over time. The progress with regard to connection of new consumers and EDM' ability to maintain and operate the project is good, but while the projects are likely to generate an operating surplus the problem is if increases in consumers will earn EDM a proper return on capital.

3.6 Renovation and Extensions of Substations

Sida funded the renovation of Beira substation and an extension of Maputo substations SE4 and SE6. Both projects were undertaken prior to 1995.

3.6.1 Renovation of Beira Substation

The renovation of the Beira substation was a turnkey project where delivery of new switch gears for 22 and 6,6 kV levels, new control plant, replacement of 110kV apparatus and civil works were

undertaken. The objective of the project was to improve the reliability of power supply to Beira. The substation is the sole supplier of power to Beira town and for the harbour the improvement of reliable power was highly prioritised. Prior to the project the substation was in bad condition due to age and poor maintenance.

A contract between EDM and Swedpower was signed in May 1993 to make Swedpower supervise the project. ABB was selected as a contractor and was assigned one year later to carry out the turn-key contract. The completion of the project was set to 25 June 1995.

The project budget included consulting services worth SEK 1.4 million and the turn-key installation worth SEK 16.6 million. The project has been carried out according to the budget. The contractor commenced operation in Beira early 1995, and a taking-over certificate was issued in mid 1995.

Due to weaknesses in the house construction some additional civil works had to be done to strengthen the floor. There were some difficulties with settling the delivery of spares to the installation, and this was only settled in March 1996. There were also difficulties in obtaining the as-built documentation from the contractor. The delay was in the range of one year.

The load is steadily increasing in the town and the surrounding areas. The substation is operational, though one of the three transformers is not in operation. This transformer is planned to be replaced in January 2001 (#119).

3.6.2 Extension of Maputo Substations

The substations SE4 and SE6 are located in Maputo and are fed from the Maputo power station. During the period 1990–95 Sida had been financing the design and construction of SE6 and the modernisation of SE4. The line between the power station and the substations was constructed by EDM in 1992 and designed for 66kV. After installation of new 66kV switch-gear in the power station, the substations subsequently had to be upgraded.

The objective of the project was to enable the substations SE4 and SE6 to operate on 66kV by installation of 66kV switch-gears in both substations. The project is from a contractual point of view a second addendum to the original contract between Swedpower and EDM. The purpose of the original contract was finalising of SE6 and was signed in January 1993, the second addendum was signed in June 1995 (#98)[2].

The extension of the two substations started in July 1995. ABB had been the contractor in the original project, and as the tender was an addendum, ABB was the only company invited for tendering[3]. A contract was signed with ABB in December 1995 and the completion date was set to December 1996. Swedpower issued a taking-over certificate in December 1996.

The two substations are both in operation and the 66 kV switch-gear is used. The thermal power plant in Maputo was shut down at the end of the 1990s, and the substations are now fed by the 66 kV line from Infulene (#119). Both projects have therefore attained their objectives largely on time, within budget, and are delivering the key services as foreseen.

[2] The total budget for the project "Finalising Substation SE6" including both addenda was SEK 15 795 000.
[3] In the Plan of operation for the period 95/96 (#61) it is stated that from experience it is unlikely that other contractors than the original will be interested to submit offers to a tender such as the one considered here.

3.7 Regional Projects

Sida funded two projects over the regional SADC allocation during the 1995–1999 period. One was a co-financing of the interconnection line between Cahora Bassa and Zimbabwe. The other was a feasibility study on a similar interconnection from Tete to Malawi.

3.7.1 Cahora Bassa-Zimbabwe Interconnection

90% of the approximately 2,000 MW produced by the Cahora Bassa hydropower station has been contracted to South Africa's power company ESKOM. ESKOM did not need all the power and was willing to release 500 MW till the year 2003. A feasibility study showed that an interconnection with Zimbabwe would be the most advantageous alternative use. A donor consortium of eight financing agencies was established where NORAD and Sida funded, among other things, the engineering services of Norconsult and Swedpower, respectively.

The *Development Objective* was "to strengthen the economic development in both Mozambique and Zimbabwe, as Mozambique had excess electricity, up to year 2003, that could generate foreign exchange income and Zimbabwe was in need of a medium term solution to cover the electricity demand at hand".

The *Immediate Objective* was "to secure the possibility of Zimbabwe Electricity Supply Authority (ZESA) to supply the required electricity to its clients as well as create income to EDM and Hidroeléctrica de Cahora Bassa (HCB) which is the owner of the Cahora Bassa power complex whilst connecting the Cahora Bassa Hydropower Plant to the Zimbabwean electricity network".

The project *outputs* were a 420 kV transmission line from Songo in Mozambique to Dema near Harare plus extensions of three substations.

Regarding project **efficiency**, implementation was delayed by about a year, in part due to the complexities of the management. There were eight funding agencies, eight implementing agencies/firms, three power companies, i.e. EDM, ZESA and ESKOM, and two governments involved. Differences in donor procedures caused problems for several of the contracts. While the construction work in Mozambique was a turnkey project, in Zimbabwe it was unbundled which caused additional costs. There were problems importing equipment into Mozambique, and heavy rains during parts of the construction period also delayed finalisation. But the task was completed within budget, and both EDM and ZESA were largely satisfied with the work of the contractors. In that simple sense the efficiency of the project was satisfactory.

The one-year project delay reduced the revenue from the interconnection sales by around USD 36 million. If the interconnection is only used through the current contract period till the end of 2003, this will reduce the expected financial internal rate of return by about 7%. If the interconnection can be used during the effective lifetime of the transmission line, the difference to the total income stream will not be important. The project will have attained the overarching objective of providing electricity to ZESA's customers and income to the two power companies, as shown in EDM's Annual Report, so **effectiveness** on balance has been good.

On the **impact** side, the transmission line has contributed to the economic growth prospects in both countries. It has contributed to improving the regional grid which is important for the establishment of a truly integrated and efficient SAPP. There have not been any unforeseen negative consequences from the project. Overall, therefore, the impact has been very positive.

The **relevance** of the project remains as high as ever, and from a regional perspective perhaps even greater now than at the time of the planning of the project.

The **sustainability** of the project and its benefits are very good since the net benefits to the parties are continuous and high, and the incentives to maintain the interconnection therefore strong. The skills and organisational set-up required to maintain the transmission line and the substations are good. Overall, therefore, this project receives a very high score.

3.7.2 Malawi Interconnection Study

The background is in brief that Malawi has an energy deficit. Its main hydropower stations lie along the Shire river which is subject to low water flows out of Lake Malawi/Lake Niassa. During the 1994–95 drought the water level was such that only about 1.5 meter of head remained at the outlet. Swedpower was given a contract to analyse the technical, economic and financial viability of an interconnection to Mozambique. The contract, at about SEK 1 million, was funded over the SADC allocation and was awarded in 1995. The final report was handed over in July 1996.

The report looks at the power balances and transmission systems in the two countries, provides a power system analysis, before proceeding to a design and cost estimate and an economic analysis. The proposal was for a 200 km 220kV interconnection from Matambo in Mozambique to West Blantyre in Malawi. The total estimated costs were USD 32 million, with the line expected to be operational in 1998 if work proceeded immediately. The economics of the interconnection looked at three factors which are briefly presented below:

- The interconnection would improve the reliability of the Malawian power system dramatically. The Loss of Load Expectancy, LOLE, would fall to the recommended levels at a fraction of the cost of using thermal power. The reason for this is that since all hydropower schemes in Malawi would be susceptible to the drought problem simultaneously, the LOLE could only be addressed through installing non-hydropower based generating facilities. The estimated economic benefit in terms of Net Present Worth (NPW) was about USD 70 million.

- The interconnection would allow Malawi to defer expensive own hydropower investments, with additional economic benefit estimated to a NPW of USD 18 million.

- Finally, in times of surplus Malawi would be able to export power to neighbouring countries, at an estimated NPW of USD 8 million.

The total NPW was therefore on the order of USD 96 million versus the construction costs of USD 32 million. Despite the very positive results, the interconnection proposal was never initiated. The possibility still exists, however. On a visit to Malawi towards the end of 2000, Sida's energy staff discussed the possibility with NORAD, which has expressed a willingness to co-finance the line. So far, however, Malawi has not indicated any interest.

3.7.3 Summing Up and Findings

- Funding of the Mozambique-Zimbabwe interconnection was reasonably efficient and effective in supporting an improvement in the economies of both countries. This gain is organisationally and financially sustainable, and remains regionally highly relevant.

- The Malawi interconnection study achieved its limited objective of producing a feasibility study. The project was successful in that it established the economic and financial viability of the interconnection and forms a solid basis for a future decision.

3.8 New Transmission/Distribution Projects

Sida has in principle agreed to fund two more transmission and distribution projects. The first is a transmission line from Gurué to Lichinga along with a several local distribution networks in the Cuamba and Lichinga areas. The other is a distribution net in southwestern Zambézia province, with focus on the Morrumbala area, i.e. the "Morrumbala project". The projects are on EDM's list of priority "Rural Electrification Projects" (REP), as were the Ribáue-Iapala and Memba projects. The REP is a response to the Government's energy strategy of extending the national grid to under-serviced areas.

3.8.1 Gurué-Lichinga Transmission and Distribution Project

Niassa province has the least developed infrastructure in the country. The two main towns, Cuamba and Lichinga, do not have reliable or sufficient power supply. Both towns have small hydropower schemes which, however, do not run during the dry parts of the year due to insufficient storage capacity. Diesel generators provide the remaining power to those who are connected to the local public power grid while some consumers – larger institutions and some firms – have installed their own generators.

A first feasibility study on a connection to Mozambique's national power grid was carried out in 1995 by Norconsult. Norconsult and Swedpower together were awarded a contract for an updated feasibility study in July 1999. The report was made available May 2000, in two volumes: a Main Report and an Environmental Impact Assessment, EIA. The main conclusion was that a 343 km long 110 kV transmission line from Gurué to Lichinga passing through Cuamba is the best solution for a reliable and cost-effective power supply. This solution will secure sufficient power to the various load centres for the foreseeable future. The study included reviews of rural electrification distribution projects to surrounding villages and population centres, prioritised in three categories by estimated costs per kWh.

The project has five parts: the transmission line with required main substations for a cost of USD 23.4 million; a back-up generation set in Lichinga that is to function as the main power supply till the transmission line is operational, at USD 600,000; and three distribution programmes costed at USD 7.4 million, USD 2.3 million, and USD 3.6 million respectively. NORAD is to function as lead donor, contributing NOK 150 million, Sida is to contribute SEK 120 million and the Nordic Development Fund NOK 50 million.

NORAD was expected to finalise its appropriations documents by end of 2000, and Sida will use this documentation as the basis for its own processing. In principle the funding agencies have agreed to proceed with the project, and the construction is expected to take place during the period 2001–2003, with the formal completion date set to 1 January 2004.

The socio-economic and environmental teams doing the EIA carried out the field work in conjunction with the transmission line specialist. This meant that the transmission line alignment ultimately took into consideration the technical, socio-economic and environmental factors simultaneously. Despite this, the EIA study noted that the line routing had not been finally decided, so "the inability to provide detailed site specific descriptions of a single line route made identification of specific impact meaningless" (Vol. II, Executive Summary p. 3). Despite the "meaninglessness", the EIA's main conclusion is that "the array of negative environmental impacts associated with this transmission line construction project are far outweighed by the positive developmental impacts" (Vol. II, Chapter 1 p. 26).

The economic and financial analyses of the transmission line looked at local hydropower and diesel generators as alternatives. The main conclusion, using various discount rates, demand forecasts, and costs of hydropower from Cahora Bassa and South Africa, was that the transmission line from the main grid was by far the least-cost alternative. The additional advantages are increased reliability and quality of the power, particularly compared with the diesel generator alternative since spare parts and diesel for the generators are a major hurdle.

Despite being the least-cost alternative, the financial internal rate of return (FIRR) is only 7.9% given current electricity prices. With the assumption that the discount rate is 6%, the margin is very thin. A more realistic or higher discount rate means this line can easily be a loss-maker for EDM. A diversified national tariff structure with higher tariffs in outlying areas like Niassa will change this picture. A tariff of USc 14.6/kWh – the one charged by the independent power grid in Vilanculos – gives a FIRR of over 14%.

The distribution networks were divided in three groups based on kWh costs: those below USc 10, those between USc 10 and 15, and those above USc 15. This study de-composed the distribution nets more finely than in EDM's REP, and these more detailed analysis provide a better basis for taking decisions.

The transmission line is as much a political decision as an economic one. The regional-distributional profile of national investments is a key issue for the continued nation-building process. A power supply that is connected to a national grid has powerful signalling effects. Unlike independent power sources like diesel generation sets, grid-based systems are seen as virtually indivisible and permanent – they give promise of continuity and almost unlimited supply. It thus represents a more solid basis for long-term planning and hence lowers a key uncertainty cost for investors and other decision makers. While one should not over-estimate these signalling effects, the first indications from the Ribáue-Iapala line show that there is a potential for new activities that can be released once power is available.

EDM will gain many of the benefits from new investors who connect to the grid and pay for the energy. But many benefits are of an externality kind that the public sector therefore should be willing to compensate EDM for. This currently happens when the government on-lends donor funds at low interest rates to EDM. The interest rate is a negotiation variable, however, which ought to be based on a more careful analysis of total social benefits. No socio-economic study on expected beneficiaries exists. The limited number of households that will be connected means the impact on poverty and substitution of fuelwood for hydropower is going to be negligible, so the lines cannot be argued for from a poverty or environmental point of view, but rather economic growth and regional balance and development.

3.8.2 The Morrumbala Project

The Morrumbala project is similar to the Iapala-Ribáue project. It is to provide electricity to a series of rural centres in an area that is considered to have important agricultural potential. Total project costs are estimated at around SEK 40 million.

The scanty project document estimates the internal rate of return (IRR) to 8% with an expected power price of USc 7./KWh with a pay-off time of about 15 years. This is similar to the Lichinga line, and thus carries with it the same kind of business risk to EDM.

The project consists of three overhead transmission lines from the Caia substation. The most important one will go through Morrumbala to Pinda and Chipanga, the second one to Mopeia, and the third to Mutarara. While the Morrumbala district has well over 300,000 inhabitants, only

about 700 households will be connected which is just over 1% of the district's population. At household level impact will thus be minuscule. The real impact will be on private sector development and improved service delivery by major institutions such as schools and health facilities.

The socio-economic study that has been carried out is interesting but uses a different approach and contains information on other dimensions than the similar study done for the Iapala-Ribáue project. The idea in both cases was to establish a bench-mark for subsequent follow-up studies. The Morrumbala study is more appropriate, as it identifies indicators that both are reasonably simple to measure and reproduce, and which can be used in more general studies such as for Human Development Indicators. This may allow for comparative studies across time and space, which is important for more general monitoring purposes.

The study raises two interesting issues. The first is the *distributional* impact of electrification, where the study believes electricity should not only be made available in "development poles", but reach out to where households actually live today. While perhaps desirable, the realism in this proposal is questionable, particularly since the study does not specify to which population density such networks should reach, and provides no cost-benefit analysis.

The other proposal is for a stronger local involvement in the identification of the consumers and uses of electricity, so that beneficiary groups are more involved in this planning. This raises a general methodological issue that the EDM projects do not seem to have any kind of participatory or stakeholder planning component involved, apart from local officials. A key issue local stakeholders may have relevant views on is how the connection costs could be structured. Connection costs often represent access barriers for many. For a household that only wants power for lighting and a minor appliance, monthly consumption would be below the 30 kWh that entitles them to the lower "social" tariff. If the connection costs are too high, though, they cannot afford this even though they could handle the monthly charges.

3.8.3 Summing Up and Findings

- Both the Lichinga and Morrumbala projects are on EDM's REP and in line with Government's energy policy.
- Current tariff policy and level makes the projects commercially questionable, however, and thus may weaken EDM's long-term viability. However, both projects are important development investments with positive political and economic externalities that the public sector should compensate EDM for. This means that financing through donor on-lending agreements could contain re-negotiable conditions regarding interest rate, grace period and repayment horizons, depending on how the actual demand for energy develops.
- More structured and standardised socio-economic benchmark studies should be carried out, both to permit impact monitoring, but also to help develop clearer criteria for ranking such projects, monitoring developmental impact, and as a basis for possible re-negotiations of on-lending agreements.

4 Cross-Cutting Issues

4.1 Poverty Reduction Considerations

The overall objective of Swedish development cooperation is to reduce poverty. In 1996 an *Action Programme to Promote Sustainable Livelihoods for the Poor and to Combat Poverty* was prepared by Sida. According to the *Action Programme* every Sida strategy document and project proposal must clearly explain how the activities proposed are designed to reduce poverty. The projects and programmes may be directed at different levels and be more or less oriented towards the ultimate target group, the poor. The action programme differentiates between:

a) direct interventions aimed at poor people;

b) direct interventions where poor people are targeted as members of a wider category of beneficiaries;

c) indirect interventions intended to create stable conditions for poverty reduction; and

d) other kinds of indirect interventions, including programme support, investment in infrastructure, private business and the environment.

4.1.1 Poverty Reduction and Sida Energy Sector Support

Considerations of poverty reduction have not been dealt with in a consistent or coherent way in Sida's support to the energy sector in Mozambique. Until 1997 no reference was made at all to poverty reduction in the project documents or the sector agreements. This is surprising but may be understandable as the energy sector support was designed prior to Sida's *Action Programme*.

After 1997 some improvements appear regarding poverty considerations in Sida's energy sector support, however, not in a consistent or explicit way. The project documents for support between 1997 and 1999 also make no reference to poverty reduction. Sida's Assessment Memo for the support during the period briefly discusses possible indirect poverty effects where improved access to electricity is expected to promote employment and social services. It also stresses that direct poverty reduction may be achieved through increased supply to people who lacks access to electricity. However no linkages or targets were designed to demonstrate how the proposed activities would benefit poor people. The sector support document for the years 2000 to 2001 makes some reference to poverty reduction but the assessment memo notes that the support is mainly relevant for economic growth and that it has limited relevance to poverty reduction.

With the involvement in rural electrification from 1997, considerations of poverty aspects are dealt with to some extent and a socio-economic impact study was carried out prior to the Ribáue-Iapala project, which is one step in the right direction. No socio-economic assessment was however made of the extension to the Memba district.

The lack of clearly demonstrated linkages between the objectives, the supported activities and its link to poverty reduction makes it difficult to assess the impact of the energy sector support on poverty reduction. The goal hierarchy of the energy sector support stops at objectives such as increasing EDM's capacity to supervise the planning, operation and maintenance of EDM's power plants.

As discussed in Chapter 3, the Swedish support has lead to improved energy sector performance. These gains in efficiency and effectiveness are important to economic growth which is a general pre-requisite for poverty reduction in the long run. The improved performance of EDM's operation and financial capacity will allow it to extend access to electricity to other parts of the country at a more rapid pace than would otherwise be the case. But growth based on access to power will primarily have an effect on poverty if it increases employment opportunities that benefit the poor. Energy and capital intensive industries will have limited *direct* employment effects on the poor.

The shift towards rural electrification may from a poverty-reduction perspective be more relevant. Access to power for small-scale entrepreneurs in largely rural regions means less capital-intensive and more local market-oriented production. This is more relevant for the poor both in terms of employment opportunities and for the supply of goods and services and at lower costs by the poor. Though a very short time has passed since the completion of the Ribáue-Iapala project, early indications are that economic activities are growing in response to the electrification of the area.

It would be interesting to track more precisely how electrification might affect the poor. Areas include enhanced employment possibilities both through direct hiring but perhaps more significantly through increased derived demand for their products and services, such as more raw cotton or cashew for increased processing capacities in local factories. More transport needs, petty trading, etc. would come from the increased cash in the local economy, though would be more difficult to attribute solely to the electrification process. Similar goes for possible income effects due to lower prices on locally produced goods and services based on the additional power supply, though some concrete examples may be found. The basic point is that a more careful benchmark of these potentially valid dimensions should be in place in order to allow for any kind of tracking of effects. The Morrumbala study may be the one that comes the closest so far.

Summing Up

- Considerations to poverty reduction have not been dealt with in a consistent or coherent way in Sida's earlier phases of support to the energy sector in Mozambique. With the shift towards rural electrification from 1997 more consideration has been given to poverty.
- The fact that no clear linkages between activities related to poverty reduction are demonstrated in the design of the support to the energy sector does, however, not mean that it has not been relevant in this regard. The gains in efficiency and effectiveness of EDM's operation may indirectly lead to poverty reduction, at least in the long term perspective.
- The shift towards rural electrification may increase the poverty focus of the energy sector support. Rural electricification projects may reduce poverty if also other development conditions are in place.

4.2 Gender Dimension

The Mozambican government has officially acclaimed that the development of the country should include the establishment of gender policies to achieve economic and social progress. In 1997 EDM initiated, with the support from Sida, a process of elaborating a Gender Policy for the company. Two seminars for top ranking officials of the company were held in 1997, which resulted in the design of an action plan for the development of the policy.

The action plan for the development of the gender policy included the following components:

Action Plan for EDM Gender Policy

- A gender training manual for a training program on gender issues which could be used as a module to be attached to each existing training programme of the training centre.
- A series of articles about the gender implementation of a Gender Policy in the company magazine.
- Preparing a pamphlet on gender issues for schools directed to girls to encourage technical studies.
- The appointment by the board of EDM of an employee as a "trust"-person to go to in case of sexual harassment
- Changing the selection system of EDM for new personal in such a way that positive treatment of qualified women will be expressed
- Set up of specific targets for different departments of EDM related to the relative percentage of women in education
- In the annual report of EDM specific information on gender will be incorporated. The results of the monitoring activities of the department of Personal will be included.

In 1998 a Dutch organisation provided technical assistance for the elaboration of the gender policy. The policy was established in 1999 largely along the lines of the action plan. The responsibility for the implementation of the gender policy lies with the department of personnel at EDM.

The action plan has been implemented satisfactorily. A gender-training manual has been elaborated for a two-day gender awareness course in connection with some of the basic training courses at the TC. Approval from the Board of EDM was given for the inclusion of this component. It includes complete instructions and readily available handouts. The courses include a presentation of the vision of the Board of EDM on gender. Stereotypes of men and women are discussed in connection with roles and activities in society and at work. Information regarding sexual harassment is also included. It is estimated that 300 employees of EDM will be trained on the gender topic each year. Three staff at EDM have been trained as course facilitators.

So far two articles on gender and equal opportunities have been presented in the internal magazine. Further, in cooperation with the Ministry of Education a pamphlet presenting information to girls, their parents and their teachers about the possibilities of choosing a more technical education has been produced and distributed in schools.

Since the number of female technicians available in the country depends on the educational system and attitudes in the society in general, EDM has set only qualitative targets for the recruitment of female personnel.

The *impact* of the gender policy in terms of increasing the percentage of women in the company and in technical areas is limited. At present about 10% of the total staff of 3000 at EDM are women. Among these only a few percent are found in the technical and operational departments or at senior management level. There are presently only two women at the senior level of the operational and technical department and one director who is head of the Personal Department. Since 1998, when gender disaggregated statistics were introduced at EDM, eight women have been employed. Of the three female directors, one was appointed in 1998. The others held their positions prior to introduction of the gender policy.

The reason for the low percentage of women within the organisation is, according to the EDM management, the general gender attitude in Mozambican society. Relatively few girls attend secondary school and even fewer proceed to tertiary education and most of these choose disciplines such as teaching and nursing, rather than technical courses.

The *relevance* of the gender course is nevertheless important. EDM's attempt to promote more female technicians as well as its gender awareness activities are important steps in the right

direction. It should, however, be recognised that the constraining factors for an effective gender policy lies to a large extent outside the control of EDM.

The *content* of the gender course should be discussed. The alarming increase in HIV/aids in the population and particularly among the better educated poses a serious problem for EDM's skills-intensive field. The Human Resource Department stressed the urgent need for awareness raising activities among its personnel regarding AIDS, and the gender course or a related module would seem a logical place to address this, apart from a much larger and more general effort within EDM.

The *sustainability* of the gender awareness training will depend on EDM's willingness and prioritisation of continued TC development. Unless more internal resources or external donor funds are allocated to training activities within EDM the sustainability of the gender training is probably weak.

4.3 Environmental Issues

In the draft Electricity Act, which was quoted for project objectives and development objectives in the project documents (# 9) for the Swedish support, article 4, item d) reads: "To improve the quality of life, guaranteeing the ecological balance and the conservation and preservation of the environment". This was maintained in the Act that was subsequently approved.

Environmental issues were not a priority concern in projects supported at the time of the phasing out decisions, i.e. 1995-96. At that time environmental concern was neither strongly reflected in the organization of EDM nor in the selection of projects or areas for Swedish support. There were no specific environmental oriented projects, and environmental issues were not specifically addressed in the training programs.

More recent support has put more emphasis on environmental issues. One of the reasons for this was the increased concerns by donors. Sida demanded, for instance, that environmental impact assessments (EIAs) be carried out for the rural electrification projects, although there is no formal requirement in the Electricity Act for such EIAs for transmission lines at these low voltage levels.

During the reorganisation of EDM, the planning department at DER was vested with the responsibility for environmental issues, and a unit for that purpose was formed. This structure was approved in 1997 and implemented in 1998. The unit consists presently of one person and the responsibilities include cooperation with other departments in EDM in relation with generation and transmission projects. Another important matter is cooperation in the environmental committee within SAPP and SAPP guidelines for EIAs of transmission projects presently considered by EDM. An environmental working group comprising EDM, MIREME and the Ministry of Environment is planned to be formed in the near future.

4.3.1 Environmental Improvements Achieved

During the period in consideration, the sector has achieved important environmental improvements. Most important has been the decommissioning of the thermal power station in Maputo, *Central Térmica de Maputo* (CTM). The CTM was an obsolete, coal-fired power station, and was one of the major sources of SO_2, NOx and particle pollution in Maputo. A number of smaller diesel-powered generation sets, both for private firms but also publicly owned ones supplying smaller towns, have also been taken out of service as the power grid has been extended.

The substitution of hydropower for thermal power has been in line with the strategy to replace as much of local power production as possible with lower-cost and clean indigenous hydropower from Cahora Bassa. This strategy, however, was more the result of economic considerations rather than environmental concern.

The improved general operation of the transmission and distribution system is likely to have had a positive environmental impact, although the extent is difficult to assess. Reduced losses result in less demand for additional capacity potentially supplied by fossil fuel combustion. Improved maintenance results in fewer power cuts. This reduces the demand for using stand-by fuels in the households, fuels that are typically more polluting than electricity, such as charcoal, kerosene and gas.

4.3.2 Environmental Issues and the Strategy

The overarching strategy of EDM is to connect all regional centres to the national grid. This has political as well as economic reasons, at least as long as the HCB is able to supply sufficient power. This is also true as long as development is equated with industrial development with comparatively high demands for power. In this strategy, little consideration is being paid to alternative sources of energy such as solar, wind and biomass which may be small-scale and represent important supplements to grid extensions in remote areas with low demands. However, planning for environmentally benign additional power sources ought already to be in place although outside the scope of the present evaluation.

In the current development scenario, supplying power in remote rural areas through local, small-scale renewable energy sources might well fill an important social as well as environmental role. EDM is not including such scenarios in its planning, but is leaving this with the National Department of Energy (DNE) at the MIREME. What is noteworthy is that Swedish support to the power sector has not improved the capacity or interest for planning such a development.

4.3.3 Environmental Effects of Rural Electrification Projects

The environmental effect of these projects was expected to be positive (#21). This was based on the substitution of hydropower for local diesel power in some of the small towns supplied, and on the potential effect of reduced deforestation for fuelwood. While the first effect is obvious, it is definitely limited, due to the comparatively small loads in question. The second effect will generally not occur until many years or decades after electrification, as also acknowledged in the document. Furthermore, poor people are not likely to substitute fuelwood for power due to the cost. Fuelwood burning for cooking is both a significant source of in-doors pollution, but also an important reason for deforestation. During the field visit, it was clear that none of the households were using electricity for cooking.

As for longer term environmental impacts, these can not be judged at the present time, as they relate to the nature of the economic expansion that may take place. Increased agricultural production increases the permanent cropland area, and increased productivity hinges on the use of fertiliser, pesticides and machines, all with their specific impacts. An example is a carpentry workshop established near Nampula. The owner expected to increase production substantially now that he had power to run the machinery, which will increase the cutting of valuable timber. Whether or not this results in unacceptable environmental effects is not possible to deduce at the present time.

4.4 Economic and Financial Sustainability

One of the objectives of the Government's recent energy policy is to establish efficient and viable sector entities, where EDM is the most important one. EDM is, however, in a difficult financial situation.

A 1997 report on Power Sector Reform notes the problems EDM was facing at the time. It was collecting little more than half the value of electricity produced. It had high operating costs due to the poor state of its network because of the war. The transmission network was uneconomically large given the customer base. The investment program was unsustainably large and only feasible due to donor funding. The revaluation of assets has led to unrealistic depreciation allowances compared with its gross revenues (# 69, pp. 10–11).

The general economic liberalisation that has taken place in Mozambique during the 1990s is having an impact on the power sector. The new Electricity Act in principle opens the sector up to competition in most areas. EDM has been transformed into a publicly owned company where management has a performance contract with Government for attainment of a set of objectives[4]. Activities like pre-paid meters and the *Nova Imagem* loss-reduction programme are addressing the key problem of low fee collection, while the Training Centre has introduced more commercial and management training.

While a good start has been made, there is still a way to go before EDM is financially sound. A 1999 feasibility study of the sector done for Danida notes that the overall strategic focus of the company is still inward-looking, control- and engineer-based rather than consumer-focused and commercially oriented (# 37). While EDM has as its general strategy a rational exploitation of the country's vast hydro-potential, it does not have a least-cost plan of how to achieve this. EDM now spends much time developing and mobilising funding for its Rural Electrification Projects (REPs).
It ought instead to focus on steps that could improve its bottom line in the short run. This includes developing a more aggressive billing and collection system, shortening the billing cycle and expanding the number of connections in urban areas. It should focus more resources on regular maintenance of its existing distribution systems and invest in upgrading these in a number of areas. It should strengthen its internal strategic planning and commercial skills based on bottom-line concerns. As an example, the study refers to the power purchasing agreement with South Africa's ESKOM, where Mozambique is in fact paying for power it does not consume. The report also notes that a more realistic tariff structure might make some power generation alternatives more viable.

In this context, has Sida's assistance helped EDM become a financially more sound company? The loss-reduction project has clearly had a major impact. As noted, EDM collected USD 12 million more in 1999 than it would have if the loss levels of five years previously were still in place. This compares with the overall operating surplus in 1999 of only USD 1.7 million[5]. Despite this important achievement, most observers agree that EDM could have developed the *Nova Imagem* programme more forcefully and should have been able to point to considerably better figures by

[4] There are a number of weaknesses in the contract. The London Economics power sector reform study points to a series of very "soft" or easy targets that weakens the efficiency-enhancing incentives (# 69, p.p. 9–10). The contract is also not clear on penalties or possible positive incentives in cases of under- or over-performance, respectively, so the overall incentive picture is unclear.

[5] The 1998 and 1999 operational surpluses of approximately USD 2.1 and 1.7 million must be seen in relation to what are registered as sales income of USD 68 and USD 66 million, respectively. In both years, however, EDM had what is probably incorrectly classified as "extraordinary income" of an additional USD 11 and 7 million, respectively. In any case, however, the surplus represents a very thin operational margin. At the same time, it should be recognised that these

1999. The corollary is that Sida, realising the need for a more aggressive commercial orientation, should have assisted more on the overall change process within EDM rather than limiting its attention to a more technical assistance at field level. But how far a donor should be held accountable for local choices and short-comings of strategic vision is of course debatable.

The Zimbabwe interconnection has also been important to EDM's bottom line. In 1999, the wheeling charges from ZESA represented nearly 7% of EDM's revenue, and a boon to the HCB in terms of income and utilisation of the hydro-potential. The feasibility study for the Malawi interconnection represents another potential revenue-avenue, though not of the same magnitude as with Zimbabwe.

The technical assistance to the transmission and distribution systems has been critical to EDM's very survival. Without the Scandinavian support during the war years, EDM clearly would not have emerged after the war with the kind of delivery systems and thus income generating potential that it did.

EDM is still financially weak. The operating surpluses of around USD 2 million generated in both 1998 and 1999 were the first years with a positive balance sheet. The year 2000 turned out much worse due to the severe flooding in the south. Transmission lines and pylons were washed away, the sub-station at Xai-Xai totally flooded, recurrent revenue was lost due to inability to provide power, and expensive power had to be purchased from South Africa.

This has set the company back considerably, as forecasts were for EDM to be able to generate a small return to its shareholders and begin paying corporate taxes in 2000. Despite the considerable progress made, EDM retains a poor credit rating meaning that taking up new loans for profitable activities like new urban connections is expensive[6]. It does not have the resources to adequately maintain its existing networks much less expand and enhance them, and it remains donor-dependent for new investments.

The REPs thus present a dilemma for EDM because they seem at best to be able to generate an operating surplus but not a decent return on capital. From a commercial point of view they would therefore rank well below a number of alternative activities that EDM could invest in. There may therefore be a contradiction between two of the objectives the Government has set for the sector and which EDM is trying to fulfil. The first is to increase area coverage through the REPs, while the second is to make the sector financially viable. This problem can be avoided if only those REPs that are financially as well as economically sound are implemented, and/or if the Government is willing to subsidise the undertaking, either on the investment side or through recurrent transfers. Today this is done through the Ministry of Finance on-lending donor funds at low interest to EDM for REPs (subsidy on capital). In the future the recently established Rural Electricity Fund (FUNAE) may enter into different set of contracts with EDM for such undertakings, but for the time being FUNAE is still too weak to play a significant role in new electrification activities.

A more critical look at the REPs are therefore required, both to ensure that the *economics* of the projects are solid, but also to ensure that the *financial* (business) results for EDM make sense. This means not only assessing the projects as such, but also looking into the overall strategic outlook for

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years represent a dramatic improvement over the previous years, where losses in 1997 were about USD 15 million and the year before an unbelievable USD 29 million.

[6] The most reasonable loan for an expansion of the Maputo-Matola network was from a South African bank. Denominated in US dollars, the bank wanted 10.6% interest, meaning EDM would have to take on a lot of exchange rate risk in addition to the high dollar interest rate. This should be compared with the FIRR of around 8% on the Gurué-Lichinga and Morrumbala REPs that Sida is going to fund.

the company and the sector. Does EDM have plans for aggressively pursuing cost-reducing and revenue-enhancing activities, including for the REPs? What is likely to happen to real tariff levels and the overall structure of tariffs at the national level over the coming two to three years? Will DNE actively try to find other actors who can come in and supplement or compete with EDM in certain areas to increase the pressures for more efficiency in the sector? Will the Government develop a realistic and sustainable policy regarding the financing of REPs that will allow EDM to earn a satisfactory return on capital?

Without a clearer understanding of what the answers to these questions are, continued funding of REPs may, paradoxically enough, weaken EDM's financial solidity. While it is the impact on the country's overarching economic development that should be the key concern for a donor, the distributional outcomes need to be looked into, to ensure that the gains from donor support accrue to the intended beneficiary groups more or less in line with what was intended, including EDM.

In this connection, it is important to understand the planning situation for EDM. For a long time, this has been characterized by a lack of resources to *implement* plans. For investments, as noted above, EDM has always been dependent on donors for funding, which has hampered independent internal planning. This does not mean that EDM did not have plans, strategies or policies , as there has been, and still is, a strong commitment towards supplying also remote areas of the country with power from the interconnected grid. This commitment is still based on developmental and political considerations rather than economic viability criteria.

What has made the situation difficult for EDM is that while it is being asked to both become a commercially viable company, it is still expected to also perform its developmental tasks. At the same time, donors may have their own sets of criteria. While Sida emphasizes poverty reduction, Danida is more set on supporting projects with an economic potential, and the World Bank is intent to support private actors in the sector.

In order to cater for all these different demands and inclinations, EDM has, over the years, developed a substantial pragmatism to develop projects that meet the criteria of various donors. While this may have been to the detriment of any particular policy of EDM itself, it is in response to a chaotic situation rather than by design. The Swedish TA has contributed substantially to this capacity of negotiation and finding solutions, since it has also been a very flexible and results-oriented. EDM has certainly been able to implement many more projects this way than it would have done with a more rigid planning structure.

Paradoxically, so have the donors, at least in the case of Sida. While the overall sector strategy states that the support to the power sector should phase out by 1999, and the overall plan and strategy has been towards this goal, the support is still continuing, and possibly increasing. One reason is that there has been a possibility to negotiate support in favour of projects that fulfil current strategic visions of Sida, such as poverty reduction. However important such projects might be in a development perspective, they may not necessarily be in line with company interests of EDM. Thus, the close cooperation between Swedpower and EDM may actually have reduced EDM's possibilities for independent planning based on its own criteria. As noted, some of these REPs may turn into liabilities in the future, if the expected social development in remote areas is not forthcoming.

Summing Up

- EDM's financial situation has improved considerably over the last several years, though performance could have been better through a clearer commercial orientation such as a more aggressive pursuit of revenue-enhancing activities like the *Nova Imagem* program.
- The Sida funded activities have been critical to the improvements in EDM's financial situation: the early transmission and distribution projects allowed the physical network for power distribution to survive and continue as the fulcrum for EDM's income generation; the loss-reduction project has generated major savings; the inter-connection to Zimbabwe is an important revenue source.
- The REPs pose a dilemma as they are not at the top of EDM's profitable investment options. The economic and financial viability of REPs should be clarified before they are presented to donors and implemented. Under current conditions they make weaken EDM's long-run financial situation.

5 Conclusions and recommendations

This final chapter contains three parts. The first one looks at some features of the power sector and its recent developments, and hence some implications for the analysis of Swedish support. The second looks at the assessments of the individual activities that Sweden so far has supported, and what the lessons may be for the future. The last section then summarises by looking ahead at possible options for Sweden to consider.

5.1 The Power Sector in Mozambique

As with most infrastructure sectors in Mozambique, the power sector currently services a small share of the population. In a country with a population of around 17 million, only about 170,000 households are connected to the national power system – an estimated 6–7%. In addition come a little under 30,000 commercial and industrial consumers. Access to electricity is as low as 4% for the whole country whereas this figure for the Maputo area is higher with 27%.

Studies done with World Bank support show that many households even in rural areas do use power for things like lighting or running radios. One common energy source is car batteries, where the real price can be around USc 40/KWh. This is 6–7 times the normal tariff charged by EDM for household consumption of about USc 7.5/KWh. While the *desire* for power is very high, there is according to these kinds of studies also both an *ability* and a *willingness* to pay. The popularity of the pre-paid meters in urban areas supports this general point.

The reality, in an extremely poor country like Mozambique, is of course a little more complex. There are contradictory pressures between ensuring that EDM becomes a commercially viable company as soon as possible, and its developmental role. One example is the issue of connection charges. From a commercial point of view, EDM should charge this at full cost and in lump-sum as a pre-condition for being hooked up, since EDM largely has all its connection costs at that time. For households, being able to pay off the connection charges for example over a year would make this payment a lot easier to handle, and thus expand EDM's household consumer market considerably. One solution is for EDM to essentially extend a loan to the households by providing the option of paying the connection fee over the course of a year as part of the general electricity bill, but with a market-based interest rate added on. The practical problem is if EDM's billing and accounts system is able to handle this additional service at reasonable cost. A similar issue is that EDM, when it disconnects a consumer, does not charge a re-connection fee once outstanding invoices have been paid – that is, there is no penalty for defaulting with EDM. The suggestion made repeatedly by external consultants, and which makes a lot of sense, is that the real costs of re-connecting plus a penalty fee should be charged. But this will probably have a limiting effect on the household market, with the long-run implications this may have on EDM's finances.

The dilemmas of working in a market environment with a financially weak consumer base appear time and again when EDM reviews its business options. The basic economics of the power sector is reflected in the fact that Mozambique, with a population and a territory twice that of Sweden, has a power demand of about 200 MW while Sweden's is around 35,000 MW – about 350 timer larger *per capita*.

None the less, the new Electricity Act is in fact encouraging new developments in the sector. On the generation side, the UTIP in the Ministry is assisting the authorities to look at new hydro-power

schemes. The most advanced planning is for the Mepanda-Uncua scheme, with a potential of 1,600–2,400 MW. A second option is the North Bank extension of Cahora Bassa, with an planned capacity of around 1,200 MW. The Panda gas fields is already being used to power the local Vilanculos power grid, and the Moatize coal mines could fire a 1,000 MW power station in northern Tete. All of these would have to be financed largely by private investors. On the transmission side, MOTRACO already represents an important actor on the side of EDM (though EDM is a co-owner). The Mepanda-Uncua scheme will require new transmission facilities that would also primarily have to be funded by private investors. In the distribution area, the Vilanculos scheme attracted five bidders for the management contract, which was awarded to a South African firm. The management of the independent power grid in Montepuez, which is based on diesel generators, was given to a French company. In both cases the client base is only around 400 customers, so even at such low numbers external actors are interested in entering the Mozambican market.

These examples, although for the time being limited, point to the potential for a much more dynamic development within the sector over the coming years. The observation made earlier, that EDM is too supply-oriented and not enough demand-driven, is therefore a real issue. The transformation of EDM into a market-responsive actor is critical for its prospects to prosper and continue as the dominant actor in the power-sector in Mozambique. This development has clearly accelerated during the second half of the 1990s – that is, the trend has become more marked since the decision by Sida to phase out its support to the energy sector.

At the same time, it is clear that a continued development of Mozambique's power sector is a *sine qua non* for sustainable and auto-generated socio-economic growth and development. Mozambique is blessed with abundant indigenous energy resources, whether hydropower, coal, gas, bio-mass, solar and perhaps even wind. These should be exploited to the benefit of the country, either as an input to own production, or in the form of exports.

Access to abundant, reliable and reasonable energy is a serious constraint in many countries. In Mozambique, this should not be the case. What is holding back development is partly weak demand, given the current state of the economy, but also lack of resources to exploit the potential. Both of these constraints are changing rapidly. The creation of SAPP opens up a much wider market for Mozambican power. More important are perhaps the proposed mega-projects. The aluminium smelter MOZAL is already on-line, where MOTRACO is providing the 425 MW it requires. The Maputo Iron and Steel factory foresees 500 MW, while the Billinton Heavy Sands titanium smelter would require 70 MW. The methanol and fertiliser plant in Maputo would be a big user of the Pande gas, as would the proposed Beira Hot Briquetted Iron plant. These and other, smaller schemes are changing the economics of power generation and transmission, and thus also distribution. With these new large-scale investments come the possibilities for mobilising the required funding also for power projects.

This changing situation needs to be borne in mind when considering whether the energy sector ought to remain as part of Sweden's development cooperation with Mozambique or not.

5.2 The Sida-funded Energy Programme

In order to assess the relevance and impact of the overall cooperation between Mozambique and Sweden in the energy sector, there is a need not only to look at the distinct activities that have been supported, but also the overall structure of the programme, and the changes to this over time.

5.2.1 Efficiency

The efficiency of the loss reduction project is excellent and this project contributed substantially to the economic performance of EDM. The efficiency of the other projects also appears to be good or at least satisfactory.

All projects have basically been implemented with procurement of goods and services from Sweden. Procurement of goods, for substations and rural electrification, has been subject to bidding in Sweden. Further cost savings might have been achieved if these procurements had been subject to international competitive bidding.

With regards to consultancy services, Swedpower has virtually been the only company involved without any competition. It is obvious that a situation with non-competitive use of one company for more than 20 years may result in a more relaxed attitude than what would have been the case with competitive bidding. This situation should be reviewed in light of the trust that has been developed, and thus the efficiency with which the consultant has been able to understand issues and respond to them. The client, EDM, seems clearly to have seen this as a strong advantage to them, and thus a cost-effective arrangement.

5.2.2 Effectiveness and Impact

The extent to which project objectives have been achieved is basically considered good for each project. For some projects it is, however, questioned whether the objectives were the most relevant with regard to the development of the sector. Certain characteristics for performance of the power sector are given below. The projects supported by Sida have certainly had influence on these, taking the volume of the support into consideration.

Technical Matters

Power generation has increased from 965 GWh in 1995 to 1,328 GWh in 1999, representing an average annual increase of about 8%, which is high for a developing country. Distribution losses have been reduced by approximately 20% of the power supplied. This is an indication of the technical performance of the supply in the power sector.

Reliability is judged by the evolution of outages or interruption frequency. This is less clear and the reason is that there are considerable variations from one year to the other. The performance at present is, however, better than during the early 1990s [this will be further discussed with EDM prior to issue of the final report.]

Economic Matters

The Sida funded activities have been critical to the improvements in EDM's financial situation: the early transmission and distribution projects allowed the physical network for power distribution to survive and continue as the fulcrum for EDM's income generation; the loss-reduction project has generated major savings; the inter-connection to Zimbabwe is an important revenue source. Performance could have been even better through a more commercial orientation such as a more aggressive pursuit of revenue-enhancing activities like the *Nova Imagem* program.

5.2.3 Relevance of Mix of Projects

The importance of the Cahora Bassa hydropower plant as the major source of generation in the power system in Mozambique is obvious. It was therefore logical that development of the main transmission facilities in the national power grid were given priority during the initial years after independence, thereby enabling new regions of the country to benefit from cost-effective

indigenous hydropower. Sida provided support to the development of the central-northern transmission system in the late 1970s and early 1980s, which was appropriate in this period. After the investments in the main transmission network, Sida began supporting operation and maintenance through considerable TA during the 1980s. The support to EDM's TC also began during this period, to strengthen technical capability and competence within EDM.

With the basic investments in generation and transmission facilities in place, emphasis was gradually moved to power distribution during the late 1980s and early 1990s. This is also natural in view of increasing access to electricity and economic development in general. Sida-funded TA was also gradually more focussed on distribution planning, and a total of eight resident advisors were in Mozambique at the peak in 1992.

In addition to technical assistance Sida also supported investments in distribution facilities in central parts of the country. This comparatively strong involvement in the power sector, focussed on EDM, comprising TA, training and investments, has been important to EDM's development. The assessment of the technical assistance and TC projects noted that EDM is now in principle capable of handling normal technical activities related to planning, operation and maintenance of transmission and distribution facilities.

As of the mid-1990s, commercial operation was given higher priority within EDM. The areas of consumer billing and revenue collection was below accepted standards with resulting commercial and administrative losses far above desired levels. Sida started to support the Loss Reduction project in 1994. This initially concentrated on reduction of technical losses, but commercial losses were more severe and emphasis was shifted to these after a short period of time. As noted several times, this project has been excellent both with regard to effectiveness, efficiency and sustainability. The timing is also appropriate in view of the increased emphasis on commercial performance of EDM during the later years.

The latest shift has been towards strengthening EDM's participation in the SAPP, as well as investments in low-voltage transmission and distribution networks ("Rural Electrification") in the under-serviced central and northern regions. These changes also seem as appropriate responses to the changes in the power sector – the internationalisation of the power market, and the need to extend the national power grid to new but important areas for the country's balanced growth and exploitation of its resources.

It should be noted, however, that with the strong concentration on EDM and the traditional power sector in Mozambique, Sida has not focused on development of renewable energy sources such as solar, wind, biomass and small hydropower plants. These may be important supplements or alternatives to grid extensions in remote areas with small loads. Development of new administrative solutions to power dissemination and support to the growth of independent power producers or distributors are also areas that have been ignored by Sida.

5.2.4 Summing Up

The Sida-funded programme in the power sector has been quite diverse, but at the same time flexible. It has changed in response to changing needs, but also as original objectives have largely been met and resources therefore could be freed up for new activities. Sweden has been innovative in using different funding instruments at its disposal: the country frame, the SADC allocation, and import support. Some of these instruments, in particular the import support allocation, contain constraints such as procurement having to be from Sweden. This may have reduced the efficiency

of activities. On the other hand, Sweden has remained an important and predictable partner to EDM.

The focus on EDM as a power company rather than as a service provider has undoubtedly held back some further changes to the profile of the support Sweden funded. It has been noted on several occasions that a more aggressive support to the restructuring and re-focusing of EDM towards a more market-based actors could have been highly beneficial. There is the contradiction in this view, of course, that this kind of support was not aggressively being sought by EDM itself. But the long-term EDM-Swedpower partnership has probably both reinforced this supply-focus but perhaps also made Sida itself somewhat complacent with regards to looking more critically at the priorities in the sector. While Swedpower has been the key link for EDM to Sida, it has also acted as Sida's main entry point to EDM, and has in this double capacity acted as an information gateway with all the potential (probably not conscious or intended) for information distortion that follows from this.

This over-reliance on one actor is therefore a structural flaw in the Sida programme. This is not questioning Swedpower's considerable skills and contributions over the years, but is rather an issue that Sida needs to address more aggressively in terms of ensuring that actors do not play several roles simultaneously. Swedpower's admission that it not only provides TA to EDM on particular projects but in fact also advises on project development and prioritisation – that is, it may be influencing the overall project portfolio that EDM is pursuing and where Swedpower may have a possible future commercial interest – is not unproblematic.

5.3 Options for the Future

Sweden's decision in 1996 to phase out its support to the energy sector formally remains in place. As noted earlier, however, Sweden's Government just recently decided to approve support to the Morrumbala project. Sida is furthermore co-financing the transmission line to Lichinga as part of Sida's support to the Niassa province. Sida therefore seems willing to consider further financial support to the energy sector if the activities are well justified.

The 1996 decision should be seen both in the context of when it was taken, and reviewed in light of the situation today. Sweden was at the time feeling rather overwhelmed by its involvement in Mozambique. It was the largest bilateral donor in a country that is extremely difficult to work in and where the conditions for sustainable development depend a lot on the donor's engagement in supporting fragile frameworks to grow and become more self-supporting. At the same time, Sweden was facing its own financial difficulties with a reduced aid budget forcing certain cut-backs. There was therefore both a need to reduce total engagement, and also to focus reduced resources on fewer activities in order to increase the probability of impact. The decision to reduce the number of sectors of engagement was thus largely driven by necessity but also by a policy of concentration.

The situation facing Sweden's cooperation management today is different. Aid budgets are increasing and seem to be set to continue to grow quite rapidly. The number of countries that are able to absorb this larger funding level is not expanding, however, in part because the political situation in several partner countries is deteriorating, making Sida in fact reduce their financing levels.

Financial resources available to Mozambique are therefore set to rise considerably during the coming years. But Sida's need to limit its administrative and policy engagement costs remains in place. It has decided that within the infrastructure area in Mozambique, it will give priority to the

road sector as far as its own management and technical skills are concerned, primarily because secondary and tertiary roads have a more direct impact on poverty reduction. Sida is therefore happy that NORAD will act as lead donor on the Lichinga transmission line project. It would furthermore like the Morrumbala project to be handled similarly to the Iapala-Ribáue and Memba projects, which were all-inclusive turn-key contracts. This minimises the demands on Sida's manpower and reduces possibilities of resource mismanagement. Given the fact that corruption is both widespread and probably increasing in Mozambique, this is a serious concern.

This approach basically means that Sida can develop a "win-win" outcome. Focusing on the power sub-sector, where investments often are capital-intensive, provides an option for absorbing considerable resources over a limited period of time. The objective should be to identify investments that are used for highly productive activities that are necessary pre-requisites for sustainable growth and hence sustainable poverty reduction. By at the same time limiting the engagement largely to such projects, the costs to the Sida administration can be kept to a minimum.

Sida's increased emphasis on support to development in the central and northern regions of the country means that the so-called Rural Electrification Projects are the most logical candidates for such financing. For the time being it is only EDM that has a clear overview of its priorities in this field. Sida could therefore focus on EDM's REP-list.

But the quality of EDM's current program and project preparations is not satisfactory. The economic and financial analyses should provide a basis for more rigorous comparisons and priorities. There is also the lack of participatory planning, so it is not always clear what stakeholders themselves prefer. This is particularly relevant if Sida wants these projects to address poverty and livelihood issues. More consistent and comprehensive socio-economic benchmark studies that permit results and impact assessments as well as contribute to more general monitoring of trends is required.

Over time, the sector as a whole most provide a clearer picture of what the priorities are, and present more broad-based least-cost solution analyses. This will only be possible as the DNE itself improves its capacity. But it is important that this process be encouraged and supported.

Sida should also be more concerned with EDM's transformation into a more commercially oriented enterprise. This issue is not irrelevant to the rural electrification projects, because if EDM is not able to accelerate its transformation into a more viable company, its ability to ensure the long-term success of these new grid extensions will clearly be undermined.

The other side of this, however, is that the business interests of EDM need to be fully acknowledged. That is, Rural Electrification projects that are primarily addressing political priorities but not EDM's own commercial concerns should entail that on-lending agreements contain re-negotiable conditions regarding interest rate, grace period and repayment horizons, depending on how the actual demand for energy develops. EDM should not be saddled with loss-making ventures – though the contracts need to provide performance incentives that have bite and provide real encouragement for productivity enhancements. The overall performance contract that EDM has with the government today is too general and without clear penalty clauses and performance incentives. The contracts for the particular projects should be clearer on these issues – but this requires better benchmark studies so that performance can in fact be monitored.

Finally, Sida should be clear on what the objectives for such electricity projects are. The "Rural" in REP is something of a misnomer, as the grid extensions are primarily for urban or town agglomerations (the similar programme supported by Danida in Inhambane province is often

referred to with the more appropriate "district capital electrification"). The objectives and expected outcomes of the projects should therefore be formulated in realistic terms – that is, contribute to economic growth and development in under-serviced and poorer regions of the country in order to attain a more balanced and nationally just development. The direct impact on gender, poverty and environmental concerns should be accepted as second-order and in the short to medium run to be minimal.

If Sida decides that it wishes to finance such electrification projects, it should also set aside a certain percentage of its sector engagement for a consultancy fund for feasibility and benchmark studies to ensure better investment choices and project monitoring. What the size of such a fund should be is difficult to gauge, but Sida should not be too limiting. It may end up investing hundreds of millions of SEK in this field, so attention to performance both during construction and the longer-term operations needs to be paid due attention. This requires that good performance management instruments have been established and are in place.

Another (or complementary) possibility is for a more general fund that actors in the power sector could apply for, to cover costs that are considered extra-ordinary in connection with the transformation of the energy sector. This could include the Training Centre, for example to upgrade activities like its commercial training programme. Other actors may apply for funding of new or innovative energy solutions for low-income households or remote rural communities.

In order to minimise the administrative costs and policy involvement of such fund/s, Sida should consider ways of handing management responsibilities to an external actor. Options could include co-financing with another donor, or setting out a management contract, perhaps to a Mozambican-Swedish consulting alliance that has no direct ownership or own stakes in the sector.

But Sida should also encourage better coordination in the sector by pushing for the establishment of coordination mechanisms and perhaps the identification of a focal donor. Sida should be willing to participate, on a "minimalist" basis, in joint reviews and meetings, largely to be kept informed, but also to push the reform agenda. Simply pumping money into the sector and believe that this will engender the desired results is not realistic, so if Sida is to continue in the sector, it will have to assume some defined level of responsibility in the partnership

Appendix A

Terms of Reference

1 Scope

This evaluation shall concentrate on the results and effects of projects that were in operation in 1995 or that have been introduced later on.

2 Focus

- Which have been the objectives, targets and rationale set out by Sida for Sweden's support to the sector?
- To what degree have the stated objectives at different levels (programme, sector and development objectives) been achieved?
- Has the Swedish support been relevant over the years in relation to the changing needs and problems as identified by the recipient? In relation to Swedish development goals?
- What results and what impact on the development of the sector has the Swedish support had, positive as well as negative? What effects can be identified on the society as a whole? What role and significance has the Swedish support had? As far as possible, this shall be discussed for each category of support – Support in Precarious Situations (civil war, natural calamities); Investments in Rehabilitation and Development of Supply Systems; Technical Assistance; Loss Reduction; and Rural Electrification – and for the total Swedish support to the sector.
- What are the results and benefits in terms of reliability and quality of supply of electric power, as well as in relation to capacity building and the liberalisation and restructuring within the energy sector?
- Have any unforeseen effects from support occurred, positive or negative?
- To what extent has the support contributed to permanent and sustainable changes or improvements in Mozambique's capacity to develop its power sector?
- Is the policy environment likely to ensure sustainability of the project's benefits?
- Has the support contributed to prepare the Mozambican power sector to work in a market economy?
- Has the mix of project categories (institutional, studies, training, investments in generation, transmission and distribution) been relevant?
- What are the total contributions through Sida to the sector, economically and in terms of power supply?
- Have the investments been financially sound? To what extent have calculated economic rates of return been achieved?'
- Is post-project maintenance of investments and support of institutional structures likely to be adequately funded and executed?

- Do the effects/impacts justify the costs involved? To be discussed for each category of support – see above.
- How has EDM's organisation developed over the years? To which extent does the organisation today have objectives for the institution building process which are both clear and agreed with other parties? Are these objectives being achieved? What impact has Sida's support to the energy sector had on the organisational development?
- How have the human resources within EDM been developed and utilised? To which extent has Sida financed projects involving training and capacity building? Has this support been relevant and what impacts can be noticed?
- What environmental considerations have been taken in the development of the Mozambican power sector? What environmental consequences, positive or negative, have been noted?
- To what extent has the development of the sector affected or impacted on poverty? On the status, influence and economic opportunities of women?
- What are the important lessons to be learned from the Swedish involvement - both general experiences in terms of development co-operation and specifically, with regard to energy sector support?

Appendix B

People Met

Aly, Issufo S, Mr., UTIP
Andersson, Arve, Consultant, TA, Regional Manager, Swedpower
Archondo, Sherri, Country Economist, World Bank
Atacador, Jose H, Mill owner, Rapale
Backeus, Leif, Mr., Birka Teknologi
Biosse, Erasmo B., Director Regional Norte, EDM
Catine, João Manuel, Director Operacional, Nampula, EDM
Dava, Angela B. C., Mrs., EDM, System Planning and Relay protection department
Dos Santos, Inácio, Economist, Financial Department, EDM
Fabião, Higino Camilo, Executive Board Member, EDM
Fernando, Augusto de Sousa, System Planning and Production Department, EDM
Fernandes, Ernesto, Executive Board Member, EDM Maputo
Goba, Chico, Deputy Director, Electrical Department, DNE
Kronen-Helgestad, Anne, First Secretary, Norwegian Embassy, Maputo
Jamisse, Jaime Fernando, Director Operational, Nacala, EDM
Jonas, Adriano, Mr., Maintenance and Technical Audit Department
Kreitz, Anders, Mr., Sida Stockholm
Langa, Bento, Director, EDM, Training centre
Maillet, Rene, Senior Technical Adviser, DNE
Mandava, Massimo, Mr., Electrical Department, DNE
Manuel, César , Mr., Maintenance and Technical Audit Department
Meguigy, Nazário I, Department Manager, EDM, Distribution, Planning and Environmental Impact
Næraa-Nicolajsen, Erik, First Secretary, Embassy of Denmark
Rename, Carlos, Mr., Electrical Department, DNE
Sousa, Adérito , Manager, EDM, Corporate Planning Division
Souto, José , Mr, EDM, Training centre
Stavsholt, Tor, Advisor, UTIP
Svensson, Carl-Gustaf, Secretary, Swedish Embassy, Maputo
Valente, José A., Project Manager, EDM
Werner, Gösta, Programme Manager Infrastructure, Swedish Embassy
Werner, Axel, Technical Advisor, UTIP
Yum, Carlos A., Commercial Director, EDM
Åberg, Erik, Ambassador, Swedish Embassy, Maputo

Appendix C

Bibliography

#	Author	Title	Year	Date	Type
1	EDM	Extension Specific agreement between Sweden and Mozambique on Support to the Energy Sector1 July 1996 – 31 December 1996	1996		Agreement
2	EDM	Specific Agreement between the Government of Sweden and the Government of Mozambique on phasing out institutional development support to EDM, energy sector. 1997-1999	1997		Agreement
3	Republica de Mozambique	Acknowledgement of agreement: Extension of Specific Agreement on institutional support to EDM, energy sector 1997 – 1999.	1997	16 December	Agreement
4	Embassy of Sweden, Maputo	Extension of Specific Agreement on institutional support to EDM, energy sector 1997 – 1999.	1997	15 December	Agreement
5	EDM	Activity period extended 1 January - 30 June 2000.	2000		Statistical
6		Specific Agreement between Government of Sweden and Government of Mozambique on Rural Electrification, Ribaue/Ilapala area, Nampula Province.	1997		Agreement
7	Rural Electrification	Amendment to the Specific Agreement between Government of Sweden and Government of Mozambique on Rural Electrification, Ribaue/Ilapala area, Nampula Province dated October 20, 1997 between Sweden and Mozambique	1998	16 July	Agreement
8	EDM,	Project Document, Energy Sector Cooperation between Sweden and Mozambique, for the period January 1997 – December 1999	1996	October	Project Document
9	EDM,	Plan of Operation for Technical Assistance to Electricity Sector in Mozambique, 1997– 1999.	1997	May	Project Document
10	EDM,	Revised Plan of Operation for Technical Assistance to Electricity Sector in Mozambique, 1997 – 1999.	1999	August	Project Document
13	EDM	Project Document, Adviser Services, EDM, special purpose for system planning and operation, interconnected grids (SAPP), 1998 – 1999.	1998	November	Project Document
14	EDM,	Progress Report Technical Assistance to Electricity Sector in Mozambique	1997	January – June 1997.	Progress Report
15	EDM,	Progress Report Technical Assistance to Electricity Sector in Mozambique	1997	January – December 1997.	Progress Report
16	EDM,	Progress Report Technical Assistance to Electricity Sector in Mozambique, January – December 1998.	1998	31-dec	Progress Report
17		Contrato Programa entre o Governo de Mozambique e a EDM, Marco 1997	1997	March	Contract
18	Sida,	Regeringsskrivelse – Landsbygdselektrifiering i Zambezia provinsen, Mozambique	2000	October	Policy
19	UD	Landstrategi för samarbetet med Mozambique 1996- 2001, Regeringsbeslut 11.	1995		Policy
20	Sida	Sida bedömningspm för utfasning av institutionsstödet till EDM 1997 – 1999.	1996	961106 beslut, 961024 PM, 960124 insats PM	Decision + PM + insatsidépapper

#	Author	Title	Year	Date	Type
21	Sida	Sida bedömningspm Rural Elektrifiering Ribaue/Ilapala, Mozambique.			Promemoria
22	Agreed Minutes	Agreed minutes from the Annual Consultations on Swedish Support to the energy sector in Mozambique, 24 November - 3 December 1997.	1997		Agreed minutes
23	Agreed Minutes	Semi-Annual Consultations on Swedish Support to the energy sector in Mozambique, May - June 1998	1998		Agreed minutes
24	Agreed Minutes	Annual Consultations on Swedish Support to the energy sector in Mozambique, 30 November – 4 December 1998.	1998		Agreed minutes
25	Agreed Minutes	Semi-Annual Consultations on Swedish Support to the energy sector in Mozambique, 26 May – 3 June 1999.	1999		Agreed minutes
26	Agreed Minutes	Annual Consultations on Swedish Support to the energy sector in Mozambique, 15-19 November 1999.	1999		Agreed minutes
27	Gunilla Åkesson, EDM – ASDI,	Socio-economic and gender study – rural electrification project in Ribaue-lapala area Nampula, Mozambique.	1997	1997	Report
28	Sida	Resultatanalys Energisektorn i Mozambique.			Promemoria
30	London Economics,	Inception Report Mozambique Power Sector Reform.	1997	1997	Report
31	EDM,	Gender and Development Seminar Final Report, Maputo 9th to 14th May 1997	1997		Report
32	Sida,	Sida's Assistance to a sustainable Energy sector.	1996	1996	Policy document
33	Ministerie dos Recoursous Minerais e Energia,	Strategy for the Mozambique Energy Sector.	1998	May	Policy
34	London Economics	Appendix 3, EDM, Basic Statistics.			
35	SEI,	Energy Interventions and Poverty Alleviation: Strengthening the linkages	1999	February	Literature review
37	Danida	Feasibility Report, Energy Sector Programme Support, Mozambique (draft).	1999		report
38	Leif Backéus	Rapport från besök Mozambique november 1999.	2000		Report
39	ICC	Inception Report for the Evaluation of Sweden – Mozambique development cooperation.	2000		Report
40	Sida	Konsultupphandling – utfasning av svenskt stöd till elsektorn I Mozambique	1996	18-sep	Decision + PM av Kårhammar +conditions
41	Lars Ekman	Strategy proposal for the energy sector, Summary of "Strategy for the Mozambican energy sector"	1999	02-sep	Report
42	Sida	Mandat: Nytt avtal för energisektorn I Mozambique	1996	09-okt	Decision
43	Sida/ Dag Sundelin	Uppdragsbeskrivning för rådgivare till energisektorn i Mocambique	1997	28-jan	Promemoria
44	Ambassaden Maputo Gösta Werner	Riktlinjer för halvårsgenomgång i Mozambique, Energi	1999	27-okt	Policy
45	Leif Backéus	Visit to Mozambique 1999-05-25 – 06-03, Report	1999	17-jun	Report
46	Gösta Werner?	PM Inför halvårsgenomgången Energi 31/5 1999	1999		Promemoria
47	Sida/INEC/INFRA	Adviser services EDM, Special purpose for system planning and operation, Interconnected grids (SAPP)	1998	23-dec	Decision + bedömnings PM
48	EDM/Swedpower	Progress Report Technical Assistance to Electricity Sector in Mozambique Project period January-June 1999	1999	30-aug	Progress Report

#	Author	Title	Year	Date	Type
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50	Government of Mozambique	Agreement between the Govenrment of Mozambique and Electricidade d Mozambique, E. P. 2000-2002	2000	March	Legal document
51		Contract financing of Technical Assistance to EDM 2000-2001	2000	February 18	Decision + Bedömnings PM
52		Project proposal Special Technical assistance to the electricity sector in Mozambique 2000-2001	1999	November	Project proposal
53	Agreed minutes	Annual Consultation on Swedish Support to the energy sector in Mozambique during 13-22 May 1996	1996	13-22 May	Agreed minutes
54	EDM	Rural Electrification Ribaue-lapala Area	1997	August	Project Document
55	EDM	EDM Annual Progress Report May 1996 for the projects: - Transmission and Distribution, - EDM Training Centre Activities, - Loss Reduction Project - Renovation Beira Substation and - Finalization Substation SE6 - Maputo	1996	May	Progress report
56	EDM	Report on Results December 94 & annual Work Plan 94/95 for the projects: - Technical assistance on Transmission and Distribution, - EDM Training Centre Activities, - Loss Reduction Project	1994	December	Progress report
57	?	Energy Sector cooperation Sweden - Moz 1992/93–1994/95: Technical Assistance on Transmission and Distribution	1992		Project document
58	EDM	Proposal for Energy Sector Projects 1991/92 - 1993/94	1990	2 October	Project Proposal
59	EDM, Sida, Swedpower	Minutes of Meeting from the Energy Sector Quarterly Meeting between Sida, EDM and Swedpower 5/9 1994	1994	5 September	Agreed minutes
60	EDM	Emergency Reconstruction of the Electric Grid in Nampula, Nacala, Monapo and Moambique Island due to Destruction caused by the cyclone “Nadia” March 24, 1994	1994	April	Report
61	EDM	Energy Sector Cooperation Sweden-Mozambique, Plan of Operation for the Period 1 July 1995 – 30 June 1996	1995	June	Project document
62	EDM	Proposal for Energy Sector Projects 1991/92	1991	14 March	Project Proposal
63	Embassy of Sweden Maputo	Extension of the Specific agreement on Cooperation within the Energy Sector	1995	29 June	Project proposal
63	Republica de Mozambique	Extension of the Specific agreement on Cooperation within the Energy Sector	1995	18 July	Project proposal
64	Arktech AB	Energy Sector Support, Mozambique	1996	7 June	Report
65	Falck, Hans	Poverty in Mozambique (draft)	2000		Report
66	EDM	EDM Training Centre Activities 1993/94 – 1994/95, Expanded Support	1993		Project document
67	EDM	EDM Training Centre Activities 1992/93 – 1994/95			Project document
68		Gurué – Cuamba – Lichanga Transmission line Project, Feasibility Study, Final Report, Volume I – Main report	2000	May 2000	Report
69	London Economics	Mozambique, Power Sector Reform, Regulation and Tariffs	1997	August	Presentation
70	Sveriges Ambassad, Maputo	Specific Agreement on Energy Sector Cooperation, 1 July 1988-30 June 1991	1988	30 June	Agreement
71		Agreed Minutes from Quarterly Review of the Energy Sector Cooperation between Mozambique and Sweden, 6-12 September	1990	12 September	Agreed minutes
72	EDM	Annual Report of the Board, 1997	1998	May	Statistical

#	Author	Title	Year	Date	Type
73	Republic of Mozambique, UTIP	2. Power Market, in Mepanda Uncua and Cahorra Bassa North Project, Feasibility Stidy	2000	12 August	Report
74	Sida	Projektbedömning: Stöd till Rural Electrification Ribaue-lapala Area, Mozambique	1997	4 August	Promemoria
74	EDM	Project Document, Rural Electrification Memba District, Extension to the Ribaue-lapala rural Electrification Project, Napula Province	1998	April	Project Document
75	Bioquest	Environmental Assessment for Electric Power Line Extension Nacala a Velha – Geba – Memba, Mozambique	1998	September	Environmental Impact Assessment
76		Project Proposal Rehabilitation and Rural Electrification	1992	July	Project Proposal
77	SEI	Environmental Assessment for Electric Power Line Extension Nampula – Ribaue – lapala, Mozambique	1997	November	Environmental Impact Assessment
78	EDM	Relatório Annual de Estatistica de Energia Eléctrica 1995	1996		Annual statistical report
79	EDM	Relatório Annual de Estatistica de Energia Eléctrica 1996	1997		Annual statistical report
80	EDM	Annual Statistical Report 1998	1999		Annual statistical report
81	EDM	Annual Statistical Report 1999 (manuscript)	2000		Annual statistical report
82	EDM	Annual Report 1997	1998		Annual report
83	EDM	Annual Report 1998	1999		Annual report
84	EDM	Revista Especial, 23 anos Iluminando o País (23 years illuminating the country)	2000	August	Popular
85	Sida	Policy for Miljöanpassat energibistånd	1996	April	Policy
86	Sida, Embassy of Sweden Maputo	Semi-Annual Report Mozambique, 1 October 1999 – 31 March 2000	2000		Annual report
87	Sida	Landstrategi för Samarbetet med Mozambique, 1 juli 1996 – 30 Juni 2001	1996		Policy
88	Sida	Landanalys Mozambique			Policy
89	Sida	Mainstreaming Equality between Women and Men, Handbook on Gender Perspectives in Energy Sector Development	1998	June	Report
90	Embassy of Sweden Maputo	Agreement on-lending	1998	6 April	Agreement
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92	EDM	Energy Demand Projections	2000		Print out
93	EDM, Area Operacianal de Napula	Nova Imagem Project (1997-2000)	2000	November	Report
94	EDM, Area Direcção Regional Norte	Loss Reduction Project	2000	November	Report
95	EDM, Area Direcção Regional Norte	Status of Ribaue-lapala Project at Nampula	2000	November	Print out
96	EDM, Nacala operational área	Local Power production 96-00, Annual energy invoice (MWh), Numbers of consumers by category	2000		Print out
97	Agreed minutes	Agreed minutes from semi annual meeting (6months) on Swedish Support to the energy sector in Mozambique	1997	5 May	Agreed minutes

#	Author	Title	Year	Date	Type
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99	EDM	Progress report Technical Assistance to the Electricity Sector in Mozambique, Project period January to December 1999	1999	30 November	Progress Report
100	NMCP	Implementation of Gender Policy at Electricidade de Mocambique	1998	28 August	Report
101	EDM, Training dep	Training Master Plan	1996	October	Plan
102	EDM, Training dep	Plano Geral de Formação,	2000	October	Plan
103	Swedpower	Interconnection of the Power Systems of Malawi and Mozambique, Final report	1996	June	Report
104	EDM	Gurué-Guamba-Lichinga Transmission line project Feasibility Study, Final Report Volume II- Environmental Impact Assessment	2000	May	Report
105	EDM	Gurué-Guamba-Lichinga Transmission line project Feasibility Study, Final Report Volume I- Main report	2000	May	Report
106	EDM	Actividades Realizadas nas Regiões Centro e Norte			Progress Report
107	EDM	Projecto de Reorganização de Gestão Comercial, Avaliaçao da Formação Realizada 15 de Novembro a 21 de dezembro	1999	December	Progress report
108	EDM	Rural Electrification Projects	2000	February	Plan
109	EDM	Report on the Training Project within Technical Assistance to the Electricity Sector in Mozambique, activities 1998	1998	December	Progress report
110	EDM	Report on the Training Project within Technical Assistance to the Electricity Sector in Mozambique, activities 1999	1999	December	Progress report
111	EDM	Qualidade Técnica de Seviço da Rede de Transporte	2000		Statistical Report
112	EDM	Relatório do Conselho de Administração 1999	2000	Julho	Statistical Report
113	Swedpower Norconsult	Cahora Bassa – Zimbabwe Interconnection, Final project report	2000	March	Report
114	Nordic Development Fund	NDF Review of the Cahora Bassa Interconnection project in the Republic of Mozambique and the Republic of Zimbabwe, draft report	1998	September	Report
115	EDM	Estudo do Impacto Sócio-Económico e nas Relações de Género, Relatório do Ponto de Partida	1999	November	Report
116	EDM	Rural Electrificatin Morrumbala, Pinda, Chipanga, Mutarara and Mopeia	1999	May	Project Proposal
117	Falck, Hans & Landfald, Kåre	The Poverty Reduction Strategy Process in Mozambique, A preliminary Assessment	2000	November	Report
118	Sakairi, Y	Private Participation in Isolated Grids in Mozambique	2000	Natural Resources Forum, Vol 24, pp 313-323	Article
119	Janeiro, H	Fax responding to evaluation team questions	2001	Jan 3	Fax

Appendix D

LFA Matrix, Project Activities

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
Maintenance						
Guidelines	All guidelines are implemented and used within EDM	Delay, approval needed from board	All guidelines are implemented and used within EDM	Guidelines approved and sent to regions. North and South region request assistance with seminars	Maintenance in accordance with guidelines. Implemementation seminars in S, C, N regions	Seminars carried out in November.
Specifications > 60kV	Finalise circuit breaker, current transformer and isolator specifications	Specifications completed	Finalise isolator and voltage trfo specs	Still not ready	Finalise isolator and voltage trfo specs	Still not ready (Not seen to be urgent. Down prioritized)
Training of Transformer Expert	Six months day to day training with adviser. Training in RAS	Training in RAS completed	Maintenance & Mgmt training in Sweden. Trafo training in RAS	Sweden seminar in July. RAS training not completed	Carry out trafo training seminars in RAS	Carried out first week of November
Work plans	Monthly follow up of work, review of plans	Work in progress	Monthly follow up of work, review of plans	Results are used for reporting to the board	Monthly follow up of work, review of 1999 plans, make plans for 2000	Results are used for reporting to the board
Investigations on transmission equipment	Investigations as required	Problem with Quelimane transformer investigated. Pollution measurements carried out. Transformer fault at Beira.	Investigations as required	Made part of specs of trafo for MOTRACO subst, etc. High work load. One more person needed.	Investigations as required	Maintenance manager appointed by EDM to be on MOZAL operation committee. All transm. Equip. checked by Dpt. All faults in the country investigated by Dept.
Create Distribution Management Organization	The team shall be trained…	Training and seminar completed by September	None		None	

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
Training course for heavy maintenance team	Seminars and training carried out (LFA)	No training carried out	OTJ training in Beira	Training will start 1st Dec 1998	Seminar for review of the whole period. Maintenance activity x-rayed and future objectives set.	Seminar was carried out in December 1999
Interchangeability standards >60 kV	Standards completed to 80% (c. trafo) and 20% (v. trafo)	Very little carried out	Current transformer and voltage transformers shall be ready	Very little work carried out	Current transformer and voltage transformers shall be ready	Very little work carried out. Project was down-prioritized.
Support adviser from home office	Support on request	First follow up and support carried out	Support on request	Carried out	Support on request	Follow-ups completed in May and Oct-Dec
Remaining activities from previous period	Registration of all trafos in Central area, tap changers. Gas analysis of remaining trafo:s	Computer listing complete. Data used in the planning.	Service on tap changers. Gas analysis continued according to plan	Computer listing complete. Data used in the planning.	Service on tap changers. Gas analysis continued according to plan	Computer lising complete. Data used in the planning. Little gas analysis carried out. Noted that this may be costly in the end, as no early warning for very costly faults is acquired.
Operation/Protection						
Support to EDM in O&P. Manuals to be produced, updated and revised	3 manuals ready in 1997	Excel spreadsheet developed	Completed	Completed	Finalised	Finalised
Collection of data in all regions	Data on distubances collected in all substations	80% of data collected	Data on peak load and disturbances collected in all substations	90% of data collected	Data on peak load and disturbances collected in all substations	90% of the data must be collected using the computers in Maputo, Chimoio and Quelimane.
Negotiations in SAPP	Attend all SAPP meetings	EDM sent bid for hosting permanent coord centre	Attend all SAPP meetings	EDM sent bid for hosting permanent coord. centre	Attend all SAPP meetings	EDM sent bid for hosting permanent coord. centre

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
Follow up transmission net	Test of relay transmissions in South system	Selectivity plans completed for Southern region	Test of relay transmissions in South system	Selectivity plans completed for Southern region	Test of relay transmissions in South system	Selectivity plans completed for Southern region
Improve the load flow	Check operations in the transmission networks	Many studies have been done	Check operations in the transmission networks	Many studies have been done	Nothing	Nothing
		Improve the fault current calculation – System is working	Data base completed	System is working	Data base completed	System is working
Follow up yearly work	No mention	No mention	No mention	No mention	No mention	No mention
Distribution planning						
Inventory of MV networks	Finalise inventory of MV networks	Inventory forms completed. No inventory in the field performed.	Finalise inventory of MV networks	New organization of EDM delays completion (?)	Finalise inventory of MV networks	Same note on organization change. Cooperation signed with UEM. Hopefully cooperation will result in a detailed database. GIS system for network management installed in by UEM. Students assist in inventory.

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
Upgrading of MV networks	Continue upgrading of MV networks in the Swednet system	Proceeded very slowly from March	Continue upgrading of MV networks in the Swednet system.	Progressing satisfactorily. Expert from Swednet visited and trained personnel in Nampula and Nacala. Most problems could be solved.	Continue upgrading of MV networks in the Swednet system.	Day-to-day work satisfactory. New Swednet version to be installed Nov. 99. Expected need for further expert assistance to install it. New installation diskettes delivered together with some upgraded networks in Maputo area which had been upgraded in Sweden.
Load flow studies and analysis	Follow up the load flow studies	-"-	Follow up the load flow studies	-"-	Follow up the load flow studies	-"-
Guidelines	Distribution planning and quality guidelines are implemented and used within EDM	Continued as planned	Distribution planning and quality guidelines are implemented and used within EDM.	Presentation made during visit 1/98 (Made in Sweden?) Quality guidelines part of SAPP involvement?	Distribution planning and quality guidelines are implemented and used within EDM.	Four volumes of guidelines translated into Portuguese and distributed. Quality guidelines proceeding as planned involving EDM through SAPP

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
Plans	Review existing plans for the distribution networks	Project proposals for Ribaue lapala, Rural electrification of Maputo and Gaza province, Network reinforcement of Tete/Matundo completed	Review existing plans for distribution networks	Proposals, updates etc for: Rehabilitation of Beira MV network Rehabilitation of Inhambane Distribution NW Gorongosa Natural Park Memba Rural Electrification Tete/Matundo MV NW reinforcement and rehab. Rehab Matola Distribution Rural electrification for Caia, Mopeia, Morrumbala, Luabo Tender docs for Tete/Matundo phase 1	Review existing master plans for distribution networks	Project proposals, updates etc for: Reinforcement and rehab of Maputo MV Rehab of Beira MV Rehab and extension of Inhambane Distribution Gorongosa Natural Park Memba Rural Electrification Tete/Matundo MV NW reinforcement and rehab. Rehab Matola Distribution Rural electrification for Caia, Mopeia, Morrumbala, Luabo + Pinda, Chipanga, Mutarara Tender docs for Tete/Matundo phase 1 Appraisal 110 kV Nampula-Pemba
Training Planning Department Team	Team theoretically trained and with practical use of knowledge	Proposal for training in economical and technical calculation elaborated. Proposal to repeat training in procurement with participation from all staff members	Team theoretically trained and with practical use of knowledge	3.5 day seminar on economical and technical calculation models implemented	Team theoretically trained and with practical use of knowledge	6 week training course performed at TC including one participant from Planning office

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
Cooperation	Cooperation with city planning authorities	Visit made to authorities of planning and Environment	Cooperation with city planning authorities	Visit made to authorities of planning and Environment	Cooperation with city planning authorities	City council of Maputo preparing a Master plan for Maputo and surroundings. Involve a.a. electricity authorities.
Training project						
A	3 year result: EDM training centre shall be able to plan, develop, implement and follow up decided training activities					
Inform counterpart on procedures	Counterpart familiar with training budget, cost follow-up, direction and tendering procurement before 30/6 1997	Counterpart familiar as required.	Counterpart shall plan and lead implementation of TP for 1998 (under supervision)	Courses in Zambia (Hydraulics) and Maputo (English) contracted	Counterpart shall plan and lead implementation of TP for 1999 (under supervision)	Counterpart has implemented and followed-up planned training activities
Work out time schedule	Plan and lead implementation and follow-up of training prg for 1997	15 of 19 planned activities were executed.	Pilot course on Micro Processors	Carried out. 7 participants	Micro processor course carried out by local instructor	Local instructor carried out the course in May and June. Second course carried out in November
Train in Human Resources Information System	4 staff using system as planning tools	3 staff trained	Pilot course on Power electronics	2 courses carried out 7+7 participants	EDM TC has local instructors to carry out Op. Amplifier course	2 instructors from EDM have the competence to carry out this course.
Two participants in HV cable course ESKOM	2 TC instructors able to work as instructors for cable XLPE jointing	2 staff trained	OTJ training on Personal Safety in Sweden	Postponed to 1999	Knowledge and skills of new technologies in Safety on el. Inst. have been transferred to 2 instructors	1 TC instructor has the skills. Acted as instructor in all courses up to 1998.

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
Two participants in OTJ programme at Furnas, Brazil	2 TC instructors upgraded	2 instructors trained			Train 2 instructors on MS Office software	12 EDM TC staff participated
One participant in Dig elect course ESKOM	1 instructor with good knowledge of Dig Elec techn.	1 instructor trained	2 pilot courses on Digital Electronics	Courses implemented 12+18 participants. Good evaluation	EDM counterparts able to carry out D.E. courses	2 instructors involved. Local instructors carried out 2*2 courses under supervision
Adjust objectives and contents for the transmission courses	Updated programme	Updated on two subjects.			2 EDM TC instructors participated in OTJ prg. On Distribution Line Construction Working with construction of Distribution lines	2 instructors participated in line construction for Northern region
Develop course documentation. Purchase equipment for Digital electronics	New module developed	New modules and short courses defined. Some equipment purchased			2 EDM TC instructors participating in course on Programmable Logical Controller	1 EDM TC instructor has competence
Installation of new equipment in cubicle at DER	Equipment for practical training available at EDM TC	Installations ready to 70%	2 TC instructors with basic knowledge on cubicle equipment at DER	Installations almost complete. Training?	2 EDM TC Managers participate in intensive English course	2 Managers have participated
					Train EDM TC instructors on how to use the oscilloscope in practise	6 instructors trained by Training Adviser (3 days)
					Attend OTJ training at ABB Sweden – give EDM capacity to teach Cable Course that was previously carried out by a consultant	Implemented at Birka Teknik & Miljö, Stockholm

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
					Study visit to Kafue Gorge Training Centre and Jokkmokkskolan in Sweden. Head of TC in Maputo and Chimoio familiarised with training prg and facilities	Study visit programme defined and implemented. Kafue 3 days, Jokkmokk 2 weeks
B	3 year result: Concluded training programmes for EDM generation Department and power stations staff will facilitate to manage, plan, operate and maintain the EDM power systems					
2 op instructors attending Hydraulic course ESKOM	2 op instructors able to give lessons	2 instructors from Chimoio trained and able.	2 op instructors from Chimoio able to give lessons	1 instructor trained	2 op instructors from Chimoio able to give lessons	2 operation instructors have the skills.
2 engineers attending Dam Safety Monitoring in Zambia	2 eng trained	No training carried out	2 engineers attending Dam Safety Monitoring in Zambia	2 persons attended the course		
9 electricians from Maputo, Inhambane, Coromana, Lichinga, Nampula, Nacala and Pemba attending course on theory and demonstration/ practice at EDM TC	Electricians with competence to give technical assistance on …	9 electricians trained	Pilot course on Maintenance related Operation	Part 1 carried out in Chimoio. Other in Kafue Gorge		

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
Seminars on Statistical planning and data analysis for power station performance and cost calculation (1997 & 1999)	Staff at Generation, Planning and Finance Dpts. Able to calculate production costs, availability of power, reliability of production systems (2 years)	Staff trained	Documentation and contents for hydro power subjects used in two courses	Documentation evaluated and have been evaluated and adjusted.	Follow-up seminar on Statistical planning and…	Carried out by ESKOM person. Generation, Planning, financ and Network Depts. People participated and have competence
Seminar on Project Evaluation	DEC engineers and managers from the regions with basic knowledge on financial project evaluation…	Four day seminar in November. Staff trained	EDM operational instructors competent on equipment in Chimoio	Training programme carried out	Follow-up seminar with 1997 consultant.	Eng. And managers form regions and central dpts participated
Short course Methods for Resource planning and Work Programming	DEC engineers and managers from the regions with knowledge on methods for resource planning	Postponed to 1998	DEC engineers and managers from the regions with knowledge on methods for resource planning	Postponed to 1999	Short course on Project Management	Carried out in Maputo by Swedpower consultant. 12 engineers and technicians participated
Study visit to Inhambane	Awareness of human senses in failure detection Daily condition monitoring of power stations	?				
		Course on fundamentals and objectives of machine surveillance included and carried out for Inhambane and Nacala staff				
					Follow-up seminar on Condition Based Monitoring system…	Carried out by RAS consultant in Maputo

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
					Seminars on Maintenance Management carried out in Nampula and Maputo	Cancelled due to consultant unavailability (working on progress report)
C:	3 year result: An elaborated gender policy for EDM					
Seminar to discuss gender strategies. Workplan for elaboration of gender policy. Participation from Boards, Central Departments (DGP, DEF, DEC, DER), regions and trade union.	Defined a workplan for gender policy A gender policy has been developed	1+3 day seminar carried out in Maputo with 28+17 participants. To be continued…	Statistics about gender and equal opportunities at EDM collected Gender Policy issues implemented in training center activities Article about Gender and equal opportunities presented in internal magazine	Dutch organization (NMCP) contacted for TA on gender Policy. Gender training manual completed. Training of 3 trainers Outline for another article in internal magazine Outline of pamphlet on gender to distribute to schools (girls for EDM) Translation of manuals completed Gender module introduced in training course	Study visit to Sweden for one EDM instructor.	Study visit for a man from EDM TC implemented in June
Loss reduction project						
3 year result: Reduce losses by 3% in Nampula and Nacala by 1997, Beira Dec 1998	Reduce losses by 3% in Nampula and Nacala		Reduce losses in Beira by 3% in 1998		Reduce losses in Quelimane by 3% in December 1999	
Office construction	Design, construction and equipment proc. completed	Completed	Office construction	Completed	New office for Loss reduction project	No achievement stated

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
Test area activities	Equipment procured, personnel trained, customers inspected, cutting programme running, Reading routines improved, meter mounting improved	Completed, Completed Completed (80% of 6750) Running Improved Improved	Equipment procured, personnel trained, customers inspected (6000) cutting programme running, Reading routines improved, meter mounting improved	Completed, Completed 75% Ongoing Running Start Jan 26	All costumers with estimated tariffs controlled for correction of invoice or meter installed Project personnel appointed and trained Inspection and rehab program running Improved reliability of loss statistics for LV grid New reading routines Cutting and re-inspection programme implemented Faster routines for reconnection after payment Retrieval of debts from clients that are difficult to cut such as Water Companies, hospitals, military installations, etc.	1794 clients sureveyed in Quelimane-Mocuba 9 of 12 appointed Ongoing Ongoing Ongoing Ongoing Ongoing Ongoing
LV documentation	Equipment procured, Swednet training completed, ongoing survey of networks, ongoing	Completed	On field training of technicians from Quelimane, Mocuba and Gurue	Proceeding according to schedule	Documentation of LV grid in Quelimane, Mocuba and Gurue. EDM staff capable to handle Swednet. Networks introduced in Swednet	Started, but slow progress. Gurue not surveyed.

1997 project document		**1997 Progress report**	**1998 Progress report**		**1999 Progress report January to December 1999 (June 6th (Sept 6th ?) 1999)**	
Activities 1997-99	Planned outputs 1997	Achievements 31st December 1997	Planned outputs 1998	Achievements 31st December 1998	Planned outputs 31st December 1999	Achievements 31st November 1999
MV inspection programme	Equipment procured. MV inst. Inspected.	Completed	Equipment procured. MV inst. Inspected.	Completed 75% ongoing	All medium voltage customers and big low voltage inspected and meters rehabilitated	All customers inspected. Rehab not started due to lack of meter equipment
Start up Nampula and Nacala 1997 Follow up Maputo Nampula, Nacala Beira	Knowledge transferred to Nampula and Nacala consultants. Ongoing loss reduction running according to programme.	Completed. Running according to programme.	Knowledge transferred from Nampula and Nacala consultants. Ongoing loss reduction running according to programme.	Completed Running according to programme		

Appendix E

The Power Sector and EDM

The energy sector policy of the Government of Mozambique defines the access to affordable energy services for households in both rural and urban areas as a major priority, but also to promote expansion of the production capacity of energy in the country (Government of Mozambique 1998, #33). Making the energy sector more efficient and economically viable is also given as a priority, as is the opening up of the energy market to private actors and ensuring proper governance.

The Power Sector

After independence in 1975, the young state inherited several independent power companies that in 1977 were merged into the state-owned *Electricidade de Moçambique* (EDM). With the promulgation of the new Electricity Act in 1997 EDM lost its status as a monopoly firm in the sector, and was also transformed into a public enterprise.

The new Act strengthened the role of the Ministry for Mineral Resources and Energy (MIREME), and also established three new organs that report to MIREME. The first is UTIP, which is to assist the Ministry develop new large-scale projects in the power sub-sector. The second is FUNAE, the rural electrification fund, and the third is the National Electricity Council (CNELEC). Of these, CNELEC's status is the least clear, as it is currently largely to function as an ombudsman in protecting consumer interests in the sector. Some actors, however, understand CNELEC to be an embryonic regulator in the energy sector. So far, however, this is a moot question since it is neither staffed nor really funded, and hence has not become operational yet.

The general strategy that EDM has pursued during this entire period is to expand the existing national transmission grid to better utilise its capacity. The basic reason for this is of course that Cahora Bassa provides reliable and very low-cost energy, and this should be exploited to the maximum extent possible for the benefit of Mozambique. The load on the existing grid is very low, not utilising the potential capacity. Load factors (peak) for the interconnected systems are not above 65%, and in the operational areas the load factors are not above 2%. EDM has also shown little interest in isolated grids, as they tend to generate costs rather than incomes for the operator since up until recently a unified national tariff was applied. The independent networks in Vilanculos and Montepuez charge tariffs about double those of EDM, but EDM itself has so far not developed differentiated tariffs based on cost-of-delivery estimates.

Options to increase access to electricity based on decentralised technologies are the mandate of the National Directorate of Energy (DNE) which is under the responsibility of MIREME. It is in the process of developing a national strategy for rural electrifiction that looks at all the technoligocally viable options, so that a more comprehensive yet realistidc approach can be developed. DNE is responsible for energy sector development including (i) policy formulation and implementation, (ii) project definition and promotion, (iii) initiation and formulation of regulations, and (iv) energy planning, management and conservation. DNE also has particular functions in areas such as rural electrification and distribution of petroleum products.

Some pilot projects have been initiated to look at the possibilities for private firm-participation in operation of isolated grids. The best example so far is the Panda gas-based network in the greater Vilanculos area (Sakairi 2000, #118).

Regarding the financing of rural electrification schemes, the creation of FUNAE (National Energy Fund) is important. FUNAE is an administrative and financially autonomous body with a board of five members from different ministries. The mandate for FUNAE is to improve the possibilities for low-income groups to have access to low-cost energy forms, and to promote conservation and a rational and sustainable management of energy sources. FUNAE is beginning to become operational as some staff are in place. In 1999, however, it only received about 10% of the funds that it should have received according to the statutes.

EDM

EDM operates as a commercial company, but should fulfil a number of responsibilities defined in a performance agreement between the company and the Government of Mozambique. This performance agreement is monitored yearly and reported to the government. The agreement states that EDM is responsible for management of the public services of generation, transmission and distribution of electrical energy, and in addition to this management of the national electricity grid and respective National Dispatch Centre.

Organisation

Over the period 1995–2000 the company has been restructured. The organisation now is divided into a managing organisation and three operational areas. The organisational structures of the company can be seen in Figures E.1 and E.2.

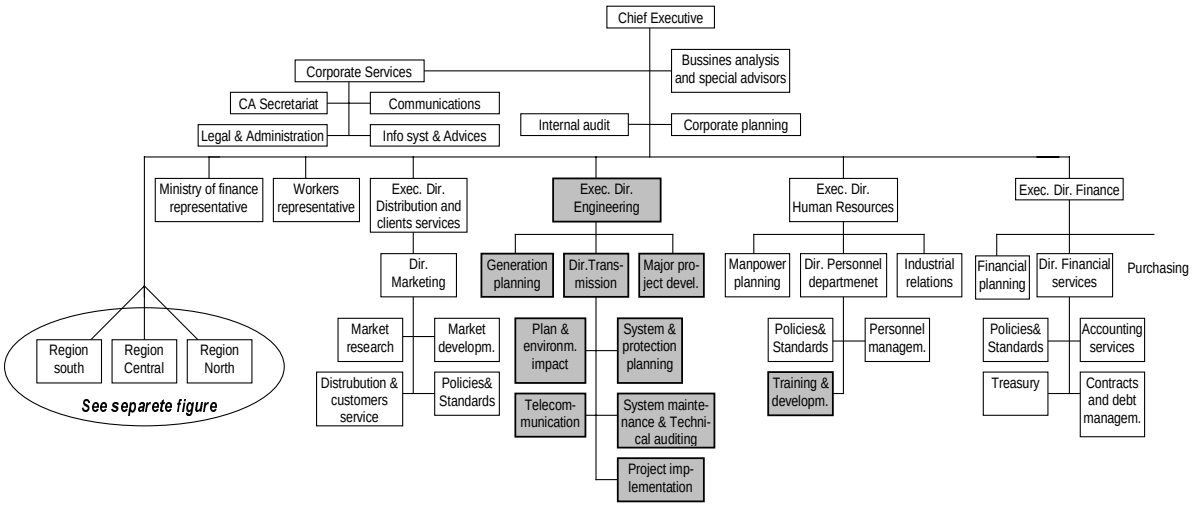

Figure E. 1: EDM's Organisational Structure (shadowed boxes: Sida supported departments)

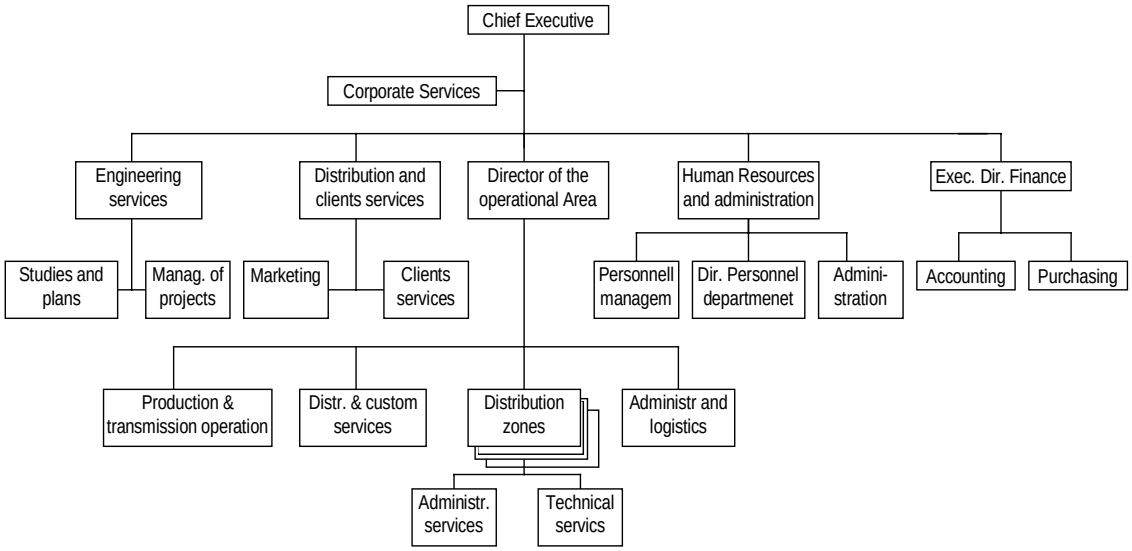

Figure E. 2: EDM's Operational Areas Organisation

There are a number of departments in EDM that has been receivers of support from Sida. The engineering departments found under the executive director of Engineering has received support for technical assistance and the training and development department has received support for training activities. Much of the support has also been allocated to the operational areas. For example the loss reduction activities are carried out at local operational level.

Power Consumption – EDM Network

The energy system is built up around the power delivered from the hydropower plant at Cahora Bassa. Cahora Bassa is operated by HCB (Hidroelectrica de Cahora Bassa), which is owned by the Portuguese state (80%) and the Government of Mozambique (20%). An agreement notes that 200 MW of the production is available for Mozambique's own use. The statistics of the power production, losses and invoicing is found in Table E.1.

Table E.1: Statistics of Production, Losses and Invoicing EDM 1995–1999

	1995		1996		1997		1998		1999	
	[GWh]	% of total	[GWh]	% of total	[GWh]	% of total	[GWh]	% of total	[GWh]	% of total
Generation	212.1	22.0%	238.8	23.3%	219	19.7%	243.8	20.3%	302.8	22.8%
Purchase	151.8	15.7%	185.5	18.1%	207.1	18.6%	615.3	51.2%	952.5	71.7%
Imports	601.4	62.3%	598.9	58.5%	686	61.7%	343	28.5%	72.8	5.5%
Total	**965.3**	**100.0%**	**1023.2**	**100.0%**	**1112.1**	**100.0%**	**1202.1**	**100.0%**	**1328.1**	**100.0%**
Export	0	0.0%	1.9	0.2%	0	0.0%	2.6	0.2%	0.1	0.0%
Transmission losses	56.2	5.8%	47.8	4.7%	75.9	6.8%	65.5	5.4%	55.8	4.2%
Gross available	**909.1**	**94.2%**	**973.5**	**95.1%**	**1036.2**	**93.2%**	**1134**	**94.3%**	**1272.2**	**95.8%**
Power station losses and auxilary consumption	17.9	1.9%	20.9	2.0%	27.6	2.5%	60.9	5.1%	86.7	6.5%
Distribution	**891.2**	**92.3%**	**952.6**	**93.1%**	**1008.6**	**90.7%**	**1073.1**	**89.3%**	**1185.5**	**89.3%**
Distribution losses	194.5	20.1%	273	26.7%	195.7	17.6%	158.4	13.2%	155.8	11.7%
Invoicing	696.7	72.2%	679.5	66.4%	813	73.1%	917.3	76.3%	1029.7	77.5%
Total losses and auxilary consumption	**268.6**	**27.8%**	**341.7**	**33.4%**	**299.2**	**26.9%**	**284.8**	**23.7%**	**298.3**	**22.5%**

In 1998 the high-voltage DC transmission line from Cahora Bassa to South Africa was rehabilitated and recommissioned. One result of this is the reduction in imported power in favour of purchased

power. Instead of importing the power from South Africa, it is now possible to purchase it directly from HCB. The power is still routed through South Africa. The wheeling charge is negotiated between EDM and ESKOM, and Sida has supported TA for these negotiations.

Of the available electricity, about 60% is sold to commercial consumers while households take the remaining 40%. There are large variations between different regions in Mozambique concerning the access to power.

Table E.2: Domestic Access to Electricity

Province	**Domestic consumers**		**Population**		**Access**	
	1998	*1999*	*1998*	*1999*	*1998*	*1999*
Cabo Delgado	4, 901	5, 134	1, 373, 627	1, 436, 496	2.1%	2.1%
Niassa	3, 228	3, 327	822, 179	848, 889	2.4%	2.4%
Nampula	25, 686	23, 931	3, 280, 289	3, 196, 472	4.7%	4.5%
Zambézia	8, 400	8, 846	3, 452, 059	3, 240, 576	1.5%	1.6%
Tete	6, 035	5, 289	1, 294, 361	1, 287, 517	2.8%	2.5%
Manica	2, 939	3, 877	1, 094, 465	1, 103, 857	1.6%	2.1%
Sofala	11, 878	14, 774	1, 478, 587	1, 424, 378	4.8%	6.2%
Inhambane	3, 250	3, 391	1, 156, 462	1, 222, 219	1.7%	1.7%
Gaza	9, 823	10, 409	1, 081, 843	1, 173, 337	5.4%	5.3%
Maputo	84, 798	87, 201	1, 882, 767	1, 906, 913	27.0%	27.4%
Total	*160, 938*	*166, 179*	*16, 916, 639*	*16, 840, 654*	*5.7%*	*5.9%*

From Annual statistical report 1999 and 1998, Average household size 6 persons

In all provinces except Maputo the access to electricity is very low. The performance contract therefore stipulates that EDM should connect an average of 8,500 new subscribers each year over the current three-year period (Government of Mozambique 2000, #50). This is only a 5% annual increase, however, which is a very low target rate. EDM could comfortably reach this number just by working on the back-log of demand in the greater Maputo area.

A unified tariff structure is applied by EDM to consumers being supplied from the national network. Till recently EDM would have to apply for tariff increases but the Government would actually decide. This has recently been changed to where EDM can in fact modify them but they can be reversed by Cabinet if it does not agree – i.e., a negative approval system. This is partly to decrease the "politicisation" of tariff setting, though EDM is enough of an actor in the field to realise that raising tariffs right before elections is probably not a smart move.

Till recently the tariff was also quite complicated, as it consisted of two components: the power charge, and the demand charge. This has now been done away with, so that consumers are now only to be billed according to the amount of energy they consume. For those households with a monthly average consumption below 30 KWh, a special "social tariff" is in place, to allow also low-income low-usage households access to power.

The big increases in power consumption will come from the mega-projects being considered. MOZAL is already operating, but several smelters are foreseen. The realisation of a number of them is still uncertain, which makes forecasting future power demands difficult. The projections for the year 2010 therefore vary from around 1,000 MW to more than 3,000 MW. This should be

compared with the existing power demand of 235 MW (peak value). But these estimates show the potential there is for Mozambique to expand its power genration just to supply internal demand.

Existing Facilities

Generation

EDM's own generating capacity is limited. There are a number of hydropower stations (11 operational turbines, 5 dams total) ranging from less than 1 MW to almost 20 MW. In addition to this a number of diesel generators, as well as steam and gas turbines can be found.

Table E.3: EDM Generation Capacity (1999)

	Available Capacity (MW)		Production (GWh)	
	1995	*1999*	*1995*	*1999*
Hydroelectric plants	82.6	82.6	183.3	266.4
Thermal	120.4	94.1	28.8	36.3
Total	203.0	176.7	211.1	302.7

Closing a number of old gas turbines as well as the closure of the thermal power plant in Maputo caused the decrease in generation capacity from 1995 to 1999. Despite this decrease in available capacity an increase in the own production has taken place. One of the reasons for this is the increased demand for power in the country, resulting in greater utilisation of the capacity, especially from hydropower.

Isolated diesel generators have been used in the rural areas to supply administration centres with electricity as off-grid solutions. Today many of these systems are found in disrepair, and operation is erratic.

Transmission (60/66 kV to 400 kV)

Mozambique is a vast country. Many of the potential energy sources are found in the North, while today the main part of the consumption takes place in the Maputo area in the South. In addition to this, people are scattered over the country thus making transmission lines an important and large component of the Mozambican power system. There is about 3,200 km of transmission lines where 220 and 110 kV account for about 75%. While these transmission lines were heavily damaged due to sabotage during the civil war, most of the damage has been rehabilitated today.

The power system was previously divided into three separate systems, but during the 1990s they have been interconnected.

Distribution (33 kV and 0,4 kV)

In 1999 there were more 6, 400 km of distribution lines (33 kV to 0.4 kV), with 25% being cables and 75% overhead lines. The development of the distribution system has mainly been in the 33-11 kV range, which is typical for rural electrification schemes.

There is not a clear strategy for rural electrification at EDM. There are some general considerations, such as expanding the Northern grid in order to be able to use the Cahora Bassa power in a efficient way, but a prioritised list of projects and a tentative time table for implementing it is not available.

International Co-operation within the Power Sector

The power sector benefits from considerable donor support. Extension of the electricity grid in rural areas is largely donor funded, with grant funds and concessional loans being on-lent at low interest rates to EDM. Further support is being provided in the form of grants and technical assistance to the DNE, FUNAE, and CNELEC.

The co-ordination of the activities is within the mandate of DNE. In practice, DNE is mainly focusing on off-grid electricity solution and other energy sources such as biomass while leaving the grid extension to EDM to manage. FUNAE could be a central actor for co-ordination of rural electrification schemes, but the lack of financial and human resources constitute major constraints.

The support to the power sector can be divided in support directed towards governmental institutions and towards EDM.

Table E.4: International Activities within the Power Sector

	GOM	**EDM**
NORAD	·	Gurué substation 110 kV line Alto Molocué – Gurué Rehab. and interconnection of central – North telecomm system
Sida		Technical Assistance Loss reduction Rural electrification of Ribáue – Iapala & Memba
Danida	Advisor DNE	Advisor service 110 kV line Xai-Xai and Inhambane Rehab and extension of Inhambane distribution network Rehab and extension of Tete distribution network Telecommunication
KfW		Rehab. Xai-Xai – Monapo & Nacala Substations Rehab. MV & HV Networks, Nampula & Nacala Rehab. Of 110kV line Nampula – Monapo – Nacala Rehab. Caia substation Rehab of rural electrification Gorongosa district
World Bank	Tariff system	
African Dev't Bank	Electrification master plan (grid solutions)	Electricity I – Maputo Electricity II

· NORAD has a health program including supply of PV-systems to health centres.
Source: Interviews, annual report 1999, #81

Appendix F

Business Relations Handled by DIPLA

The following is intended to summarize Contractual Agreements and other external documents of high importance for optimization and development of the core business of EDM. The documents have been or are being discussed during the years of 1999 and 2000 and will also be subject to discussion in the nearest future. By discussion it is meant full responsibility or comments and additions of vital importance. The list shall be regarded as a summary but not limited to:

- Wheeling Agreement between EDM and MOTRACO. Terms and conditions for wheeling of power from HCB via the MOTRACO network.
- MOTRACO, shareholders agreement
- MOTRACO, guarantee agreement
- MOTRACO, operational and maintenance agreement
- MOTRACO, telecommunication agreement
- MOTRACO, system operation agreement
- Power Sales Agreement between MOTRACO and MOZAL
- Power Purchase Agreement between ESKOM and MOTRACO
- Power Supply Contract between HCB (Cabora Bassa) and ESKOM
- Contract of Power Supply to Mozambican Network between HCB, ESKOM and EDM to the Southern Region of Mozambique
- Contract of Power Supply between HCB and the Central/Northern Region
- Negotiations and closures of agreements for treatment and application of the HCB/EDM/ESKOM contracts for non-covered conditions
- Power Supply and Wheeling Contract between EDM and ESKOM
- Power Supply Agreement between HCB and Zimbabwe Electricity Supply Authority (ZESA)
- Wheeling Agreement between EDM and ZESA on the 400 kV interconnection
- Wheeling Agreement between EDM and ZESA on the 110 kV interconnection
- Negotiations and closures of technical and commercial matters in the Corridor Sands Project, especially PPA and PSA. The Corridor Sands Projects aims at exploiting a heavy sand deposit and involves a total investment of approximately one billion USD
- Creation of a Special Purpose Company for financing, construction and operation of a USD 45 million transmission line investment between Maputo and Chibuto for supplying Corridor Sands

- Negotiations and closures of technical and commercial matters in the Maputo Steel and Iron Project, especially PPA and PSA. MISP aims at construction of steel manufacturing facilities in Maputo and involves a total investment of more than one billion USD.
- Extension of Wheeling Agreements with MOTRACO for power supplies to Corridor Sand MISP
- TOR and evaluation of feasibility studies for necessary infrastructure actions for power supply to the Beira area with a number of industrial mega projects
- TOR, evaluation and steering function in projects for reorganization of EDM, separation of account and general business development
- TOR, evaluation and steering function in projects for tariff development
- Financial arrangements and agreements in connection with industrial mega projects
- Trading and settlement functions as well as financial follow-up, controlling and reporting of major procurement business
- Power balance planning and organization
- Bilateral sales arrangements to members within SAPP; negotiations and closures of business agreements including working out of contracts and its applications. Especially contacts in progress with SEB (Swaziland) and Escom (Malawi). The latter also includes technical and commercial matters about construction of an interconnection between Malawi and Mozambique
- Organization and development of new functions for EDM's participation in power trading business on the SAPP Short Term Energy Market.

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