PN-ACT-749

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

Center for Environment
Office of Energy, Environment, and Technology

In collaboration with:

THE REGIONAL CENTER FOR SOUTHERN AFRICA, and THE SOUTHERN AFRICAN DEVELOPMENT COMMUNITY

DRAFT

SADC DEFINITIONAL MISSION REPORT

October 1999

Prepared under Contract for:
United States Agency for International Development
LAG-I-00-98-00006-00
Harnessing Market Forces to Provide Energy and Reduce Potential Greenhouse Gases In Sub-Saharan Africa

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23865-104-0006

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TABLE OF CONTENTS

INTRODUCTION 1
A Vision Of Regional Energy Trade 1
Background And Objectives 2
Overview 3
REMOVING BARRIERS TO TRADE AND INTEGRATION 4
Institutional Infrastructure 5
Physical Infrastructure 7
Current And Future Demand 7
Generation 8
Transmission And Interconnections 8
Distribution 10
Issues Common To All Countries 10
REGIONAL ISSUES 12
Electricity Trade 12
Southern African Power Pool 12
SADC Issues 13
SAPP Issues 13
POTENTIAL INTERVENTIONS 15
National-Level Interventions 15
Potential Interventions at the Individual Country Level 21
Malawi 21
Mozambique 22
Zambia 22
Zimbabwe 23
Potential Regional Interventions 24
SADC And Related Regional Assistance 24
Assistance to SAPP 24
Appendix A – Letter of Intent 26
Appendix B - Potential Interventions 29
Background 29
Non-SAPP Regional Interventions 29
SAPP Interventions 31
Appendix C – Specific Country Reports 36
Malawi 36
Overview 36
Institutional Framework 36
Structure 36
National Policy Objectives For Or Affecting The Power Sector 37
Legislation And Regulation 37
Tariffs 38
Financial Condition Of Power Sector Entities 38
Energy Sector Private Investment Potential 39
Primary Energy Supply and Production 40

Liquid Fuels 40
Natural Gas 40
Coal 40
Renewable Energy 40
Existing And Planned Power Systems 41
Summary Of Structure Of Power Sector 41
Current And Future Demand 41
Existing Electric Power System 42
Plans For Future System 44
Electricity Trade 46
Donor Activities 46
World Bank 46
African Development Bank 47
Other Donor Activities In The Energy Sector 47
Mozambique 48
Overview 48
Institutional Framework 48
Structure 48
National Policy Objectives For Or Affecting The Power Sector 48
Legislation And Regulation 50
Tariffs 50
Financial Condition of Power Sector Entities 52
Energy Sector Private Investment Potential 52
Primary Energy Supply And Production 52
Liquid Fuels 52
Natural Gas 53
Coal 55
Renewable Energy 56
Existing And Planned Power Systems 56
Summary Of Structure Of Power Sector 56
Current And Future Demand 56
Existing Electric Power System 57
Plans For Future System 57
Electricity Trade 61
Donor activities 62
World Bank 62
African Development Bank 62
Other Donor Activities In The Energy Sector 62
Namibia 63
Overview 63
Institutional Framework 63
Structure 63
National Policy Objectives For Or Affecting The Power Sector 64
Legislation And Regulation 65
Tariffs 66

Financial Condition Of Power Sector Entities 66
Energy Sector Private Investment Potential 67
Primary Energy Supply And Production 68
Liquid Fuels 68
Natural Gas 69
Coal 69
Renewable Energy 69
Existing And Planned Power Systems 70
Summary Of Structure Of Power Sector 70
Current And Future Demand 70
Existing Electric Power System 73
Plans For Future System 74
Electricity Trade 75
Donor Activities 77
World Bank 77
African Development Bank 77
Other Donor Activities In The Energy Sector 77
Zambia 78
Overview 78
Institutional Framework 78
Structure 78
National Policy Objectives For Or Affecting The Power Sector 79
Electricity 79
Tariff Policy 80
Institutional 81
Legislation And Regulation 81
Tariffs 82
Financial Condition Of Power Sector Entities 82
Energy Sector Private Investment Potential 82
Primary Energy Supply And Production 84
Liquid Fuels 84
Natural Gas 84
Coal 84
Renewable Energy 84
Existing And Planned Power Systems 85
Summary Of Structure Of Power Sector 85
Current And Future Demand 85
Existing Electric Power System 86
Plans For Future System 87
Electricity Trade 90
Donor activities 91
World Bank 91
African Development Bank 91
Other Donor Activities in the Energy Sector 91

Zimbabwe 92
Overview 92
Institutional Framework 92
Structure 92
National Policy Objectives For Or Affecting The Power Sector 92
Legislation and Regulation 93
Tariffs 93
Financial Condition Of Power Sector Entities 94
Energy Sector Private Investment Potential 94
Primary Energy Supply And Production 95
Liquid Fuels 95
Coal And Coal-bed Methane 95
Renewable Energy 95
Existing And Planned Power Systems 96
Summary Of Structure Of Power Sector 96
Current And Future Demand 96
Existing Electric Power System 97
Plans For Future System 98
Electricity Trade 100
Donor Activities 101
World Bank 101
African Development Bank 101
Other Donor Activities in the Energy Sector 101

AC	Alternating current
CCGT	Combined cycle gas turbine
CEC	Copperbelt Energy Corporation
CFD	French Development Agency
DANIDA	Danish International Development Assistance organization
DC	Direct current
DNE	National Directorate for Energy (Mozambique)
DOE	Department of Energy (Malawi, Zambia)
DRC	Democratic Republic of the Congo
ECB	Electricity Control Board (Namibia)
EDM	Electricidade de Mocambique
ESKOM	South Africa's national electric utility
ERB	Energy Regulatory Board (Zambia)
GDP	Gross domestic product
GOM	Government of Malawi
GOZ	Government of Zambia
GRN	Government of the Republic of Namibia
GWH	Gigawatt-hour
HCB	Hidroelectrica Cahora Bassa
IDA	International Development Association
IDC	Industrial Development Corporation (South African parastatal)
IFC	International Finance Corporation
IMF	International Monetary Fund
KFW	German Development Bank
KG	Kilogram
KM	Kilometer
KV	Kilovolt
KWH	Kilowatt-hour
LME	London Metal Exchange
Lonropet	Lonrho Petroleum

LPG	Liquified Petroleum Gas
MEWD	Ministry of Mines and Water Development (Zambia)
MIGA	Multilateral Investment Guarantee Agency
MJ	Megajoule
MOU	Memorandum of Understanding
MME	Ministry of Mines and Energy (Namibia)
MRLGH	Ministry of Regional and Local Government and Housing (Namibia)
MW	Megawatt
NamPower	Namibia's national electric utility
NE	Northern Electricity (Namibia)
NGO	Non-governmental organization
NORAD	Norwegian Development Agency
NRSE	New and renewable sources of energy
PPA	Power purchase agreement
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SCF	Standard cubic feet
SIDA	Swedish International Development Cooperation Agency
SNEL	Societe Nationale d'Electricite, the DRC's nat'l electric utility
SPI	Sasol Petroleum International
TAU	SADC's Energy Sector Technical and Administrative Unit
TJ	Terajoule
TPY	Tonne-per-year
UNDP	United Nations Development Program
US	United States
USAID	United States Agency for International Development
ZCCM	Zambia Consolidated Copper Mines
ZESA	Zimbabwe Electricity Supply Authority
ZPA	Zambia Privatization Agency

INTRODUCTION

A Vision of Regional Energy Trade

In the not too distant future, the electricity sectors of SADC countries will be very different than they are today. It has to change for a variety of reasons! The electricity system needs to expand. This means more generators, additional transmission lines and facilities and increased distribution assets. Governments simply don't have the resources to bring this about and their traditional banker, the World Bank, has been drastically reducing the size and types of loans it will make in the electricity sector. The Bank is now requiring removal or reduction of subsidies, restructuring of the sector, regulation and private provision.

In this new sector some class of electricity end-users in one SADC country will be able to purchase electricity directly from a generator or retailer in another country and because of this there will be tremendous savings to all countries. Generators will be very efficient because of competition to purchase kilowatt hours (kWh) on the basis of price. This will also mean that generation will locate where overall costs are lowest and economies of scale can be realized. Malawi, for example, would not need to invest in expensive thermal generation that would be used only when there is a drought. It will be able to purchase electricity from anywhere in the system. Consumers will benefit directly in the lower generation costs because there will open access and transmission tariffs will be regulated and transparent. Transmission will not be able fully absorb the profits but will have to pass on savings to consumers.

To get to this future there are a number of important steps which countries (1) must separately take that impact their markets and (2) jointly take to create and set the legal and regulatory boundaries of the regional market. On a country level certain physical investments must be made such as new generation plant or transmission facilities. Most SAPP utilities do not have the financial resources nor do their governments to undertake this investment. They will have to depend on private investment. To attract that private investment, governments must move to restructure and regulate the sector. This alone will not guarantee trade but it is an important step of helping to create rules of the game (removing barriers) so that investment in new facilities is catalyzed.

Regional electricity trade requires (a) a surplus of electricity, (b) a way of getting the surplus to the market (transmission and distribution) and (c) a market where the transactions cost to buyers and sellers is less than the gains from trade. The first two requirements can be met as countries restructure and reform their energy sectors, as discussed in the last paragraph. Any individual country can do this and will benefit regardless of whether other countries take the same steps. The last requirement, however, requires intergovernmental agreement as long as buyers and sellers are in different countries and subject to different rules of the game. It also requires a market – a place where buyers and sellers come together to trade.

The definitional mission's assessment shows that the countries, although to varying degrees, are moving in the right direction and there are concrete actions which USAID could do to help them

establish the legal, policy and regulatory rules and regulations to attract private investment.

However, the establishment of a regional market and regional trade are further off. SADC has taken important steps with its energy protocol. But this protocol needs to have more detail and strength to be operational. SAPP is taking steps to have the physical market infrastructure (coordination center and technical standards) in place so that a power pool as it now functions will be ready to meet this future. It can't do it alone and USAID is providing important assistance in helping SAPP with this infrastructure (See Appendix A). Regional agreement is required on many important items so that developers feel secure in investing in large power plants or transmission facilities, so regional trade can flow freely and so that the benefits of competition and private provision are passed along to the final customer. This is often best facilitated by a neutral informed broker such as what the RCSA is doing within the telecommunications sector or USAID is doing with the West Africa Gas Pipeline.

Background and Objectives

USAID and the Southern African Development Community (SADC) agreed to undertake a joint mission to Southern Africa with the ultimate aim of increasing regional integration and trade, thereby promoting regional growth. The specific objectives of the mission were to identify barriers to expanding energy trade and to develop a menu of options for potential USAID/SADC collaborative interventions in the SADC energy sectors that would either directly strengthen regional energy trade or, by serving as an example in one country, provide enabling frameworks that would remove barriers to increased trade and integration.

Two separate USAID-sponsored teams traveled to Southern Africa in April 1999. Each team consisted of a team leader from Bechtel Consulting, another international expert, and a representative from the SADC Energy Sector Technical and Administrative Unit (TAU) in Angola. One team visited Namibia, Zambia, and Malawi, while the other went to Zimbabwe and Mozambique, with each country visit lasting one week.

The activities of this trip were fact finding, technical interpretation, and assessment. They were designed to address several basic questions, principal among which were:

1. What barriers to regional trade in energy exist?
2. Which of these barriers are best dealt with by USAID?
3. Which of the barriers best addressed by USAID will have the greatest potential impact?

Two principal areas of concern were addressed in answering these questions: sector reform and regulation (indirect contributors to trade), and directly increasing trade in electricity. In the course of their investigation the Teams sought to assess conditions in the countries, identify barriers to and opportunities for private investment, competition, and increased electricity trade, develop approaches to removing barriers or capturing opportunities, and determine the need for strengthening the institutions that could foster those activities.

In each country the respective teams visited the USAID mission and met with the key participants in the electricity sector. The meetings were arranged by the SADC energy contact points in each country. The team was able to meet with essentially all of the people and organizations necessary for the mission, and gathered an extensive set of documents related to

the important issues, such as Electricity Act legislation, initial regulations, power sector master plans, Privatization Acts, and many others.

The United States (US)-based team members wish to express their sincere gratitude to the representatives from SADC TAU who accompanied them, the SADC country energy contacts who set up most of the meetings, and especially to the representatives we met from the in-country organizations for their cooperation, candor, and assistance in our performance of this study. The level of support and responsiveness was exceptional, making the work as efficient as possible.

Overview

The remainder of this report is organized as follows.

- Section 2 summarizes the Team's observations regarding barriers to regional integration and trade in energy.
- Section 3 discusses Regional Issues including SADC and SAPP
- Section 4 summarizes the set of potential interventions that have been identified.
- Appendix A is a copy of the Letter of Intent between USAID and SAPP.
- Appendix B provides a more detailed set of potential interventions.
- Appendices C provides the details of the information developed for each country.

REMOVING BARRIERS TO TRADE AND INTEGRATION

The SADC region countries are now transforming their energy sectors so that they fuel economic growth rather than put the brakes on it. This process of transformation is not unlike that which Asian countries began in the late 1980s. In many SADC countries, Government provision of energy is pervasive and government ownership has led to inefficiencies, high cost structures, inflexibility to change, under investment, inappropriate prices and other problems. Utilities are less efficient – for example:

- System losses in Mozambique averaged 55% in 1993 or many of the SADC utilities had less than 50 customers per employee as opposed to the World Bank median of 104;
- The national demand for commercial energy (fossil fuels and electricity) relative to supply is high; and,
- Energy prices do not reflect their "true" costs.

These conditions have resulted in both scarcity and higher costs. The transformation that is taking place is aimed on a national level at increasing the supply of energy in a rational, least cost manner through the provision of enabling frameworks and regulation, and through increased private sector involvement.

At the same time, many of the SADC country utilities have become interconnected and begun bilateral exchange as a means of reducing reserve requirements and taking advantage of surpluses in other countries. Yet the same forces that are being unleashed to transform the sectors will render utilities incapable of "setting the rules of trade". As long as utilities are state owned and not regulated, they have been free to exchange power among themselves as they have in the past. But competition, regulation and private provision will require that transparent rules of trade be established giving open access to all generators. This requires that governments establish the rules of the game – not utilities.

Many of the SADC countries are taking steps toward freeing their national markets to the forces of competition. While an important precursor to trade, trade among countries is not guaranteed simply because corporations wish it so. Investment in the physical infrastructure is required and it is generally agreed that most governments in the region and their parastatal utilities do not have the required resources. Nor can an association of parastatal companies such as SAPP bring this about. It is not the role of power pools and/or national utilities to guide government investment policies for the power sector. Trade in electricity takes place across a monopoly enterprise – the transmission entity or grid. Thus some form of rules or regulation is required to ensure access to the transmission system and transmission prices that are not monopolistic. The bottom-line is that Governments must create and frame the market by agreeing on such items as customs duties, who can trade, and tariffs for the monopoly carrier of goods and services.

This section presents the Team's findings based on their country visits and interviews with SAPP and the SADC TAU. It describes the current state of existing infrastructure (physical and institutional) and draws light to the barriers that exist.

Institutional Infrastructure

Typically, at the country level the main government organization is named or equivalent to a Department of Energy (DOE). In some countries it functions as a quasi-regulator; in others there is a separate regulatory body for electricity only or for energy in general. The regulators lack independence from the government and utilities with respect to both decision-making and fiscal matters pertaining to the power sector. There is a national electric utility, sometimes incorporated but still 100% government-owned, that typically owns and operates virtually all of the generation and transmission in the country. It also owns and operates most of the distribution, but not necessarily all. Table 2-1 summarizes the institutional frameworks in the countries visited.

Table 2-1. Summary Of Institutional Frameworks

	Malawi	Mozambique	Namibia	Zambia	Zimbabwe
Formal Policy	Draft	Yes	Draft	Yes	Yes
Energy Or Electricity Law	Needs Revision	Yes	Draft	Yes	Draft
Separate Regulator	Yes	Coming	Not Yet	Yes	No
Needs Strengthening?	Yes	It Will	It Will	Yes	It Will
Open Access Permitted?	Yes	Yes	Coming	Yes	Coming
Open Access Tariffs Exist?	No	No	No	No	No
Competition Permitted	Yes	Yes	Yes	Yes	Yes
Cost-reflective Tariffs	A Goal	A Goal	Yes	A Goal	A Goal
National Utility:	Yes	Yes	Yes	Yes	Yes
State Ownership	100%	100%	100%	100%	100%
Unbundled?	No	No	No	No	No
Generation	100%	See Note	100%	Most	100%
Transmission	100%	See Note	100%	Most	100%
Distribution	100%	See Note	Most	100%	100%
Commercialized?	No	No	Some	No	No
Financial Condition	Poor	Poor	Good	Poor	Poor
Existing Private Participants:					
Generation	No	See Note	Not Yet	Yes	Coming?
Transmission	No	See Note	No	Yes	No
Distribution	No	See Note	Yes	No	No

Note: Mozambique is unique in that the Cahora Bassa hydro plant is many times lager than the nation's entire demand, but exports nearly all of its generation to South Africa and Zimbabwe. It is not part of EDM, but is owned by the governments of South Africa and Portugal (through their ownership of the firm HCB). The transmission interconnections from the plant to South Africa and Zimbabwe are also not part of EDM.

The power sectors are at various stages in the process of restructuring and reform. Attracting private investment in the energy sector is a priority in all the countries, and all have taken at least some steps to encourage investment.

Even with this accomplished, the prospects for private investment vary widely. Macroeconomic conditions such as inflation, low overall and per-capita gross domestic product, and poor infrastructure are among the barriers.

Regional Institutions

There are two principal regional institutions dealing with electricity issues – SAPP and SADC.

SADC

SADC coordinates and addresses energy issues through the TAU in Angola. The TAU is transforming to a Commission which will give it access to broader funding and staffing opportunities. Two of the principal energy initiatives of the TAU have been the (1) Energy Action Plan which highlights the regions energy project needs for donor funding and (2) the Energy Protocol approved by SADC Ministers. Based on the directives set out in the Energy Protocol of the SADC the objectives of energy cooperation in the region shall be, among others, to:

- Harmonize national and regional energy policies, strategies and programs on matters of common interest;
- Cooperate in the development of energy and energy pooling to ensure security and reliability of energy supply and the minimization of costs;
- Cooperate in the development and utilization of energy in the region in the following sub-sectors: wood fuel; petroleum and natural gas; electricity; and other cross-cutting themes of interest to member countries;
- Promote joint development of human resources and organization capacity in the energy sector;
- Strive to achieve standardization in appropriate energy development and application including the use of common methods and other techniques; and,
- Cooperation in the research, development, adaptation and dissemination and transfer of low cost energy technologies.

SAPP

Central to SADC's energy program is the Southern African Power Pool (SAPP) under which the member countries will be linked into a single electricity grid.

The major objective of SAPP is to provide a reliable and economical electricity supply to the consumers of each of the SAPP members, consistent with the reasonable utilization of natural resources and the effect on the environment.

In order to achieve this overall objective SAPP will:

1. Coordinate the planning and development of interconnections between the respective networks of participating member utilities in order to expand the Interconnected Power System (IPS) and electricity trading in the region. This function needs to be reassessed as SAPP moves from power exchanges to a real-time market for electricity;
2. Reduce investments and operating costs, enhance reliability of supply and share in the benefits resulting from coordinated planning and operation of the IPS;
3. Coordinate the planning, development and operation of generation and transmission facilities in their respective networks with minimum impact on the environment.

There were compelling reasons for stronger regional collaboration and these included:

- Demand/supply imbalances;
- Economies of scale;
- Security and quality of supply;
- Financial constraints, both of utilities and governments;
- Benefits from joint thermal / hydro system operations;
- Better monitoring and control of environmental issues of concern.

To meet the overall objective, the participating utilities in the SAPP have undertaken to share information and knowledge and develop common operating criteria and procedures. With the establishment of a SAPP Coordination Centre, in Harare, it is hoped that the compilation and exchange of information between participating members will be encouraged and that the level of trading transactions between participating members will be significantly increased. SAPP is already looking at ways to improve the telecommunications network between all members and has developed an Operator Training Program for Y2K Roll Over & a SAPP Y2K Preparedness Plan. Other issues of mutual concern that SAPP continues to investigate and study include automatic generation control, frequency control performance and power oscillations on the interconnections.

Physical Infrastructure

Current And Future Demand

In 1997 the regional peak demand in the SAPP countries was 33,400 MW, of which South Africa contributed 84%, or about 28,000 MW. Due to its higher system load factor, its share was 86% of the regional energy demand of 210,000 GWH.

In mid-1998 the South African consulting firm SAD-ELEC forecast regional growth that averaged 2.6% per year in its Low case and 3.9% in the High case. Nearly all individual countries have higher forecast growth rates, but South Africa's lower forecast rate (2.2% - 3.5%) dominates the average because of its large share of the overall demand.

- Malawi: 1997 peak demand was 175 MW, and Base Case forecast growth is 5.5% per year.

- Mozambique: 1997 peak demand was 198 MW, and forecast growth is 6% to 6.5% per year after 2000, more before.
- Namibia: 1997 peak demand was 350 MW, and Base Case forecast growth is 5.2% per year.
- Zambia: 1997 peak demand was about 1,050 MW, and forecast growth is 2% per year.
- Zimbabwe: 1996 peak demand was 1,828 MW, and forecast growth is 4% to 6% per year.

Especially for the countries with low demand, a few (or even one) large projects such as a mine or a smelter may have as much load as total existing demand. The forecast average growth rates shown above do not properly illustrate this step-change characteristic.

Generation

Installed generating capacity was about 49,500 MW in 1997, which provided about 43,000 MW of available capacity after accounting for de-rated units and the mothballed coal plant capacity of ESKOM, South Africa's national electric utility. The generation mix is dominated by South Africa's coal fired plants in the south and hydro elsewhere, especially along the Zambezi River in Zambia, Zimbabwe, and Mozambique.

Allowing for 15% reserve margin, there was an excess of about 4,500 MW. However, this "excess" is misleading because it ignores the inter-temporal nature of demand and supply (was it available when it was needed) and it does not account for the spatial separation between demand and supply. For example, this excess supply would not have been available to Angola, Malawi or Tanzania because they are not connected to the grid. Demand growth in South Africa was flat in 1998, suggesting a period of four or five years before the first new plants will be needed[1].

Southern Africa as a whole currently has excess generation, but individual countries are short of capacity and/or energy. Individual countries have a strong desire for power self-sufficiency and for export earnings that may result in new generation being built despite the current excess.

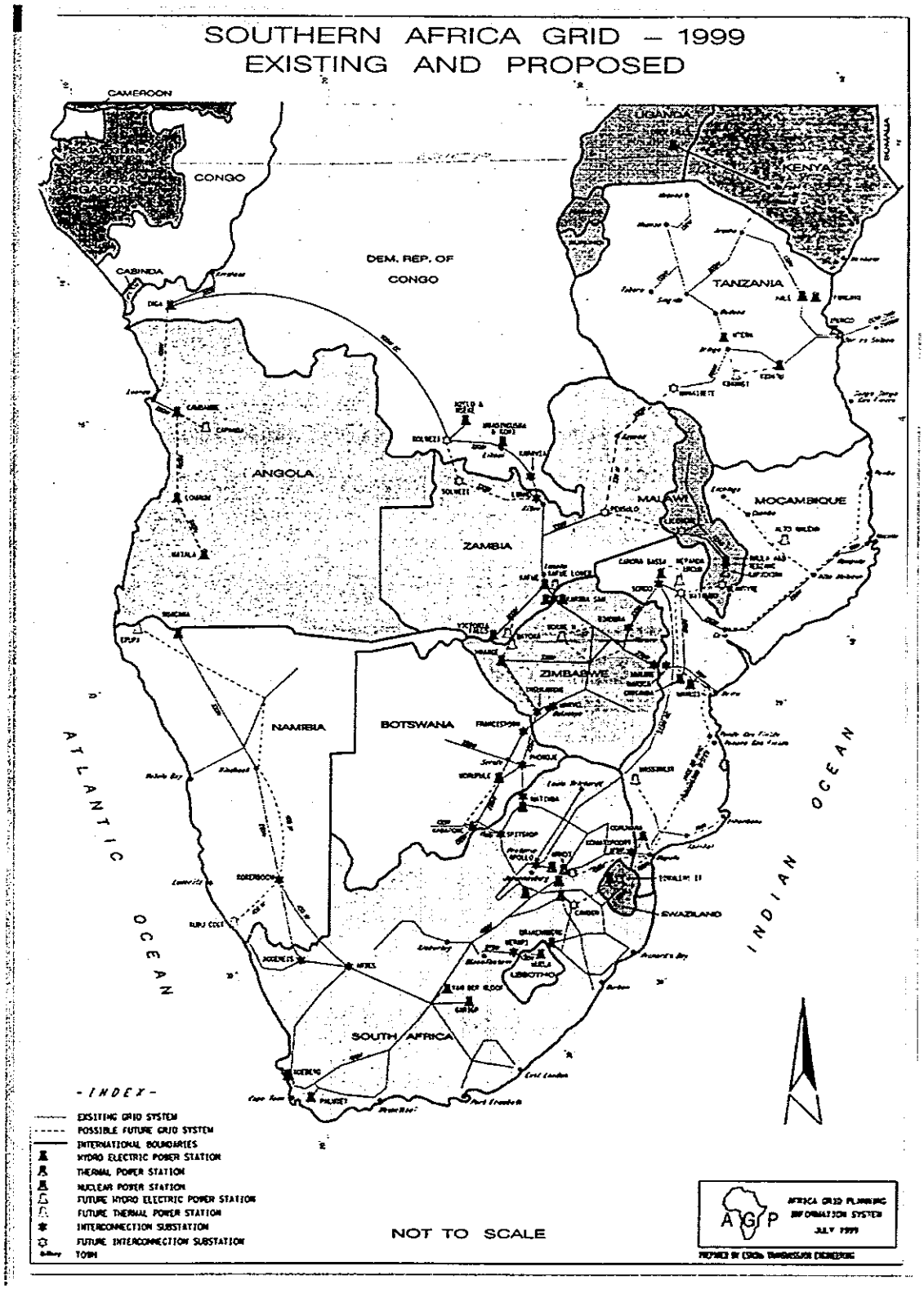
Where the utilities are financially weak the generating plants tend to need rehabilitation and improved maintenance practices.

Major new generation being considered includes thousands of MW each of hydro, coal, and gas-fired plants.

Transmission And Interconnections

Where the utilities are financially weak the transmission system also tends to need rehabilitation and improved maintenance practices. They are characterized by insufficient investment and need to be extended to serve a larger fraction of the country and to provide ties or strengthen ties to the regional grid. This can be seen from the map on the following page that shows the interconnections among SADC countries. Note that Angola, Malawi and Tanzania are not currently connected to the regional grid.

[1] This does not take into account the Government's goal of new connections.


SOUTHERN AFRICA GRID – 1999
EXISTING AND PROPOSED
CAMEROON
CONGO
GABON
CABINDA
DEM. REP. OF
CONGO
UGANDA
KENYA
TANZANIA
ANGOLA
ZAMBIA
MALAWI
MOCAMBIQUE
ZIMBABWE
NAMIBIA
BOTSWANA
SWAZILAND
LESOTHO
SOUTH AFRICA
ATLANTIC
OCEAN
INDIAN
OCEAN
- INDEX -
EXISTING GRID SYSTEM
POSSIBLE FUTURE GRID SYSTEM
INTERNATIONAL BOUNDARIES
HYDRO ELECTRIC POWER STATION
THERMAL POWER STATION
NUCLEAR POWER STATION
FUTURE HYDRO ELECTRIC POWER STATION
FUTURE THERMAL POWER STATION
INTERCONNECTION SUBSTATION
FUTURE INTERCONNECTION SUBSTATION
TOWN
NOT TO SCALE
AGP
AFRICA GRID PLANNING
INFORMATION SYSTEM
JULY 1999

Given the excess generation and diversity of resources, **strengthening weak or building new interconnection should be a development priority** necessary to protect against dry hydrologic conditions and provide anticipated export earnings.

Distribution

Distribution is usually the weakest function. Most of the rural population (for example, 99% in Malawi) does not have access to electrical power, the technical condition of the systems are poor, and commercial practices need to be improved. But the conditions extend beyond rural populations. In Zimbabwe, for example, less than 15% of the population has access to electricity.[2]

Extending service to the unserved population is a common policy objective, but in subsistence agriculture rural areas the distribution of electricity is largely not financially viable due to low levels of consumption, low customer density, and high operating costs. Promoting isolated generation from renewables[3] such as solar photovoltaics is also a policy objective, but does not solve the basic economic problem.

Issues Common To All Countries

To varying degrees all the countries want to make their power sectors more efficient and attract private investment and/or donor funding. For these and other reasons all the countries visited are undertaking power sector reform and restructuring in one form or another. To achieve these objectives most successfully, a comprehensive program would include the following elements. Priority interventions could address the problems where those elements are missing or imperfect.

- Establish national policy objectives for the power sector. These may include reform-oriented objectives such as eliminating monopolies, increasing competition, privatizing state-owned companies, attracting foreign investment, establishing new interconnections, improving efficiency, and more independent regulation of the power sector. They also may include objectives such as expanding rural electrification and the use of small-scale renewable energy, and achieving national self-sufficiency, which can impose economic burdens.
- Define the desired necessary elements of reform and restructuring consistent with the policy objectives. These would usually include unbundled power sector functions, competition in generation and supply, independent (or at least autonomous) regulation, private investment allowed in the power sector (especially independent power producers (IPPs)), open access to the transmission and distribution grids for producers and at least large consumers, rationalized and cost-reflective tariffs for monopoly functions and elimination of cross subsidies, and the reorganization, corporatization, commercialization, and eventual privatization of the existing state-owned vertically integrated monopoly utility.
- Develop or formalize an Energy or Electricity policy consistent with and supportive of the national policy objectives and the necessary elements of reform and restructuring.

[2] World Bank, How Do Sub-Saharan Utilities Compare, 1996.

[3] Renewable energy is not in the Regional Center for Southern Africa's Strategy but is covered herein because it will be of interest to other donors.

- Approve the legal framework for the reformed and restructured power sector, especially by creating and empowering an appropriate regulatory body (the regulator).
- Provide a legal and macroeconomic framework supportive of private investment in general and foreign private investment in particular.
- Put the regulator in place and establish its initial regulations.
- Implement rationalized cost-reflective tariffs and eliminate cross subsidies.
- Provide for open access to the transmission and distribution grids.
- Provide for the financial strength of the existing utility as a result of rationalized tariffs, improved collections, cost control, reducing debt, etc..
- Implement a rationalized planning process for generation and transmission system expansion.
- Implement a rationalized planning process for national electrification.
- Encourage the development of IPPs.
- Train personnel, especially the staff of the regulator and relevant Ministry, in the subject areas implied by the activities above.

Note that in order to accomplish something like regional harmonization of laws or regulations, specific activities like some of those noted above would have to be accomplished in individual countries.

REGIONAL ISSUES

Electricity Trade

There is a strong interest in expanding electricity trade, with the potential for substantial benefit. For example, even though Malawi has surplus generation in most years, in 1997 a drought led to widespread load shedding, which the interconnection with Mozambique would have prevented. Overall SADC trade amounted to about 13,000 GWH in 1996. Zimbabwe imported over 2,000 GWH, the most of any country. Botswana, Lesotho, Mozambique, Namibia, and Swaziland rely on imports to serve most or all of their demand. When interconnected, Malawi will rely on Mozambique for backup generation in case of drought. South Africa is the largest exporter. The Democratic Republic of the Congo (DRC), Zambia, and Mozambique also are or have the potential to be major exporters.

When the interconnections from Cahora Bassa to Zimbabwe and South Africa are operational and contracts for the power in place, exports from Mozambique could average 15,000 GWH in an average hydro year, far surpassing all other regional trade combined.

ESKOM dwarfs all the other utilities combined in terms of the amount of its generation and load and its financial and technical resources. Its dominant position is a matter of concern to some of the other utilities.

Southern African Power Pool

The SAPP Agreement between Operating Members was first signed on 8 December, 1995. Operation of SAPP is governed by that document, which limits Operating Members to those Electricity Supply Enterprises which are Members of the SAPP, which are interconnected with other SAPP Members, and which agree to comply with the Agreement. The purpose of the Agreement is to establish the basic principles and rules under which the interconnected portion of the SAPP will operate.

SAPP falls midway in the range from loose pools, with few obligations and rights, to tight pools, with more obligations but more rights. The main rights are to receive emergency support and transmission for emergency support. SAPP also provides a convenient mechanism that makes it easier to engage in a wide range of mutually beneficially transactions with uniform guidelines. The main obligations are to provide emergency support and transmission for emergency support if available, and to maintain at least a minimum level of generation reserves.

Other important benefits that some pools provide include:

- Reducing overall planning and operating reserves.
- Maximizing the output of low-cost resources.
- Providing security of supply, especially during unusually dry hydrologic conditions or emergencies.

SAPP is used for many transactions beyond the obligations, and it has strong support among the utilities of the region. However, the pool itself does not obligate members to plan or operate as

an integrated whole, so not all the benefits will be achieved unless they choose to do so voluntarily.

The individual countries' desire for electricity self-sufficiency is a major barrier to be overcome if the full benefits of power pooling are to be achieved.

SADC Issues

SADC is the primary regional organization, with a variety of energy-related activities and an energy contact person in each country

- It would be beneficial to have the policies and legislative and regulatory framework in the SADC member countries be consistent in important matters with each other (harmonization) and this can be partially achieved at the SADC TAU level through developing the details of the Energy Protocol. Ideally they would promote competition, private investment, rationalized pricing, least cost regional planning, financially and technically sound utilities, and an evenhanded approach to IPP development.
- The SADC countries do not have strong interconnections. Building new and improving existing interconnections and increasing transfer capability would provide substantial benefits by increasing the region's ability to undertake regional planning and electricity trade, eliminating constraints, improving security of supply, increasing regional reliability, equalizing the physical infrastructure among countries, and assisting in the electrification of the areas through which the interconnections pass.

SAPP Issues

SADC was instrumental in establishing SAPP. The management structure of SAPP has at its highest level the SADC Energy Ministers and Officials, who as a group are responsible for policy matters, requests for membership by non-SADC countries, and other matters referred to them by the Executive Committee. The SADC Energy Sector TAU provides a secretariat for the SAPP Executive Committee, advises and assists the Executive Committee, and performs other liaison-related functions. SAPP has several other links to SADC and its organizations. However, since SAPP is the key regional institution involved in the power sector, we devote a separate subsection to it here.

SAPP has strong support among the utilities of the region, but participants recognize the potential for improvement. Interventions could assist in achieving those improvements. These areas include:

- Areas Of Controversy. All the Operating Members of SAPP that we visited see certain controversial areas as posing problems that need to be resolved. Several people suggested that having an unbiased outsider address the issue might contribute to its resolution. These areas include:
  - ➢ High wheeling rates could make otherwise beneficial SAPP transactions uneconomic. The SAPP utilities are suspicious of each other's calculations of wheeling rates. Presently there is an interim agreement on wheeling rates with a flat rate for wheeling not directly related to the cost of providing the transmission services. The calculation of

wheeling rates involves making assumptions on data and rate principles, which are inherently arbitrary.

- Treatment of interruptible load and demand side management
- Methods and standards for testing generating units
- Calculation of the Operating Reserve Obligations
- Calculation of the System Peak Obligation and the Accredited Capacity Obligation for the next 12 months
- Calculation of the Net Generating Capacity in each Member's system
- Calculation of the payments and penalties for Insufficient Generating Capacity and administer rules governing Net Generating Capacity

- One of the key benefits of SAPP could come from savings due to joint planning. However, the SAPP imposes no obligation to undertake joint planning, it just makes it easier for the utilities to plan together. There is not a uniform approach to planning, or broad understanding of planning issues. A desire for national self-sufficiency is a problem in minimizing overall SAPP generation costs. The Purdue study is viewed by some as being too academic, and not necessarily the way SAPP planning should be done.
- The need for certain changes to the SAPP rules and framework was mentioned by several people.
  - SAPP participants should be able to sell to or buy from parties other than member utilities.
  - Membership should include all existing institutions that control or influence significant amounts of generation or transmission, and IPPs.
  - Dispute resolution procedures need improvement.
  - Requirements for sharing information should be specified.
  - The requirement that SAPP transactions be paid for in US$ is a problem for some utilities.
  - The reserve margin requirement may be too high.
- Technical standards are not uniform, do not cover all the necessary areas, and are not necessarily followed. Comprehensive uniform standards that were followed would improve reliability, operations, and in some circumstances the capability to undertake additional economic transactions.

POTENTIAL INTERVENTIONS

There are a large number of potential interventions aimed at restructuring and regulatory reform at a national level and, despite the lack of strong, transparent laws and enabling rules and regulations some private sector investment is taking place. Little donor effort is being provided to create and/or strengthen the institutions that must bring about this change and to oversee it and even less is being done to craft the "rules of trade" and promote the regional electricity market. This section describes those priority interventions aimed at the very foundation of competition, private investment and regulation of industry.

There is a variation in the progress toward energy market reform among the countries visited and there were different opinions about the nature of reforms required. However, there was broad consensus that increasing regional energy trade would be beneficial, that future capital for the energy sector must come from the private sector, and that the requisite institutions needed to implement the necessary changes, which would need supplemental nurturing. There is broad scope for beneficial assistance. The reform processes that are under way are not complete and are not fully integrated in any of the countries.

Energy trade is a regional issue and the strengthening of regional institutions and promotion of regional cooperation will be critical to maximizing the potential for energy trade. At the same time, many of the institutions required to support increased trade will continue to be at the national level.

In developing the set of interventions below the focus was on activities that could be implemented and conducted effectively in the near term. Appendix B lists a more complete set of interventions, including some that have a longer time frame.

National-Level Interventions

There are numerous similarities among the countries visited. As a result, a number of interventions have been identified that are applicable to more than one country. Others reflect the specific conditions and stages of reform of the individual countries.

General Issue: To varying degrees all the countries want to make their power sectors more efficient and be attractive to private investment and/or donor funding. For these and other reasons all the countries we visited are undertaking power sector reform and restructuring in one form or another. To achieve these objectives most successfully, a comprehensive program would include the following elements:

- Define the desired necessary elements of reform and restructuring. This would usually include unbundling power sector functions, providing for competition in generation and supply, independent (or at least autonomous) regulation, providing for private investment in the power sector (especially IPPs), open access to the transmission and distribution grids for producers and at least large consumers, rationalized and cost-reflective tariffs for monopoly functions and elimination of cross subsidies, and the reorganization, corporatization, commercialization and eventual privatization of the existing state-owned vertically integrated monopoly utility.

- Develop and formalize an Energy or Electricity policy consistent with and supportive of reform and restructuring.
- Provide a legal and macroeconomic framework supportive of private investment in general and foreign private investment in particular.
- Approve the legal framework for the reformed and restructured power sector, especially by creating and empowering an appropriate regulatory body (the regulator).
- Put the regulator in place and establish initial regulations.
- Implement rationalized cost-reflective tariffs and eliminate cross subsidies.
- Implement open access to the transmission and distribution grids.
- Provide for the financial strength of the existing utility through the implementation of rationalized tariffs, improvement in collections, greater cost control, reductions in debt, etc.
- Reorganize, corporatize, commercialize, and eventually privatize the existing state-owned vertically integrated monopoly utility.
- Implement a rationalized planning process for generation and transmission system expansion.
- Implement a rationalized planning process for national electrification.
- Encourage the development of IPPs.
- Train personnel, especially the staff of the regulator and relevant Ministry, in the subject areas implied by the activities above.

Note that in order to accomplish something like regional harmonization of laws or regulations, specific activities like some of those noted above would have to be accomplished in individual countries. However, this would be greatly facilitated if a detailed protocol were adopted that clearly spelled out many of the issues.

General Environment for Private Investment

Issue: Even though some private investment in power may be taking place, the general environment for private investment is not favorable in most countries. There needs to be a legal basis and concrete, transparent implementing rules and regulations.

Potential Activities (any one or all would be useful):

- In any country or set of countries: Review the legal framework and recommend changes that would improve the general climate for private investment.
- In any country or set of countries: Review the implementation of the existing legal framework and recommend changes that would improve implementation.

Policy

Issue: Not all countries have yet completely defined their program of reform and restructuring. A formal Electricity Policy, may not exist, may be inconsistent with the desired program, or may be inadequate to properly support such a program.

Potential Activities (any one or all would be useful):

- In any country or set of countries: Review the conditions in the country and develop and propose a program of reform and restructuring consistent with the national Government's objectives and local conditions.
- In any country or set of countries: Develop and propose an Electricity Policy designed to support the desired program of reform and restructuring.
- Assist in the development of the Electricity Policy for Malawi in coordination with World Bank support.
- "The rules of the game are still being formulated in Malawi" – USAID could play a role in getting them off on the right foot.

Legislation

Issue: Existing legislation may be inconsistent with the desired reforms, legislation to support the desired reforms may not exist, or existing or draft legislation may not be adequate.

Potential Activities (any one or all would be useful):

- In any country or set of countries: Review existing electricity legislation. Review draft electricity legislation. Develop and propose an Electricity Act designed to support the desired program of reform and restructuring.
- After approval of the Electricity Policy for Malawi, develop and propose a revised Electricity Act consistent with the approved Electricity Policy.
- In Zimbabwe: Provide assistance to the Ministry of Transport and Energy in completing revisions to the Electricity Act with focus on transmission access rights and wheeling.

Regulation

Issue: Independent, skilled and experienced regulatory bodies do not yet exist. While the World Bank has helped to create the environment that spawned the regulatory body, much work still remains to be done to make these bodies operational.

Potential Activities (any one or all would be useful):

- In any country or set of countries: Provide assistance in organizing and otherwise implementing the regulatory body.
- In any country or set of countries: Provide a basic support program in power sector regulation including training and technical assistance.
- In any country or set of countries: Provide legal or other assistance in creating model agreements for licensing, concessions, etc..
- In any country or set of countries: Provide assistance in tariff methodologies, separation of costs into generation, transmission, and distribution, the development of transfer pricing, wheeling rates, incentive tariff approaches in transmission and distribution, etc..
- In any country or set of countries: Provide assistance in developing technical and other standards for the regulator.

- In any country or set of countries: Provide assistance in developing open access regulations and tariffs.
- Provide assistance to the Zambia Energy Regulation Board (ERB) in the petroleum sector. It recognizes the need for assistance in all areas, but the Swedish International Development Cooperation Agency (SIDA) apparently will be providing assistance for building its capacity – but not in petroleum. The ERB approached the Lusaka USAID office for assistance in the petroleum sector, and a dialog is under way.[4]
- Provide assistance to the ERB in developing open access regulations and tariffs, which they intend to put in place.
- Provide assistance to the ERB in determining and regulating the costs of ZESCO.
- Develop and implement a program to bring together ESCOM, the Malawi Electricity Council, and financial institutions.
- Provide technical assistance for the Malawi Electricity Council and the Department of Energy. At present the Council has no donor support. Assistance would include support in energy pricing similar to the requirements for all countries. Assistance is also required for training of the relatively inexperienced staff and in drafting initial regulations.
- In Mozambique: Develop a support program for power sector regulation in response to the new Electricity Law. The assistance should initially be directed to staff performing regulatory functions at the Ministry of Mineral Resources and Energy and re-deployed as the independent regulator is organized. The program should include the following:
  - Technical assistance in tariff methodology development and separation of accounts
  - Seminars, on-the-job training and selected training abroad (e.g., the World Bank regulatory training in Florida).
  - A regional conference of SADC officials responsible for power sector regulation.
- Develop model concession agreements to facilitate energy trade. It is envisioned that these would be originally developed for one of the several energy developments being proposed in Mozambique and then generalized for use elsewhere.

Restructuring

Issue: Restructuring programs may be non-existent, not fully thought out, or inconsistent with their objectives.

Potential Activities (any one or all would be useful):

- In any country or set of countries: Perform a restructuring study. Implement the approved restructuring program.
- Provide restructuring advice to Mozambique, where there appears to be interest in distribution restructuring. They would like to see: each generator as a unit, transmission as a unit, and several regional distribution units.

[4] Not a RCSA area of involvement and a dialog is under way with G/ENV/EET.

- Review the plan for the restructuring of ESCOM and propose modifications, as appropriate. Presently the plan is for six firms: Generation, Transmission, three Distributors, and Construction.
- In Mozambique: Provide restructuring assistance for the power sector focusing on unbundling transmission and distribution. (Most generation is from IPPs or is imported and this is likely to continue.)
- Identify a twinning arrangement for ZESCO with a US utility.
- Assist ZESCO in spinning off its non-core activities.
- Provide assistance in developing ZESA's commercial capabilities (training and support for separation of generation, transmission, and distribution accounts by region)

Attracting Private Investment

Issue: There are a number of barriers to attracting substantial new foreign private investment. There are some exceptions, such as the Kudu Gas Field Developmet, to the rule, but until the enabling frameworks are in place, the few private investments that do take place will remain as exceptions

Potential Activities (any one or all would be useful):

- In any country or set of countries: Develop and implement a program to provide support in all aspects of IPP development.
- In Zambia: Support private investment in Kafue Lower through assistance in:
  - Licensing
  - Review/approve power purchase agreement (PPA)
  - Standards
- Improve the prospects for private power sector investment in Zambia through assistance in:
  - Licensing.
  - Review/approve power purchase agreement (PPA).
  - Standards.
  - Development of a model tendering process.
  - Development and implementation of a program to support the Department of Energy's May 5 program (hydro and transmission investment possibilities).

Training

Issue: Very few people in the SADC countries have experience in areas supporting reform and restructuring. Training in almost any area would be useful.

Potential Activities (any one or all would be useful):

- In any country or set of countries: Provide training in reform and restructuring in general, or any of its components:

- Policy, macroeconomic framework, legal framework for power sector restructuring.
- Encouraging private investment.
- Unbundling power sector functions.
- Open access to the transmission and distribution grids for producers and large consumers.
- Modern accounting practices.
- Providing for competition in generation and supply.
- Power sector regulation.
- Tariff methodologies, tariffs, forms of subsidies.
- The reorganization, corporatization, commercialization, and eventual privatization of the existing state-owned vertically integrated monopoly utility.
- Provide for the financial strength of the existing utility through the rationalized tariffs, improved collections, cost control, reducing debt, etc..
- Planning for generation and transmission system expansion.
- Planning for national electrification.

- Provide short term training for the Malawi Electricity Council on tariffs, licensing, etc. They are also interested in a study tour to Washington in December 1999 and have approached the World Bank for funding.
- Provide training by sending the Malawi policy staff to other countries to see what is going on elsewhere.

Planning

Issue: The planning processes are relatively weak and constrained by the desire for self-sufficiency in power production.

Potential Activities (any one or all would be useful):

- In any country or set of countries: Perform or support the performance of a comprehensive long-term generation and transmission expansion planning study for the power sector.
- Prepare a master plan for the electrification of Zambia.
- Perform a new long term planning study for Malawi, including a new calculation of long run marginal costs for ESCOM. The World Bank said it is time for a new study.
- Calculate life cycle costs for renewable / rural energy investments.

The Team was met by requests for assistance in the setting of tariffs in all countries. Responsibility for energy pricing is also in a state of flux in all countries, so that assistance will have to be tailored to individual country needs. At the same time, there is scope for the development of training that can be applied to more than one country. Electricity and gas transmission pricing, the use of incentive pricing mechanisms, and the introduction of market

approaches to pricing of electricity generation and ancillary services are the key areas of interest which have a high potential for impacting energy trade.

Malawi, Namibia, and Zimbabwe are all still in the process of creating or revising their Electricity Acts. All countries need to complete some elements of their overall energy legislation. Support in the drafting of legislation could have a significant impact on the nature of reforms in those countries.

There are a number of additional inter-country interconnections that have been proposed (Mozambique/Zimbabwe, Mozambique/Malawi, Zambia/DRC, Zambia/Tanzania, Zambia/Malawi). These all require interconnection studies. The development of Terms of Reference for these studies is a way to leverage assistance to projects that would have a large trade impact.

Potential Interventions at the Individual Country Level

There are additional potential interventions in Malawi, Mozambique, Zambia, and Zimbabwe. In Namibia, specific requests for assistance were for training or for improvements to SAPP.

Malawi

The Department of Energy (DOE) has primary responsibility for energy issues. Malawi has an Electricity Act (1998) but is currently working on an Electricity Policy Statement which is expected to provide further liberalization of the power sector. The Electricity Council, created under the Act, is the power sector's primary regulatory body. The Electricity Supply Corporation of Malawi (ESCOM) is the 100% state-owned, vertically integrated monopoly responsible for virtually all the generation, transmission, and distribution in the country.

Malawi is not currently connected to any SAPP members. The following proposed interventions are aimed at capacity building at the Electricity Council and the Department of Energy and at influencing the implementation of the Electricity Policy statement to prevent barriers to electricity trade in the event of interconnection.

- Assist in the development of the Electricity Policy for Malawi in coordination with World Bank support, in order to address the important issues of access, wheeling, transmission tariffs, etc.
- Act as a neutral broker between Mozambique, Malawi and South Africa to reach agreement on necessary points to allow interconnection with Mozambique and purchase of their power.
- After approval of the Electricity Policy for Malawi, develop and propose a revised Electricity Act consistent with the approved Electricity Policy.
- Provide technical assistance for the Electricity Council and the Department of Energy. At present the Council has no donor support. Assistance would include support in energy pricing similar to the requirements for all countries. Assistance is also required for training of the relatively inexperienced staff and in drafting initial regulations.
- Review the plan for the restructuring of ESCOM and propose modifications, as appropriate.

Mozambique

Mozambique passed an Electricity Law in 1997 that provides for the unbundling of generation. transmission, and distribution services, third-party access to the national grid on commercial terms, and for independent regulation. The National Directorate of Energy under the Ministry of Mineral Resources and Energy is responsible for energy policy in Mozambique. Electricidade de Mocambique (EDM) is the state-owned power supplier and is responsible for operating the three separate interconnected systems in Mozambique. The Electricity Department at the National Directorate of Energy is responsible for managing isolated systems.

The regulatory authority is yet to be set up and regulation currently is done in the National Directorate of Energy by staff in the Electric and Liquid Fuels Departments. A National Electricity Council will be formed to take over the regulatory function to evolve to a more independent institution.

Mozambique is making rapid progress. A number of coal, hydroelectric and natural gas projects are being proposed and the pressure is great on newly-formed institutions to make evaluations, conduct international negotiations and create viable regulatory bodies. This is a challenge, but with a large potential payoff. The following set of proposed interventions is directed at near-term capacity-building.

- Develop a support program for power sector regulation in response to the new Electricity Law. The assistance should initially be directed to staff performing regulatory functions at the Ministry of Mineral Resources and Energy and re-deployed as the independent regulator is organized. The program should include the following:
  - Technical assistance in tariff methodology development and separation of accounts
  - Seminars, on-the-job training and selected training abroad (e.g., the World Bank regulatory training in Florida).
  - A regional conference of SADC officials responsible for power sector regulation.
- Develop model concession agreements to facilitate energy trade. It is envisioned that these would be originally developed for one of the several energy developments being proposed in Mozambique and then generalized for use elsewhere.
- Provide restructuring assistance for the power sector focusing on unbundling transmission and distribution. (Most generation is from IPPs or is imported and this is likely to continue.)

Zambia

The Ministry of Mines and Water Development (MEWD) is the focal point of energy activities in the country, responsible for developing and implementing policy and for the overall development of the energy sector. The Electricity Act (1995) provides for the regulation of the generation, transmission, distribution, and supply of electricity and the Energy Regulation Act (1995) establishes the Energy Regulatory Board (ERB) and provides for licensing and tariff setting.

The government-owned Zambia Electricity Supply Corporation (ZESCO) provides virtually all of Zambia's generation and most of the transmission and distribution. However, a segment of

the subtransmission system serving the northern copper mining area and a portion of the interconnections with the Democratic Republic of the Congo is privately owned.

The Swedish International Development Cooperation Agency (SIDA) is currently providing assistance to the ERB. The following interventions are aimed at areas outside the scope of the existing assistance:

- Provide assistance to the ERB in the petroleum sector, in developing open access regulations and tariffs, and in determining and regulating the costs of ZESCO.
- Develop a program to take the current ZESCO and transform it into a company that can be unbundled and privatized. This requires defining the future structure for ZESCO and its progeny. Then coordinate the implementation of the overall restructuring process, including working with other donors.
- Upon completion of the structural definition of ZESCO, perform/coordinate the activities necessary to commercialize to company.
- Improve the prospects for private power sector investment in Zambia through assistance in:
  - Licensing.
  - Review/approve power purchase agreement (PPA).
  - Standards.
  - Development of a model tendering process.
  - Development and implementation of a program to support the Department of Energy's May 5 program (hydro and transmission investment possibilities).

Zimbabwe[5]

The Department of Energy under the Ministry of Transport and Energy is responsible for energy policy in Zimbabwe. Under the existing Electricity Act of 1985, generation, transmission, and distribution are done by the government-owned Zimbabwe Electricity Supply Authority (ZESA).

The Electricity Act is under revision. The major areas of reform are an accounting separation of generation, transmission, and distribution functions, accommodation of independent power producers and open transmission access, and independent regulation. ZESA has formed a subsidiary, Zimbabwe Power Company, for developing new power projects as of the beginning of 1999. This structure is in response to expected requirements of modifications to the Electricity Act. The Zimbabwe Power Company is pursuing the independent Gokwe North coal-fired power project.

Zimbabwe is the largest electricity importer in SADC. It is particularly well situated at the center of SAPP to benefit from electricity power transactions. ZESA has bilateral contracts with ESKOM, Hydroelectrica Cahora Bassa (HCB), ZESCO, and SNEL. Its treatment of transmission wheeling will be critical to regional power trade. Capacity-building assistance will

[5] **Country level activities in Zimbabwe will not be entertained through USAID.**

necessarily be limited until the passage of the revision to the Electricity Act and the creation of a regulator; however the following near-term assistance to existing institutions is recommended:

- Provide assistance to the Ministry of Transport and Energy in completing revisions to the Electricity Act with focus on transmission access rights and wheeling.
- Provide assistance in developing ZESA's commercial capabilities (training and support for separation of generation, transmission, and distribution accounts by region)

Potential Regional Interventions

SADC And Related Regional Assistance

There are many good reasons to work directly with the SADC TAU, particularly as it transforms to an Energy Commission. Two distinct types of work are involved: (1) collaborative assistance to the SADC in helping it to address its new role, providing comprehensive input in developing the details of the Energy Protocol and in development of the Implementing Rules and Regulations, and in preparing other regional enabling frameworks. This is very much like the assistance USAID has provided to the Telecoms Commission; and (2) inviting SADC technical staff to work alongside the technical assistance teams in the field in a particular country.

The team identified two priority areas.

1. The SADC Energy Protocol requires a great deal more work before it becomes a set of operating guidelines. While reaching this accord was a landmark and represented the removal of some barriers, it can now be said that the next major barrier in creating a regional energy market is the lack of detail in the protocol.
2. SADC requires assistance in more fully developing their Energy Action Plan. While the team acknowledges the importance of this activity, it believes this to be secondary to the development of the Protocol. Thus the team recommends that either another donor be found to take on this activity or that it wait until after the Protocol has been fully developed and is operational.

Assistance to SAPP

SAPP is an evolving organization. Operating rules are still being defined and there is a need for developing consensus on complex technical and commercial issues. There is a need to survey the current state of technical standards throughout SAPP and each Operating Member's compliance with SAPP standards, including the capability of national control centers. Our discussions to date have indicated that there are areas of disagreement among members and it is expected that the survey would reveal more. Examples of technical assistance that could be directed at these areas follow:

- Perceived high wheeling rates. Define rights of access to transmission and sharing transmission capacity, wheeling rates, and other requirements (e.g., unbundling of costs, data collection, metering), procedures, multi-system wheeling, etc. (Note: in some cases this could be a part of a larger effort in an individual country (or on a regional basis) to unbundle the power sector and calculate open access transmission tariffs or transfer prices for generation, transmission, and distribution.)

- Treatment of interruptible load and demand-side management. Develop an approach for insuring that pool rules adequately value demand-side options.
- Standards for testing generating unit. Establish methods and standards for testing generating units.
- Member capacity obligations. Define procedures for deriving the Operating Reserve Obligations, establish procedures for deriving the System Peak Obligation and the Accredited Capacity Obligation for the next 12 months, define procedures for deriving the Net Generating Capacity in each Member's system, establish procedures for deriving payments and penalties for Insufficient Generating Capacity and administer rules governing Net Generating Capacity, and evaluate the current and potential future impact of the reserve margin requirement on SAPP.

USAID has provided assistance to the SAPP that has been well received and could provide the basis for greater regional cooperation. However, experience elsewhere indicates that the nature of the planning function is likely to change significantly as market reforms are introduced. Theoretically, less central planning is required as the various players make decentralized decisions based on signals from the market. Balancing the benefits of joint planning with the benefits of a decentralization of the market will be a key legislative and regulatory issue. Technical assistance will be required in assessing the impact of market reforms on the type of planning required for SAPP, assistance in conducting planning studies, and in implementing market-based approaches to planning.

SAPP is the primary enabling institution for energy trade in the region. SAPP operating rules have a potentially profound effect on the goal of increasing regional trade. Actions that require near-term attention are:

- Specify an approach that would permit SAPP participants to sell to or buy from parties other than member utilities.
- Broaden membership to include all existing institutions that control or influence significant amounts of generation or transmission, and IPPs. Develop a procedure to give a stronger voice to these players.
- Evaluate the requirement that SAPP transactions be paid for in US$.
- Specify the requirements for sharing information
- Improve dispute resolution procedures.

The Southern Africa region is poised for economic growth and energy trade can at once be an engine for this growth and a physical manifestation of growing regional cooperation. Many of the elements to support increased energy trade are in place and a vision for a regional energy market is evolving. However, capacity-building at both the regional and national levels will be required to make this vision a reality.

Appendix A – Letter of Intent

U.S. Agency for
International
Development

LETTER OF INTENT
FOR
THE ASSISTANCE BY USAID OF THE ESTABLISHMENT OF THE SOUTHERN AFRICAN POWER POOL (SAPP) CO-ORDINATION CENTRE IN HARARE:

1.0 PREAMBLE

1.1 On 28 August 1995 the Intergovernmental Memorandum of Understanding (IGMOU) was signed and this heralded the birth of the Southern African Power Pool (SAPP). Full operations of the SAPP with seven interconnected members took place with the commercial operation of the 400kV RSA-Zimbabwe interconnector.

1.2 Trade within the SAPP continues to increase based on the Operations Guidelines updated from time to time by the Operating Sub-Committee (OSC) and the schedules in the Agreement Between Operating Members which are reviewed and updated by the Planning Sub-Committee (PSC).

1.3 The SAPP agreements make provisions for an independent legal entity to be referred to as the Co-ordination Centre (CC) which is administered by the OSC.

1.4 The OSC recommended and the Executive Committee (EC) approved the establishment of the CC in Harare, Zimbabwe. The CC constitution is in place but the OSC has not been successful in identifying a suitable candidate from within the region for the post of CC Manager. The EC approved that the OSC should approach the international donor community for assistance with the establishment of the CC. Discussions were held in Harare with some donor agencies including USAID on this subject.

2.0 KEY ELEMENTS OF THE ASSISTANCE

This letter of Intent (LOI) for the agreement of the SAPP to be assisted by USAID in the establishment of the CC in Harare sets out the principal terms and conditions set out below.

2.1 An Expert with power pool operations (title yet to be determined) will be provided for a period of two years, paid for by USAID. Best efforts will be made to have the said Expert in Harare by April 1999. SAPP will provide USAID with a clear definition of the roles and responsibilities of the respective expert and understudies. USAID will make the Expert available for consultations with SAPP prior to April 1999 to assist in the selection process for the understudies.

2.2 A power pool partnership will be arranged between SAPP and (preferably) two U.S. power pools, giving a high priority to the Mid Atlantic Power Pool (MAPP). This will be done through USAID's program with the United States Energy Association (USEA).

2.3 Upon completion of the Operating Subcommittee's plans for an independent telecommunications system with associated Information Technology (IT), expertise will be provided to review the proposed configuration and to provide comments / suggestions for the Operating Subcommittee in estimating the system costs.

2.4 Having jointly estimated the cost of the telecommunications system, USAID will work, if necessary, with other donors to assure full funding of the telecommunications and IT systems. Installation of the systems and training of appropriate staff in its operation will be included.

2.5 A web-page design expert will collaborate with the Operating Subcommittee to establish a SAPP Co-ordination Centre website, paid for by USAID.

2.6 The Co-ordination Centre Expert will be further supported with technical assistance including legal and environmental issues and the provision of related critical training.

2.7 SAPP Operating Subcommittee undertakes to have suitable office accommodation and support-staff available prior to the arrival of the Expert in Harare. Similarly, the Co-ordination Centre understudies (titles yet to be determined) will be available upon arrival of the Expert. Best efforts will be made to assist the Expert in securing suitable accommodation for the two-year period.

Two originals in English language, both texts being equally authentic.

SIGNED AND DONE AT HARARE THIS ..... Day of January 1999 in
FOR AND ON BEHALF OF THE SOUTHERN AFRICAN POWER POOL

.....
Eng. F Masawi – Chairman : SAPP Management Committee

THUS DONE AND ACCEPTED at .....
on this ..... Day of January 1999.

FOR AND ON BEHALF OF USAID

.....
Dr. S Schweitzer – Office of Energy, Environment and Technology

SOUTHERN AFRICAN POWER POOL

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OUR REF : ER/msm
WHEN CALL WITH REFERENCE
TO THIS LETTER PLEASE ASK FOR

F MASAWI

20 January 1999

Addressees Below

Dear Sir:

ALLOCATION OF URGENT SAPP PROJECTS

The Southern African Power Pool (SAPP) would like to advise as follows on the allocation of urgent financial assistance required by SAPP members for the efficient operation of the Power Pool. The allocation is a result of a series of discussions and correspondence between the SAPP and various Donor Agencies, in particular the World Bank, USAID and DFID.

ITEM	PROJECT DESCRIPTION	DONOR AGENCY	SAPP SUBCOMMITTEE
I	Establishment of the SAPP Co-ordination Centre	USAID	OSC
2	SAPP Wheeling Study	DFID	PSC
3	Audit of SAPP Control Centers	AFD	OSC
4	Environmental Strategy	World Bank	EnvSC

The respective Sub-Committee Chairpersons are requested to contact the Donor Agencies directly as appropriate to arrange the necessary implementation details and agreements.

In order for the SAPP to address other requirements, further assistance would be required and a Donor's Conference during the course of the year is under consideration.

Yours faithfully
Southern African Power Pool

F Masawi

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Appendix B - Potential Interventions

Background

Nearly everyone the team visited believed that some interventions would be valuable in improving the prospects for private investment in the power sector, increasing electricity trade in the Southern African region, or strengthening the institutions that are most important in establishing the conditions to achieve these goals.

Representatives of individual institutions tended to indicate that their needs were more physical (computers, vehicles, etc.) than technical (training, assistance in drafting regulations, etc.). However, they also tended to indicate that other institutions did have more of a need for technical assistance.

Non-SAPP Regional Interventions

Harmonize Regulations, Etc.

Issue: It would be beneficial to have the policies and legislative and regulatory framework in the SADC member countries be consistent in important matters with each other (harmonization).

Potential Activities (any one or all would be useful):

- Review the current policies and legal and regulatory frameworks (as they relate to power sector activities) in the SADC countries.
  - Objectives, energy/electricity laws, regulatory bodies, tariffs, open access, restrictions on foreign investment/ exchange controls, banking, all aspects of IPP development, taxes, subsidies, planning approach (self-sufficiency), financial and physical condition of utilities, etc.
- Develop a model policy and legal and regulatory approach designed to promote competition, private investment, rationalized pricing, least cost regional planning, financially and technically sound utilities, and an evenhanded approach to IPP development.
- Identify problem areas with respect to this model framework and develop and propose solutions.
  - Review current and expected future market development in South Africa and evaluate in the context of the model framework. Identify problem areas and propose solutions. (South Africa and ESKOM dominate the regional power sector with respect to demand, generation, financial resources, and expertise. South Africa is singled out due to its dominant role in the region's power sector. ESKOM is so big, one must take it into account when considering regional interventions.)

⇒ Develop a proposal to reform South African power sector, especially the regulator.

⇒ Disaggregate ESKOM, especially by creating many generation companies.

- Develop concepts for and propose potential regional roles for the regulatory bodies, obtain consensus, and develop an approach to achieve implementation.
- Provide training for policy makers, legislators, regulators, energy department personnel, and utility personnel on the issues noted above:
  - ➢ Current national policies and legal and regulatory framework;
  - ➢ Model policy and legal and regulatory framework;
  - ➢ Problem areas;
  - ➢ Potential regional roles for regulatory bodies.

Interconnections

Issue: The SADC countries do not have strong interconnections. Building new and improving existing interconnections and increasing transfer capability would provide substantial benefits by increasing the region's ability to undertake regional planning and electricity trade, eliminating constraints, improving security of supply, increasing regional reliability, equalizing the physical infrastructure among countries, and assisting in the electrification of the areas through which the interconnections pass.

Potential Activities (any one or all would be useful):

- Conduct a comprehensive regional interconnection study, considering different regional interconnections and combinations of interconnections.
  - ➢ Identify barriers to development of interconnections.
  - ➢ Assess relative priorities for development of interconnections.
- Develop detailed Terms of Reference for interconnection feasibility studies (Mozambique/Zimbabwe, Mozambique/Malawi, etc.).
- Conduct interconnection feasibility studies.
- Assist in the development of detailed arrangements for specific transmission interconnections where a Memorandum of Understanding (MOU) has been signed, specifically the line between Malawi and Mozambique.
- Provide training for decision makers, analysts, planners, and other interested parties on the issues associated with interconnections.

General

Issue: SADC is not as effective as it might be in Southern African power sectors. Other regional issues are also potentially important.

Potential Activities (any one or all would be useful):

- Review the SADC program and constraints for the power sector, develop an approach to strengthen it, and obtain consensus on the approach;
- Conduct a market assessment for regional photovoltaic manufacturing capability for the Southern African market;
- Study the impact of country-by-country environmental standards, develop an approach to implementing regional standards, and propose it to SADC or the SADC countries;
- Study the impact of country-by-country dam safety standards, especially the impact of hydrologic assumptions, develop an approach to implementing a regional standard, and propose it to SADC or the SADC countries.

SAPP Interventions

Coordination Center

Issue: Many organizations have a strong desire for the Coordination Center to become fully operational as soon as possible.

Potential Activities (any one or all would be useful):

- Define the full set of requirements for equipment (including communications), procedures, data, etc., to operate the Coordination Center;
- Support getting the Coordination Center into full operation by assisting in establishing data bases, operating surveys, emergency procedures, operating protocols, etc.;
- Train Coordination Center staff, when they are in place;
  - See next section for training for system controllers in the individual countries.

Training

Issue: The level of expertise of system controllers for the SAPP utilities varies, and few are experienced in interconnected system operation. It would be beneficial to achieve a uniform high level of expertise, which is desired by all Operating Members of SAPP that we visited. The SAPP Operating Guidelines require that "Each System and/or Control Area shall provide its personnel with training that is designed to promote reliable operation."

Potential Activities (any one or all would be useful):

- Train system controllers in:
  - Interconnected power system operation, inadvertent interchange accounting, emergency capacity replacement, automatic generation control, time and frequency control, area control error, etc.

- Appendix IV A of the SAPP Draft Operating Guidelines lists about 200 suggested items for training for system controllers, in the areas of normal and abnormal operations, communications, interconnected system operation, modern power system control aids, and personnel supervision.
- Activities specific to the SAPP.

Wheeling Rates and Related Issues

Issue: High wheeling rates could make otherwise beneficial SAPP transactions uneconomic. The SAPP utilities are suspicious of each other's calculations of wheeling rates. Presently there is an interim agreement on wheeling rates with a flat rate for wheeling not directly related to the cost of providing the transmission services. The calculation of wheeling rates involves making assumptions on data and rate principles which are inherently arbitrary. All the Operating Members of SAPP that we visited see wheeling rates as a problem that needs to be resolved. Several people suggested that having an unbiased outsider address the issue might contribute to its resolution.

This is an "Area of Controversy", discussed in the subsection below, but is worthy of a separate subsection because it is viewed as being so important.

We were told that "the British were working on wheeling rates", but we were also told by a member of the SAPP Operating Subcommittee that he did not know of any work the British or anyone else was doing in this area, and he was in a position where he would be aware of any such activity.

Potential Activities (any one or all would be useful):

- Study the impact of wheeling on SAPP. Which transactions occur, which are rendered uneconomic, what would happen if the current situation were changed.
- Develop an approach to handling the key issues regarding wheeling within SAPP, propose it to the SAPP, and obtain consensus.
  - Principles;
  - Rights of access to transmission and sharing transmission capacity;
  - Wheeling rates;
  - Requirements (e.g., unbundling of costs, data collection, metering), procedures, multi-system wheeling, etc.
- Gather the necessary information and calculate the wheeling rates using the consensus approach.
- Note: in some cases this could be a part of a larger effort in an individual country (or on a regional basis) to unbundle the power sector and calculate open access transmission tariffs or transfer prices for generation, transmission, and distribution.

Areas Of Controversy

Issue: In addition to wheeling, there are a number of other issues which are controversial within SAPP, and which all the Operating Members of SAPP that we visited see as problems that need to be resolved. Several people suggested that having an unbiased outsider address the issues might contribute to their resolution.

Potential Activities (any one or all would be useful):

The same general approach to addressing any or all of these issues could be followed as the approach to addressing wheeling.

Study the issue and evaluate its current and potential future impact on SAPP.

- Develop an approach to handling the issue, propose it to the SAPP, and obtain consensus.
- Gather the necessary information and calculate the resulting parameters using the consensus approach.
- Note: in some cases this could be a part of a larger effort in an individual country (or on a regional basis) to address the issue.
- The issues include:
  - Treatment of interruptible load and demand side management;
  - Methods and standards for testing generating units;
  - Formula to derive the Operating Reserve Obligations;
  - Determine the System Peak Obligation and the Accredited Capacity Obligation for the next 12 months;
  - Determine the Net Generating Capacity in each Member's system;
  - Determine payments and penalties for Insufficient Generating Capacity and administer rules governing Net Generating Capacity.

Planning

Issue: One of the key benefits of SAPP could come from savings due to joint planning. However, the SAPP imposes no obligation to undertake joint planning, it just makes it easier for the utilities to plan together. There is not a uniform approach to planning, or broad understanding of planning issues. A desire for national self-sufficiency is a problem in minimizing overall SAPP generation costs. The Purdue study is viewed by many as being too academic, and not the way SAPP planning should be done.

Potential Activities (any one or all would be useful):

- Review current planning approaches, propose a set of planning criteria and assumptions to SAPP, and obtain consensus;

- Provide technical assistance and training on long term generation and transmission system expansion planning;
- Provide a study of regional transmission capabilities and ratings;
- Provide a study that develops an optimum long term regional generation and transmission expansion plan. Repeat the study on a regular basis. (In effect. create the regional plan until SAPP itself is prepared to do it.)

Harmonize Regulations. Etc.

Issue: It would be beneficial to have the legislative and regulatory framework in the SAPP member countries support the goals and transactions of SAPP, and be consistent in important matters with each other (harmonization). Ideally they would promote economically desirable transactions and least cost regional planning.

Potential Activities (any one or all would be useful):

- Review the current legal and regulatory frameworks (as they relate to SAPP) in the countries of Operating Members, identify problem areas and areas which are inconsistent among countries, and develop and propose solutions;
- Develop concepts for and propose potential roles for the regulatory bodies with respect to SAPP, obtain consensus, and develop an approach to achieve implementation;
- Develop concepts for and propose a forum for regional regulatory boards to meet, discuss problems, and develop consensus on solutions, with special focus on promoting SAPP transactions.

SAPP Rules / Framework

Issue: The need for certain changes to the SAPP rules and framework was mentioned by several people.

Potential Activities (any one or all would be useful):

- Develop proposals for specific changes to the relevant SAPP documents that would address the issues noted below, and obtain consensus:
  - Specify an approach that would permit SAPP participants to sell to or buy from parties other than member utilities;
  - Broaden membership to include all existing institutions that control or influence significant amounts of generation or transmission, and IPPs. Develop a procedure to give a stronger voice to these players;
  - Improve dispute resolution procedures;
  - Specify the requirements for sharing information;

- Modify the requirement that SAPP transactions be paid for in US$;
- Evaluate the current and potential future impact of the reserve margin requirement on SAPP. Develop an approach to handling the issue, propose it to the SAPP, and obtain consensus.

- Develop an approach for harmonizing the SAPP and the ESKOM (South Africa) internal pool.
- Evaluate the current and potential future impact of the penalties specified in the existing documents (now there is a temporary waiver). Develop an approach to handling the issue, propose it to the SAPP, and obtain consensus.

General SAPP

Issue: Additional communication and discussion would assist in moving SAPP forward.

Potential Activities (any one or all would be useful):

- Hold workshops on SAPP issues such as pool status, the policy changes, implementation needs, and financial support needed to move ahead, and the conditions for private sector participation in SAPP investments.
- Based on such workshops, develop, propose, and obtain consensus on approaches for addressing problems and generally assisting in the functions of SAPP.

Technical Standards

Issue: Technical standards are not uniform, do not cover all the necessary areas, and are not necessarily followed. Comprehensive uniform standards that were followed would improve reliability, operations, and in some circumstances the capability to undertake additional economic transactions.

Potential Activities (any one or all would be useful):

- Survey the current state of technical standards throughout SAPP and each Operating Member's compliance with SAPP standards, including the capability of national control centers (the French may be auditing the control centers);
- Develop a program to assist utilities that cannot reach minimum levels of AGC, telecom, etc. because of financial problems.
- Provide technical assistance on technical standards: benefits, requirements, alternatives, implementation, training needs, priorities, etc.

Appendix C – Specific Country Reports

Malawi

Overview

Malawi has a population of 10.5 million (6% of the SADC total) and a 1997 GDP of US$ 2.0 billion (1% of SADC total). Malawi's economy is based largely on agriculture, which accounts for more than 90 percent of its export earnings, contributes 45 percent of gross domestic product (GDP), and supports 90 percent of the population. The country's export trade is dominated by tobacco, tea, cotton, and sugar. From 1995-97, good economic policies contributed to a strong average annual growth of 9 percent. However, in 1997/98, the pace of reforms decelerated and expenditure control weakened, leading to an estimated 1997/98 GDP growth rate of about 5 percent. Malawi's economy still depends on substantial inflows of economic assistance from the international financial institutions and individual donors.

Malawi has no petroleum or natural gas resources. It has scattered deposits with estimated recoverable reserves of 2 million tonnes and annual production of about 100,000 tonnes, none of which is used for power generation. The power system is isolated, with generation dominated by 220 MW of hydro plants that generate virtually 100% of the annual energy total. About 22 MW of thermal units serve as backup and in isolated areas of the country. Only 1% of the rural population has access to electricity. A 64 MW hydro plant is under construction, and an interconnection to Mozambique appears likely in the near term. Key power sector challenges include rehabilitating the existing equipment (which has deteriorated due in part to lack of financial resources), completing the hydro plant and interconnection, completing the reform process now under way, and extending service to more of the population not presently grid-connected.

Institutional Framework

Structure

The Department of Energy (DOE) has primary responsibility for energy issues. Within the last year it has been transferred from the Ministry of Energy and Mining, which was disbanded, to the Department of Statutory Corporations, with another move under consideration. The recently created Electricity Council is the power sector's primary regulatory body. The Electricity Supply Corporation of Malawi (ESCOM) is the 100% state-owned, vertically integrated monopoly responsible for virtually all the generation, transmission, and distribution in the country.

Malawi's economy as a whole and the power sector in particular are engaged in a process of reform, in large part in response to the influence of the World Bank and International

Monetary Fund (IMF). Legislation has been passed liberalizing the economy and establishing new institutions such as the Privatization Commission and the Malawi Investment Promotion Agency. ESCOM, formerly a Commission of the Government of Malawi (GOM), was recently incorporated, and is on the list to be privatized, along with about 100 other firms which have been or are scheduled to be privatized.

National Policy Objectives For Or Affecting The Power Sector

The World Bank will fund consulting work (scheduled to be complete by the end of July, 1999) to assist a Task Force coordinated by the Privatization Commission in formulating a formal power sector policy statement. Some legislation relevant to the power sector has been passed in advance of the formal policy statement, including the Electricity Act, passed in July, 1998. The GOM appears to have the following general policy preferences:

- Privatize formerly state-owned enterprises.
- Reduce the number and power of monopolies.
- Increase competition.
- Improve efficiency.
- Attract especially foreign investment.
- Promote participation by the Malawi public in enterprises.
- Raise revenue for the GOM

Policies specific to the power sector appear to include:

- Corporatize, commercialize, and eventually privatize ESCOM.
- Regulate the power sector through the Electricity Council.
- Open the power sector to participation by third parties.
- Attract private investment.
- Provide for open access to the transmission and distribution grids.

Legislation And Regulation

The Electricity Act establishes the Electricity Council, which regulates the power sector. It will be have to be revised after the power sector policy is approved. The Electricity Council is now in the process of organizing itself and starting its work. It has only five permanent employees, with support staff, of a target of about 20. The Electricity Council views its main responsibilities as being:

- Oversee the opening up and liberalizing of the power sector.
- Licensing bona fide applicants.
- Establishing standards for generation, transmission, and distribution regards safety, technical issues, quality of supply, commercial practices, etc..

- Encourage the extension of the network to provide service to a larger fraction of the population.
- Establishing the principles for setting tariffs.
- Encourage ESCOM to improve its efficiency.

Other legislation relevant to the power sector includes the Privatization Act, which will govern the privatization of ESCOM, and the Environment Management Act, which governs the environmental regulations to which ESCOM must comply.

Tariffs

The Electricity Council controls tariffs through its licensing power. It must approve proposed tariffs in initial applications, and all subsequent changes. The Electricity Act does not provide explicit requirements regarding the calculation or level of tariffs, but the Electricity Council has indicated that its general approach will be cost-based: what does the firm (ESCOM for now) need to cover its costs, including the cost of new investments. There is a formula based mostly on inflation regarding what is acceptable for tariff increases.

ESCOM reported in April 1999 that tariffs were 4.6 US cents per KWH, and that their target was 6 cents/KWH, which represented long run marginal cost as calculated in 1992 based on hydro generation. There are several standard tariffs, which include monthly fixed charges, energy charges at rates varying according to usage, demand charges, etc.. Special charges apply to customers served by diesels in isolated areas of the country.

Financial Condition Of Power Sector Entities

Historically tariffs were not based on costs, and were not sufficient to cover costs. In recent years ESCOM had been losing up to US$ 60 million per year, but with two tariff increases leading to the current levels the firm indicates it is essentially at breakeven. Nevertheless its financial condition is weak.

- The physical system is in poor condition and experiences frequent breakdowns in generation, transmission, and distribution.
- The depreciation of the Malawi Kwacha against major currencies and lack of foreign exchange have made it difficult to obtain replacement parts.
- Debt service arrears amounted to 610 million Kwacha at the end of fiscal 1997-8. The firm has very little ability to self-finance system expansion.
- The lack of funds makes it impossible to undertake what would be considered routine maintenance elsewhere.

One suggested partial resolution of the financial problems would be for the GOM to take over ESCOM's debt, possibly as a debt for equity swap during the privatization process. Other factors which would contribute to improvement include reducing staff by at least the 250 (of 2,200) positions already identified as redundant, spinning off the 500

positions providing non-core services such as security and transportation, and in general improving the commercial focus of the firm's managers.

Energy Sector Private Investment Potential

The legislation noted above, including the Electricity Act, forms the foundation for the participation of private investors in the power sector. Also, in general a favorable legal climate for foreign investment has been established, with respect to exchange controls, foreign participation, and so on. Investors, both domestic and foreign, may invest in any sector of the economy, with no restriction on ownership, the size of the investment, the source of funds, or whether the products are destined for export or the domestic market.

However, implementation has been a problem, the physical infrastructure (roads, phones, power, etc.) is poor, and there is a general lack of management skills and organization. The agriculture-based economy is one of the world's poorest, but has grown at 5% to 9% pre year since 1995, even while inflation has bounced from 7% to 50% per year. The country's 1994 transition from authoritarian one-party rule to democracy has been smooth and a degree of stability exists. The economy still depends on substantial inflows of economic assistance from international financial institutions and individual donors.

The Malawi Investment Promotion Agency was established to provide free one-stop assistance to investors, such as identifying joint venture partners when requested, making introductions tot he financial community and service providers, and facilitating all aspects of the investment process, including relationships with GOM agencies. The Privatization Commission has privatized about 30 firms, none yet in the energy sector.

Malawi has taken steps to give investors confidence that their assets will be secure, including the Constitution and existing laws and regulations. Malawi is a member of the Multilateral Investment Guarantee Agency (MIGA) and is an eligible country under a number of other investment insurance programs. The GOM is also a member of the International Center for the Settlement of Investment Disputes.

The scope for private participation in the power sector is limited for the time being. The recommended next major projects are a pumping station at the outflow of Lake Malawi, the interconnection with Mozambique, and rehabilitation of the existing system. New generation is not needed until 2010 or later in the Base Case forecast. Accordingly, a new IPP probably would be competing against the short run marginal cost of the system., which will be hydro most of the time. The GOM would prefer to finance the Mozambique interconnection with donor funds, but failing that a private project might be the only way it would get built.

It is not clear what pricing principles ESCOM would propose for a privately owned project selling services to it, or what principles the Electricity Council would suggest or approve.

ESCOM is on the list to be privatized, but indicates that the privatization process will be in several stages:

1) Commercialization of ESCOM, especially the distribution function, which it hopes will be well under way by the end of 1999.
2) Issue shares to be traded on Malawi Stock Exchange, including a possible debt for equity swap at the time of issuance.
3) Seeking a strategic partner beginning perhaps in the year 2000.

Mchenga, the only operating coal mine in Malawi, is on the list of enterprises to be privatized. Consultations are now underway.

Primary Energy Supply and Production

Total energy consumption is estimated to be 17,000 terajoules (TJ) in 1996. Over 85% of Malawi's population lives in rural areas and has little access to commercial energy resources. Petroleum provides 4% of final energy consumption, electricity 1.8%, and coal 1.2%. The traditional energy resources firewood and charcoal provide an estimated 93 % of total energy demand, supplying nearly all rural and most urban households.

Liquid Fuels

Malawi has no petroleum resources. It imports 100% of its supply, which consumes 15% of the nation's scarce export earnings. To make the problem worse, the imports come entirely by truck, adding to the cost.

The Petroleum Control Commission arranges for petroleum imports, sells to the distribution firms, and sets prices.

Natural Gas

Malawi has no natural gas resources, and consumes none.

Coal

Malawi has scattered deposits, mostly in the north and south. Estimated recoverable reserves are 2 million tonnes and annual production is about 100,000 tonnes, none of which is used for power generation. Malawi exports some coal to Tanzania, near the operating Mchenga mine, but imports some from Moatize in Mozambique because the mine is much closer than the Mchenga mine to the primarily industrial uses near Blantyre.

The coal resource tends to be in thin seams with relatively thick overburden, except for small deposits. As a result the cost of production is high.

Renewable Energy

The traditional energy sources are all renewable, but current usage rates are estimated to exceed sustainable biomass supply. Overproduction has led to deforestation, viewed as the most serious environmental problem in the country. The deforestation has contributed to a siltation problem affecting the hydro plants. GOM programs to address the problems of overuse focus on reforestation and conservation efforts.

Apart from biomass, the major renewable resource is the hydro potential on the Shire river, which drains Lake Malawi, and to a lesser extent other rivers. The existing generation mix includes 220 MW of hydro plants which generate virtually 100% of the annual energy total. The 128 MW Kapichira hydro plant is under construction, with the first 64 MW due to be operational in 1999. The undeveloped economic potential of the Shire and South Rukuru rivers is estimated to be about 500 MW and 4,000 GWH/year. More costly projects on other rivers or sites roughly match those figures.

There are about 5,000 solar photovoltaic installations in Malawi, half of which are not operational due to poor installation or lack of maintenance. Significant increase in the number of installations is not expected without aggressive programs to promote and assist in financing such installations.

Existing And Planned Power Systems

Summary Of Structure Of Power Sector

The chief governmental organizations are:

- The DOE has primary responsibility for energy issues.
- The Electricity Council is the power sector's primary regulatory body.

The main power sector organization is ESCOM, the 100% state-owned, vertically integrated monopoly responsible for virtually all the generation, transmission, and distribution in the country.

Current And Future Demand

Only about 2% of all households are connected to the ESCOM grid. At the end of fiscal 1996/7, ESCOM supplied 66,000 customers, of which 77% were households and 22% small commercial. Between 1990 and 1997 sales rose by 5.3% per year on average. Losses were fairly stable at about 15% of generation, and the system load factor ranged between 61% and 66%.

An international consortium completed a Power System Development and Operation Study (Master Plan) in December 1998. It forecast demand based on a range of assumptions regarding growth in population and economic parameters, new connections, individual projections for a few large customers, tariff increases, and reductions in system losses. Table C-1 presents Low, Base, and High Case demand forecasts from the Master Plan.

Table C-1. Demand Forecasts

	Peak Demand, MW			Energy Demand, GWH/Year		
Year	Low	Base	High	Low	Base	High
1997 (actual)	175	175	175	950	950	950
2000	200	205	215	1110	1150	1200
2005	245	270	320	1350	1500	1770
2010	295	345	455	1620	1910	2530
2015	370	460	670	2020	2535	3680
Avg. Growth, % /Year	4.2	5.5	7.8	4.3	5.6	7.8

Existing Electric Power System

Generation

Table G-2 shows the installed capacity of the main existing plants in Malawi. In addition there are several small diesel generators serving isolated areas or as backup in the ESCOM system, and some private parties have backup generators.

All the hydro plants shown except Wovwe are on the Shire river, which is fed by Lake Malawi. If the lake level drops to the low levels experienced in the early 1900s, then those plants would produce no generation and the country would be practically without electric power. For example, in 1997, drought reduced the flow in the Shire such that a maximum of 120 MW could be generated. At times demand was up to 160 MW, resulting in massive load shedding.

In addition, heavy rainfall over the area south of Lake Malawi causes major erosion in the catchment basins of the Shire's tributaries. This leads to deposits of sediments in the Shire and the reservoirs serving its power plants, reducing their effectiveness

Table C-2. Power Plants In Malawi

Power Plant	Rated Capacity, MW	Units x MW	Initial Years
ESCOM Hydro			
Nikula Falls A	24	3 x 8	1966/67
Nikula Falls B	100	5 x 20	1980/81, 86, 92
Tedzani Falls	92	4 x 10, 2 x 26	1973/77, 95
Wovwe	4.5	3 x 1.5	1995
Subtotal	221		
ESCOM Thermal			
Blantyre (Gas Turbine	15	1 x 15	1975
Lilongwe (Diesel)	4	1 x 3, 1 x 1	1972, 1980
Subtotal	19		
TOTAL MALAWI	240		

Transmission And Transmission Interconnections

The main transmission network includes about 1,000 KM of 132 KV lines, 850 KM of 66 KV lines, and related equipment. Sub-transmission at 33 KV comprises about 2,000 KM of line and related equipment. The system generally runs the length of the country from generation in the south to the main loads in the south, central, and northern areas. The transmission system has long lines running nearly the entire 900 KM length of the narrow country. As a result a small portion (less than 1%) of the system in the far north cannot at present be connected to the main network because of voltage problems.

Malawi is not connected with any other power systems in the region and therefore loses the potential benefits of interconnected operation in reducing planning and operating capacity reserve requirements, emergency support, and others.

Distribution

Distribution is at 11 KV (2,500 KM) and 400/230 volts (3,000 KM). The distribution system serves primarily urban and peri-urban customers, with little extension into rural areas. Performance has been unsatisfactory due to scarcity of materials and foreign exchange. The system has been adding about 5,000 new customers per year, mostly in the four largest cities. Planned reinforcements to reduce technical losses are limited by lack of funds, but line investigations to check for non-technical losses continues.

Plans For Future System

Generation projects

Phase I of the Kapichira hydro plant is well along in construction and is expected to come on line at 64 MW within the next year. Phase II, another 64 MW, could be complete by about 2003. Total project cost is estimated at US$ 156 million. Financial support has been secured from five foreign sources, including the World Bank.

The Master Plan evaluated all major power facilities with respect to rehabilitation needs. The estimated cost for generation system rehabilitation was US$ 19 million.

The Master Plan considered several different categories of alternatives for meeting energy and capacity needs over the planning horizon through the year 2015:

- Improved control of Lake Malawi through a pumping scheme controlled by a weir at Mangochi, a regulation scheme with no pumping, and a new dam/reservoir downstream, including power generation facilities at the dam.
- The best of the hydro projects identified earlier, including the second 64 MW phase of Kapichira.
- Thermal units: diesel fired gas turbine, diesel fired combined cycle, coal fired steam plant, and wood fired steam plant.
- Interconnections with Mozambique or Zambia.
- Demand side management.

The evaluation considered a range of hydrologic conditions, discount rates, and fuel costs. A key factor was the unreliability of Lake Malawi's output in drought conditions, affecting most of the national hydro generation. The Master Plan results demonstrated the following points:

- Either the pumping scheme at Mangochi or an interconnection is crucial to reducing overall system costs. Presumably either one is necessary to backup or firm up the Shire River hydro system. Both should enter the resource plan.
- The interconnection to Mozambique is clearly superior to the interconnection to Zambia due to its lower capital cost.
- Among the thermal units, only gas turbines enter the generation mix, and then strictly to meet loss-of-load probability targets. A coal plants would not enter, even if coal were free, because in 80% of all hydrologic years Malawi has surplus hydro output. Therefore the lowest capital cost alternative has a huge advantage.
- The second 64 MW phase of Kapichira enters the resource plan when needed to meet system energy demands. No other hydro units are needed within the planning horizon in the Base Case demand scenario, not even Mpatamanga, which would produce energy at about 2 US cents per KWH based on average hydrologic conditions.

The proposed Base Case expansion plan includes the pumping station at Mangochi as soon as possible (assumed 2001), the interconnection with Mozambique as soon as possible (assumed 2002), the second phase of Kapichira when its energy is needed (calculated 2010), and three 33 MW standby gas turbines when needed for system reliability (calculated 2012 – 2015). Demand side management is economically beneficial and should be pursued.

In the Low Case, the gas turbines are not needed within the planning horizon. In the High Case, three additional 33 MW gas turbines are needed, along with the 90 MW Lower Fufu hydro plant. Presumably this plant was selected even with slightly higher unit costs because its small rated capacity is a better fit to the rate of load growth.

If no reasonable agreement for the interconnection with Mozambique can be reached, the interconnection with Zambia could replace it. If the Mozambique line is limited to 200 MW, the Zambia interconnection would also be needed about 2015 – 2020, depending on load growth and other factors.

Transmission And Interconnection Projects

The GOM has signed a memorandum of understanding with the Government of Mozambique for an interconnection between Blantyre and the Matambo substation in Mozambique. The 220 KV line would have transfer capacity of 200 MW and a length of about 210 KM, of which 80 would be in Malawi. Swedpower completed a feasibility study in 1996. Estimated cost of the line is US$ 25 million. The GOM would like to finance it as a partially or wholly independently owned project, or through donor funds.

An interconnection with the Zambian grid has been studied at the pre-feasibility level in a joint exercise of the power utilities of Malawi, Zambia, and South Africa. The 220 KV, 167 MW line would have 305 KM in Zambia and 125 KM in Malawi. Estimated cost is about US$ 50 million.

There are also plans to extend Malawi's network to serve some isolated Zambian areas near the border, as well as Malawi loads along the way, for which funds are now being sought.

The Master Plan evaluated all major power facilities with respect to rehabilitation needs. The estimated cost for transmission system rehabilitation was US$ 11 million.

The Master Plan summarizes the transmission system additions required or recommended over the planning horizon. This includes the equipment needed to accomplish the interconnections and connect the new generators to the main system, extend the system to accommodate load growth, address existing design problems, and rehabilitate the system.

Distribution Projects

The Master Plan evaluated all major power facilities with respect to rehabilitation needs. The estimated cost for distribution system rehabilitation was US$ 19 million.

The Base Case demand forecast assumed that the number of domestic connections would increase by 7.5% per year, somewhat above the recent level of new connections. The estimated cost of distribution system improvements, in addition to the rehabilitation work, amounted to US$ 36 million during 1999 – 2005 and $ 45 million during 2006 – 2010. The total of $ 81 million exceeds the amount to be spent on generation ($ 64 million) or transmission ($ 61 million, including the interconnection) during the same period.

Electricity Trade

With no existing interconnection, in the past Malawi has had no electricity trade. ESCOM is a Member of SAPP, but not yet an Operating Member, which requires an interconnection to other Member(s) of the SAPP. ESCOM intends to become an Operating Member as soon as possible.

The primary benefit of the interconnection to Mozambique will be to back up the Shire River hydro system. Actual imports will be almost zero under most hydrological conditions, especially during the first 10 years of its service life. Accordingly, payment for the line should include a relatively large fixed annual component to cover the fixed cots of the line, with wheeling and energy priced more in line with their marginal costs.

The interconnection also offers the possibility of exporting Malawi's surplus hydro generation, especially in the early years of operation. It could also be used to wheel power from Mozambique through the ESCOM system to the northern parts of Mozambique, which are not presently served by any major grid.

Completing interconnections with both Mozambique and Zambia would greatly increase the prospects for Malawi's participation in broader regional trade, but the added costs are a significant barrier.

Donor Activities

The World Bank, the European Union, and the United Nations are the major multilateral agencies active in Malawi. The United States, Britain, Canada, Japan, Germany and the Netherlands are the major bilateral donors. Almost all donors are involved a variety of programs in finance, infrastructure, social sectors, agriculture, the environment and poverty alleviation. Donor coordination in Malawi has been systematic. Major donors and sectoral donor working groups in the areas of economic management, poverty reduction, water and agriculture meet regularly. Consultative Group meetings also bring donors together to discuss assistance to countries, most recently in 1997.

World Bank

The World Bank has 14 active projects in Malawi totaling US$583 million in International Development Association (IDA) credits. About two-thirds of these commitments support social sector projects, public sector management, and the financial sector. The other third is devoted mostly to infrastructure projects. About 8% of overall support is in the energy sector. The World Bank also provides technical assistance and

advisory services on formulation of sector investment strategies, assessments, and expenditure reviews.

In the power sector, the World Bank is supporting the development of the Kapichira hydro project and the development of the power sector policy statement.

African Development Bank

The African Development Bank has no significant power sector projects in Zambia.

Other Donor Activities In The Energy Sector

If possible, the GOM would like the interconnection to Mozambique to be funded by donors, possibly Sweden for the section within Mozambique and Norway for the section within Malawi.

The United Nations Development Program (UNDP), the Danish International Development Assistance organization (DANIDA), and others are supporting several projects to remove barriers to renewable energy in Malawi. The US$ 10 million program focuses on solar photovoltaics, mini- and micro-hydro, biomass, and wind energy for water pumping.

Mozambique

Overview

Mozambique has a population of 15.7 million (8.3 percent of the SADC total) and its 1997 GDP was $US 2 billion (1% of the SADC total). Before the peace accord of 1992, Mozambique had been devastated by civil war. Still one of the poorest countries in Africa, Mozambique has begun to exploit its sizable resources. Foreign assistance programs help supply the foreign exchange required to support the budget and pay for imports of goods and services.

Mozambique has estimated proven natural gas reserves of 70 billion cubic meters(28 percent of SADC total) and about 0.5 percent of the estimated recoverable coal reserves in the region. Its installed electric power capacity is 2,383 MW in 1996 at the Cahora Bassa power plant. The restoration of electrical transmission lines to South Africa and the completion of a new transmission line to Zimbabwe will permit it to regain its status as one of the regions largest electricity exporters. Lack of domestic transmission requires imports to supply most domestic demand. The Mozambique and South African Governments are developing the Maputo corridor, linking the port of Maputo with Witbank, South Africa and a number of energy projects utilizing hydropower, natural gas and coal resources have been proposed.

Institutional Framework

Structure

The National Directorate of Energy under the Ministry of Mineral Resources and Energy is responsible for energy policy in Mozambique. Electricidade de Mocambique (EDM) is the state-owned power supplier and is responsible for operating the three interconnected systems in Mozambique. The Electricity Department at the National Directorate of Energy is responsible for managing isolated systems. Under the new Electricity Law, management of some of these systems will be sent out to tender. The largest power supplier, Hidroelectrica Cahora Bassa (HCB) is an independent power producer owned by the governments of Mozambique and Portugal.

National Policy Objectives For Or Affecting The Power Sector

The government expects the exploitation of Mozambique's energy resources to become a major generator of economic growth and foreign exchange earnings in the medium term. Several large private sector projects under consideration (see subsection below) are premised on the utilization of these resources. A comprehensive strategy for the development of these resources was sent to the Council of Ministers in 1998. The strategy aims at increasing energy exports, as well as fostering the participation of the private sector in energy supply and distribution. It also covers institutional and policy reforms required for attracting private sector investments, as well as tax and royalty policies.

The government is committed to providing the conditions for the development of affordable household energy sources, as well as ensuring their long-term sustainability. The electricity law promulgated in July 1997 provides a framework for the restructuring of the power sector by opening the transmission and distribution systems to private sector entrants.

The government is transforming the state petroleum company, PETROMOC, into a limited liability company and is restructuring and downsizing it. To this end, the government will complete an inventory of PETROMOC's assets and adopt and implement a formal asset divestiture plan by end-1998. The private oil companies operating in the sector are creating a joint company to ensure that import costs do not increase as a result of the fragmentation of import operations. This will affect power sector costs as isolated systems and peaking in Maputo will continue to be dependent upon liquid fuels.

In 1996, EDM became a public corporation and signed a three-year contract with the government with the following items.

Tariff Policy

Tariffs should:

- Be adequate to assure the financial health of the corporation.
- Guarantee self-sustaining growth.
- Maintain a social tariff for domestic customers for minimum usage.
- Reflect impact of inflation and currency devaluation.
- Promote agricultural and industrial development.

Commercial Policy

During the Contract Program term, EDM will develop a commercial policy to improve the quality of service and a client-oriented system of service, promoting structures that reduce energy losses and improve the efficiency of utilization, in this way promoting the image of the enterprise.

Financial Policy

- Assure operation of the enterprise and return on capital investment.
- Guarantee a capacity to repay debt in the short- and medium-term debt (liquidity) and long-term (solvency).
- Assure an adequate financial structure.

Administration And Personnel Policy

- Stimulate the productivity and improve the qualifications of our personnel.
- Optimize the number of workers in the firm.

- Adjust existing work procedures with a view to developing and improving the Administration and Human Resource Program.

Investment Policy

During the contract period top priority will be given to:

- Rehabilitation of infrastructure destroyed during the war
- Extension of the transmission and distribution systems to progressively reduce thermal generation
- Assure and improve the quality of supply and service to customers
- Reinforce the efficient utilization of resources
- Guarantee security of supply
- Proceed with the implementation of the interconnection with neighboring systems Implement the information process and improve the communication within the corporation.

Legislation And Regulation

The Electricity Law of 1997 has opened the electricity sector to competition in generation and distribution. Third-party access to the national grid on commercial terms and independent regulation are both elements of the Law. The regulatory authority is yet to be set up and regulation currently is done by the Energy National Directorate by staff in the Electric and Liquid Fuels Departments. A National Electricity Council will be formed to take over the regulatory function to evolve to a more independent institution. Tariff setting is to have limited independence during the interim period as tariffs are to be approved by the Council of Ministers.

The Environmental Law was passed in 1997. In December 1998, an environmental impact regulation was passed and new projects are required to have an EIS. There is no practical experience with application of this legislation at this time.

Tariffs

Retail tariffs are currently administer by the National Directorate of Energy. This responsibility will be shifted to a new regulatory body under the new Electricity Law. Also under the new law, the financial management of EDM will be improved by re-deploying the billing information system and by adopting new, simpler electricity tariffs and tariff adjustment mechanisms.

There are currently different tariffs for customers of EDM and for those served by entirely isolated systems. The average EDM tariff is around 5 US cents per KWH and the average isolated tariff is about 18 US cents per KWH. For EDM, there are currently separate tariffs for high and medium voltage customers and for large, general and domestic low voltage customers. There is a social tariff for 30 KWH per month for domestic use.

A study was carried out by the World Bank in 1995 to consider alternative structures of electricity tariffs in Mozambique. The existing tariff regime at that time did not reflect the economic costs of meeting additional demand. The conclusions of the study were the following:

- If EDM were to introduce a new tariff structure, reflecting long-run average incremental costs, the rates could be based upon two-part tariffs, involving a capacity fee per kilowatt of coincident peak and an energy charge per kilowatt hour, at both high voltage and medium voltage levels.
- Such a tariff structure would yield an average tariff below the target level.
- It would not be a high priority in Mozambique, under present conditions, to incorporate regional differentials in the tariff structure, to account for variation in locational cost.
- The illustrative tariff system could easily be refined (e.g. toward more advanced forms of peak-load pricing or location-specific rates) if analysis by EDM in the future should indicate that the situation has changed sufficiently to warrant it.
- EDM may apply the illustrative tariff system to its different customer classes, it would retain the right to negotiate special terms for large and strategically important customers, if merited by cost differences.
- Any alternative tariff structure must be implemented in combination with reforms aimed at improvements in customer metering, billing and revenue collection.

In 1996, the World Bank conducted a survey of low-voltage users in cooperation with the Ministry of Mineral Resources and Energy and the National Directorate for Energy (DNE). A sample of 912 low voltage electricity customers randomly was selected from the population of customers served through EDM's Southern, Central, and Northern systems and from electricity users supplied in two isolated areas. It was found that rates would reduce demand, but the rate increases sought for by EDM are unlikely to crowd out a large number of this domestic customer group. Still, 15 percent of the customers questioned said they would discontinue purchasing electricity if it became too expensive. However, the strong preference given to kerosene and Liquified Petroleum Gas (LPG) as potential substitutes for electricity and the low propensity to switch back to traditional sources of energy such as charcoal or fuelwood suggest that most households connected to the grid are more concerned about fuel and service quality than about costs.

Cahora Bassa started selling power for the first time in 16 years last year. The price of Cahora Bassa power is negotiated between ESKOM and the owners of HCB. The agreement reached had to be endorsed by the governments of South Africa, Portugal and Mozambique. The actual tariff has not been made public; however, it is believed to be less than ESKOM's average cost of 2.5 US cents per KWH.

Financial Condition of Power Sector Entities

EDM made a profit during 1997, the last year for which financial statements have been completed and approved.

Energy Sector Private Investment Potential

Mozambique has significant gas, coal and hydro resources, as discussed previously. Recovery from 16 years of war will provide needs for investment in infrastructure. Economic growth in 1997 was almost 8% and foreign investors have begun to look favorably at Mozambique. This is based on the end of war and reforms that have been implemented by the government. More than 900 of 1,250 state firms have been privatized, public spending has been controlled and further foreign debts have only been incurred on the most concessionary terms.

Encouraging the rehabilitation and expansion of infrastructure, including energy facilities, is a high priority of the Government of Mozambique. Investors are given the following: security and legal protection of property over goods and rights in connection with investment made; freedom to import capital or borrow loans to carry out investment; the remittance of funds, abroad, in connection with exporting foreign investors' profits, payment of royalties and other charges abroad, and loan repayments and interest charges due abroad. Investors are allowed to repatriate invested upon liquidation of an investment. Mozambique is a member of MIGA and OPIC (insurers against non-commercial risks) and offers recourse to arbitration through International Convention and Center for Settlement of Investment Disputes (ICSID) and the Paris-based International Chamber of Commerce.

The Investment Promotion Center is responsible for the promotion of investments, for assisting the Minister of Planning and Finance in matters concerning investments and for assuring the implementation and fulfillment of the investment legislation. There are a number of tax incentives that apply to investments in energy infrastructure and for investments in particular geographic regions with significant energy resources.

Primary Energy Supply And Production

Liquid Fuels

Mozambique has no known liquid fuel reserves. All petroleum products are imported largely from South Africa as the small refinery at Maputo was mothballed in 1984. The state-owned oil company, PETROMOC, handles virtually all fuel imports.

Distribution and marketing of fuels products and lubricants is carried out by the state-owned oil company, PETROMOC with over 50% of the market share, BP (40%) which also operates the only lube blending plant in the country, Mobil (7%), and Caltex (0.5%) which is mainly involved in bunkering activities. PETROMOC is the largest supplier of diesel fuel to isolated diesels for electricity generation.

Maputo and Beira are important are the major ports for domestic imports. The pipeline between Beira and Harare has been extended and is operating close to full capacity. This pipeline handles all liquid fuel imports for Zimbabwe. Revenues earned from the use of the pipeline are significant.

A new oil product jetty accommodating vessels of 50.000 tons has been completed at the port of Beira. The existing jetty is being rehabilitated. The other port that can accommodate large vessels is Nacala; however, due to low consumption in the area and poor transport connections to the rest of the country, the importance of Nacala in the distribution of petroleum products is diminishing.

Natural Gas

Although a number of gas fields in Mozambique were discovered in the early 1960's by Gulf Oil, they remained unexploited owing to continuing civil war and a lack of major gas consumers. The further discovery of large reserves (estimated at more than 60 billion cubic meters) of commercially exploitable natural gas in the Pande gas field in Inhambane province and the possibility of utilizing natural gas in regional industrial growth has brought renewed interest in Mozambique's upstream prospects by foreign oil companies.

The Mozambique national hydrocarbon exploration company, Empresa Nacional de Hidrocarbonetos de Mocambique (ENH), is involved both as a licensor on behalf of the government and as a participant in some of the fields. Individual developments are discussed below.

Pande: Enron Corporation of the US signed an exclusive US$ 2 billion dollar agreement with ENH to develop the extensive Pande gas field subject to the raising of finance and the location of a major gas customer. The project consists of a $ 1 billion development of the gas field, including the building of a pipeline to South Africa by Enron, and a $ 1 billion iron reduction plant to be developed by the South African parastatal Industrial Development Corporation (IDC) in conjunction with Iscor. The first gas is scheduled to be piped by the end of the century. Sasol, was involved in earlier stages in this project and still expresses interest in the concept of a commercial Southern African gas grid. The IDC's iron reduction plant in Maputo would consume less than 5 percent of Pande gas output estimated at 60 billion cubic meters of gas a year. NORAD has funded a project to project gas to nearby towns for power generation. Some gas is currently being used to fired a 3 MW combustion turbine for power generation in Vilankulos. Expansion is planned to Inharsara, and Nova Mambone on an isolated basis and there are also plans to put the management of this generation out to tender.

Buzi-Divinhe: The Canadian Zarara-Scimitar Hydrocarbons Corporation (75%) and Leopardus Resources Limited (25%) joint venture holds rights to the onshore Buzi-Divinhe block in the coastal region of east central Mozambique south of the port of Beira. The small Buzi gas field was originally discovered in 1962 by Gulf Oil, and latest exploration results have revealed a cluster of small gas fields that give rise to optimism for finding further reserves. The gas, although scattered, is plentiful. The planned Buzi

gas project involves production increasing to about 1.5 million cubic meters per day within 5 years. The venture is drilling a first exploratory well. Bandua-1. Scimitar is to pay for all of the exploration and development costs. JCI has signed a letter of intent to pay the joint venture partners $500,000 for an option to buy up to 35 billion cubic meters of gas over a 30 year period for an iron ore reduction plant JCI was planning to build in Beira. The option would be exercisable after test drilling had been completed in the Divinhe-Buzi concession.

Inhaminga: Scimitar holds rights to the onshore Inhaminga block, located north of the Buzi-Divinhe block. A reserve figure has yet to be established although the company expects to produce up to 0.5 million cubic meters per day within 2 years. Despite the block's strategic location on the highway, railway and pipeline corridor from Beira to Harare in neighboring Zimbabwe, exploitation of this permit remains uncertain as regional gas markets have yet to be assured.

Mazenga: Sasol Petroleum International (SPI) has signed a memorandum of understanding with ENH to act as operator on 45,000 km^2 onshore Mazenga onshore prospect, about 250 KM from Maputo in southern Mozambique stretching north from Inhambane to the borders of ENH-Enron's Pande gas field. It also borders on Arco-Zarara's Temane gas field, south of the Save river. The block straddles the provinces of Inhambane and Gaza in southern Mozambique. In terms of a subsequent agreement between SPI and Arco, Arco acquired a 50% interest in this block.

M-10: Leopardus Resources acquired exploration rights to the offshore M-10 prospect. During 1997, SPI acquired an interest in the block. In July 1997 Arco International Oil and Gas Company, SPI and Zarara Petroleum Resources of Canada were awarded exploration rights over the block. Arco will be the operator with SPI taking over the operations three to six years after the first sales of commercial gas or oil. The partners will jointly evaluate the block in detail, and negotiations with the government of Mozambique regarding production sharing agreements will commence shortly thereafter.

Rovuma Basin: The Rovuma Basin in northern Cabo Delgado province is considered to have great potential. Lonrho Petroleum (Lonropet) has signed a joint oil and gas production agreement with ENH which allows the partners to explore and later develop oil and gas in a 38,000 KM^2 area of both onshore and offshore acreage south from the border with Tanzania. The permit is covered by a seven year Production Sharing Agreement The area is extremely under explored. The source potential has been proven by the presence of hydrocarbons in the Mocimboa-1 well, drilled by Esso in 1986, as well as numerous seeps throughout the Rovuma Basin.

Sofala: Leopardus Resources acquired exploration rights to the offshore Sofala prospect. In July 1997 Arco, SPI and Zarara Petroleum Resources were awarded exploration rights over the block. Arco will be the operator with SPI taking over the operations three to six years after the first sales of commercial gas or oil. The partners will jointly evaluate the block in detail, and negotiations with the government of Mozambique regarding production sharing agreements will commence shortly thereafter.

Temane: Gas was discovered at Temane in Southern Mozambique in 1967 by Gulf Oil, but no market existed at the time. Leopardus Resources acquired exploration rights to the Temane onshore prospect. In July 1997 Arco, SPI and Zarara Petroleum Resources were awarded exploration rights over the block. Arco will be the operator with SPI taking over the operations three to six years after the first sales of commercial gas or oil. The partners will jointly evaluate the block in detail, and negotiations with the government of Mozambique regarding production sharing agreements will commence shortly thereafter. In 1998, the three companies signed an agreement with the Mozambique government to explore the Temane gas field. The project is expected to cost at least $20 million and generate 3500 jobs in Inhambane province. The consortium will conduct a seismic survey and drill up to five wells within seven years. If gas is found, other wells are to be drilled to assess the field's potential size. Drilling and seismic work over the initial period is set to cost the consortium $US 10 million. The consortium's commitment also includes putting up money for training Mozambique nationals and developing related exploration infrastructure. The Temane group signed a technical evaluation accord with JCI for the Temane property in July 1997. The gas will be used by a planned iron ore reduction plant to be built in the Beira area north of the capital and by Sasol in South Africa. Leopardus Resources bought Zarara's stake in Temane in mid-1998.

Zambezi: BP Exploration Operating Company has signed an agreement with the Mozambique government to explore an 80,000 KM^2 tract in the Zambezi River delta, north of the port of Beira where seismic surveys of the shallow waters conducted in the 1980's proved inconclusive. BP plans to conduct initial surveys in waters up to 2,000 meter depths to establish the existence of seabed oil seeps. A production-sharing contract covering half of the exploration area is being negotiated between BP and the government.

Coal

Reserves of 10 billion tonnes of coal have been found in Tete Province, of which the most promising is the 2 billion tonne Moatize deposit. Mozambique's only coal mine, the Moatize coal mine near Tete which produced up to 600,00 tonnes per annum but was badly damaged by flooding in 1993. JCI has an option on the mine and has formed a consortium with CVRD, Ingwe and Austral Coal to spend US$ 480 million developing the mine to export 3.2 million tons of coking coal annually from Beira. The mine is expected to produce between one and five million tonnes per annum from reserves of 250 million tonnes.

The quality of coal at Moatize is excellent for coking with a sulfur content of 0.9% and a calorific value of 30 MJ/KG. The ash content is 26%. There are six coal seams varying in width from 2 meters to 40 meters.

JCI also plans a US$ 662 million hot briquetted iron plant as well as infrastructure projects including a $ 1billion coal-fired power station, $ 224 million deep water port, $ 250 million railway system upgrade to allow coal to be railed to the port for export and a $ 450 million investment in Mozambique's electricity transmission system.

Renewable Energy

The major source of hydropower for Mozambique is Zambezi river. The Cahora Bassa power plant, on the Zambezi, has a capacity of over 2,000 MW. More than 100 additional sites have been identified for possible hydropower generation with a combined average energy output of 75,000 GWH/year and potential installed capacity of about 12,000 MW.

Combustible renewables made up approximately 90 percent of the 1996 domestic energy balance.

Wind speeds average from .7 to 2.6 meters/second and vary by season, time-of-day and by area. The resource is unsuitable for power generation, but can be used for water pumping. About 50 water pumps are currently run on wind power.

Existing And Planned Power Systems

Summary Of Structure Of Power Sector

Ministerial responsibility for the power sector lies with the National Directorate of Energy in the Ministry of Mineral Resources and Energy. EDM is currently responsible for transmission and distribution in commercially viable areas. EDM became a public corporation in 1995. Further restructuring will be done as a result of implementation of the Electricity Law.

The Electricity Department of the National Directorate of Energy is responsible for rural electrification. The largest domestic generator is Hidroelectrica Cahora Bassa, which produces power for export to South Africa and Zimbabwe.

Current And Future Demand

EDM domestic sales were 779 GWH in 1997 of which 64% was in the Southern System, 24% in the Central System and 12% in the Northern System. Peak demand was 198 MW. The number of customers was 177,793 for an average annual consumption of 4400 KWH per customer per year. Growth has been at 8 percent per year in the last two years. Approximately 5 percent of Mozambicans has access to electricity. SAD-ELEC in South Africa has estimated electricity demand growth in Mozambique to be between 6 and 6.5 percent per year after the year 2000. This estimated growth does not include the planned Mozal smelter will which, at 450 MW, will more that triple electricity demand in the country. A description of the Mozal project follows.

The 233 thousand tonne-per-year (TPY) Mozal aluminum smelter is to be owned by a consortium of Billiton (47%), Mitsubishi Corporation (25%), the Industrial Development Corporation (24%) and the Mozambique Government (4%) and is expect to require a total investment of US$ 1.36 billion. The Mozal project will make Billiton, the western world's third largest aluminum producer. The consortium believes Mozal will be cost competitive and remain profitable even with seriously low aluminum prices in the future. Mozal's initial break even point will be at an aluminum price of US$ 750/tonne. After this

Mozal is forecast to have a cash operating cost of $980/tonne at a London Metal Exchange (LME) aluminum price of $1,650 per tonne.

The smelter will have the capacity to double production and consume about 450 MW of electricity and 500,000 tons of alumina a year, some of which will be supplied from the Worsley alumina mine in Australia and from Malawi. The consortium has agreed a particularly low price for its electricity for the first six years with ESKOM and EDM. Thereafter, the smelter will be locked into a competitive electricity contract for six years and an agreement comparable to that of Billiton's Hillside smelter for a further twelve years. During the second 12 year phase of project, electricity prices will be linked to LME aluminum prices.

Existing Electric Power System

Transmission And Transmission Interconnections

The Mozambican power system is divided into three separate systems. The Southern and Central systems are at 100 KV. The Northern System has a maximum voltage of 220 KV. The Southern System supplies Maputo and is interconnected with South Africa by means of 110 KV and 275 KV lines. The Central System supplies Beira. The Northern System contains the Cahora Bassa power project and is interconnected with South Africa and Zimbabwe. The interconnection with South Africa is by means of a 533 KV DC line. The 400 KV Songo/ Bindura/Dema interconnection with Zimbabwe began operation at the end of 1997. This line is currently energized at 330 KV.

Generation

The Southern System is supplied by imports from South Africa and by 70 MW of liquid-fuel-fired simple-cycle combustion turbines located in Maputo for peaking purposes and the small Corumana plant. The Central System is supplied by the Chicamba and Mavuzi hydro plants and the Northern System is supplied by the Cahora Bassa plant. Numerous diesel generators supply isolated system. A gas-fired combustion turbine supplies an isolated system in Vilankulos. This is summarized in Table E-1.

Distribution

The distribution systems have been noted for high losses. In 1996, reported technical and non-technical losses were 34 percent. NORAD has sponsored a Loss Reduction Project for distribution systems in the Southern System. Losses in 1997 were reports to be 26%.

Plans For Future System

Generation Projects

Mozambique has through the independent power producer HCB, a large surplus of generating capacity over internal demand. However, most of the capacity is committed to export contracts with South Africa and Zimbabwe. The present priority of EDM, the

national utility, lies in system rehabilitation. Generation capacity development is therefore likely to be left to the private sector, with or without participation from EDM.

Extension of Cahora Bassa: During the construction of Cahora Bassa, provision was made for a future north bank development (up to 1,100 MW). Several studies have established that the present spillway arrangements are insufficient and that both present operations and future downstream developments would benefit from additional spillway capacity. The inclusion of 550 MW of the above mentioned capacity may be economically justified. The likelihood of this project being implemented is relatively due to a number of complicated political issues to be resolved between HCB, EDM and ESKOM as well as between the Governments of Portugal, Mozambique and South Africa.

Table D-1 EDM Generating Capacity

Source of power	System	Type	Nominal capacity MW	Effective capacity MW	Source of power	System	Type	Nominal capacity MW	Effective capacity MW
Capacity connected to grid					**Isolated Capacity**				
Maputo	Southern	Coal fired	57.5	0	Angoche	Isolated	Diesel	1.6	0.95
Maputo	Southern	Combustion Turbine	78.5	62	Inhambane	Isolated	Diesel	4.28	2
Corumana	Southern	Hydro	16.6	14	Lichinga	Isolated	Diesel	1.3	0.65
Beira	Central	Combustion Turbine	12	12	Lionde	Isolated	Diesel	3.95	2.55
Mavuzi	Central	Hydro	52	44.5	Mocuba	Isolated	Diesel	0.84	0.7
Chicamba	Central	Hydro	38.4	34	Nacala	Isolated	Diesel	19.83	6.09
Cuamba	Central	Hydro	1.09	1	Nampula	Isolated	Diesel	6.54	4.13
Lichinga	Central	Hydro	0.75	0.6	Pemba	Isolated	Diesel	8.04	5.6
IPP Capacity					Quelimane	Isolated	Diesel	7.15	6.25
Hidroelectrica de Cahora Bassa (HCB)	Northern	Hydro	2075	415	Xai-Xai	Isolated	Diesel	2.67	1.8
Emochá		Hydro	0.4	0.4	Cuamba	Isolated	Diesel	0.51	0.4
Total EDM Capacity			257	168	Tete	Isolated	Diesel	0.8	0.3
Total Isolated Capacity			61	34					
Total IPP Capacity			2075	415	Vilankulos	Isolated	Combustion Turbine	3.0	3.0
Total Resources			2393	618					

Mpanda Uncua: A number of pre-feasibility studies have been carried out on various hydropower developments in the country, mainly for export. The most likely option for future hydropower supply from Mozambique seems to be development of the Mpanda Uncua or alternative Cambewe Foz sites, both downstream of the existing Cahora Bassa plant. Currently a full feasibility study on the Mpanda Uncua site has been awarded (also including consideration of the Cahora Bassa North bank project) with expected completion by the end of 1999.

The study will be an update of a 1996 study. From the 1996 study two main options can be derived: base load operation with an installed capacity of 1,600 MW or mid-merit operation with 2,400 MW of installed capacity. The choice of the final design option will depend on the relative merit of the extra peaking capacity compared to other alternatives for meeting mainly South African system requirements.

The Mpanda Uncua site is basically a "flow of the river" location where the dam is used for regulation of flow and short-term storage. The reservoir will be kept as near full as possible, implying that operations will depend on discharges from the Cahora Bassa reservoir.

Mpanda Uncua, being a large hydro power project, will require the construction of associated high voltage transmission facilities (either AC or DC) to bring the power to markets in Mozambique and South Africa. This increases the financing requirements of this project. In general, the Mpanda Uncua project will have a size and financing requirement that might cause problems for timely implementation of the project, particularly taking into account the relatively high risk profile of Mozambique in terms of foreign investments and in light of a number of other large scale developments in the country.

Moatize Coal-fired Plant: Based on the Moatize coal deposit JCI, the South African Mining house, is exploring the possibility of restarting mining operations with the main purpose of exporting coking coal. However, production of coking coal will result in large volumes of low grade steam coal being produced as well. The only viable alternative for use of this steam coal is found to be possible use in a coal fired power station. JCI is therefore investigating the construction of a 1,000 MW coal station, targeted for commissioning by 2004. The Moatize coal project would be linked to an iron processing plant in Beira (importing iron ore while exporting coking coal on the same ships). Other necessary components of the project are a new deep water harbor north of Beira and rehabilitation of the Tete - Beira railway line.

The coal fired power station would only be required to pay the true transfer cost for coal as fuel. Furthermore, the developers are aiming at bringing in potential users of the power as owners in the power station, offering a low cost supply of electricity in return for a very modest return on the power station investment. The power station will primarily be aimed at markets/customers in central and northern Mozambique and in Zimbabwe. Although the provisional numbers coming out of the project study are attractive, the power station is reliant on many other components to materialize as outlined above. This could easily imply that a decision to proceed may be delayed.

Gas-fired Developments: Mozambique also has a potential for gas-fired power generation from resources such as the Pande and other fields. A study was carried out on the overall concept of gas for power generation in Mozambique. Indications showed that development of a combined cycle gas turbine (CCGT) either in Beira or Maputo was at the time (1995/96) not a competitive option. Since then the KW cost of combined cycle and simple cycle combustion turbine power stations have almost halved. A power generation project of 500 - 1,000 MW in combination with a large scale industrial development such as the proposed Maputo iron and steel project where the marginal cost of additional gas production/transport would be low therefore looks more promising. Indicative figures from the proposed Pande developments indicate that considerable additional capacity would be available in the transport system from Pande to Maputo to

also serve other gas use options. Gas fired power generation as an anchor customer to start gas developments in Mozambique looks unlikely at this point.

Transmission And Interconnection Projects

- MOTRACO Project: This project is for the construction and operation of two power lines and a 400 KV substation in order ensure the supply of electric power to the MOZAL aluminum smelter based on imports from South Africa. Negotiations are underway amongst EDM, ESKOM and the Swaziland Electricity Board for the commercial terms of this project.
- 275 KV Swaziland/Mozambique Interconnection.
- 220 KV Malawi/Mozambique Interconnection.
- 220 KV Zimbabwe/Mozambique Interconnection.
- Central dispatch of the Southern System.
- Interconnection of HCB with Central System.
- Interconnection of Xai-Xai and Inhambame.
- Rehabilitation of 110 KV Nampula - Monapo - Nacala line.
- Mpanda Uncua-Maputo. This project is envisioned to link an expansion of the Mozal aluminum smelter with the Mpanda Uncua project via a planned US$500 million 1500 KM transmission line to Maputo. This project depends on both the development of Mpanda Uncua and the expansion of the Mozal project. In would represent to first interconnection of the three systems in Mozambique.

Distribution Projects

Planned projects include the following:

- Reinforcement of the Maputo and Beira systems.
- Urban electrification in Maputo, Beira, and Chimoio.
- Rural electrification and rehabilitation of numerous distribution systems.

Electricity Trade

Electricity trade is critical to the Mozambican economy and to the reliability of its supply. With the Mozambique/South Africa and Mozambique/Zimbabwe interconnections in operation, Mozambique is the largest power exporter in the SADC region. At approximately 15,000 GWH per year, this far surpasses the magnitude of all other regional exports combined. This is an important source of foreign currency.

The largest demand area is largely supplied through imports since it is not connected to the major sources of domestic supply. Imports amounted to over 60 percent of total domestic supply in 1997.

Donor activities

World Bank

The World Bank is funding 19 projects in all sectors with a total commitment of $US 870 million. The World Bank supports the government's program for broad-based, poverty-reducing growth by maintaining a comprehensive policy dialogue with the government and through investment and adjustment lending and aid coordination. The World Bank has sponsored the Credelec Project at EDM to improve billing procedures.

The International Finance Corporation (IFC) has approved a US$120 million investment for the establishment of the Mozal aluminum smelter project in Maputo, Mozambique. This investment represents one of the largest commitments for IFC's own account ever approved by the Corporation.

African Development Bank

The main objective of the Bank's medium-term lending program (1996-1998) was poverty alleviation. For achieving that objective, the strategy of operations involved: (i) human resources development; (ii) support of the family-farming sub-sector; (iii) rehabilitation of physical infrastructure; and (vi) supporting government policies and programs which are geared to accelerating sustainable economic growth. This required lending in the social, agricultural, public utilities, and transport sectors, and involved project financing as well as policy-based lending.

Other Donor Activities In The Energy Sector

The Norwegian Development Agency (NORAD) has been active in the Loss Reduction Project for EDM and gas supply to Vilankulos for ENH. Other donors have included the Danish Development Assistance (DANIDA), the French Development Agency (CFD), Portuguese Cooperation, the Swedish International Development Agency (SIDI) and the German Development Bank, KFW.

Namibia

Overview

Namibia has a population of 1.6 million (1% of the SADC total) and a 1997 GDP of US$ 3 billion (2% of SADC total). Mining and processing of minerals accounts for about 25 percent of GDP, which has grown substantially in real terms since 1990. Agriculture is dominated by cattle and sheep raising. The country has one of the richest potential fisheries in the world. The economy has a dual structure, with the white-dominated sector comprising 5% of the population accounting for US$ 16,500 per capita income, while the 70% of the population engaged in subsistence agriculture averages only US$ 85 per capita.

Namibia has no petroleum and minor coal resources. The offshore Kudu gas field has significant proved (but undeveloped) reserves. The Ruacana hydro plant supplies close to half the nation's electrical energy, with imports from South Africa supplying nearly all of the rest. Key electric system development objectives include reducing reliance on imported electricity through development of the Kudu power plant (to use Kudu field gas) and/or the Epupa hydro plant, downstream from Ruacana, and to extend electric service to many of the 90% of rural households not presently grid-connected.

Institutional Framework

Structure

The Ministry of Mines and Energy (MME) is responsible for energy policy and master planning, has been the initiator and driver of the country's rural electrification program, and is responsible for regulating the energy sector. NamPower, the national electric utility, is constituted as a private limited company operating in terms of the Companies Act, but is 100% owned by the Government of the Republic of Namibia (GRN). It is a vertically integrated electric utility, operating under a Performance Agreement (expires June 1999) with the GRN, signed by the MME. NamPower is responsible for essentially all of the generation and transmission in the country. It distributes retail electricity to about 2,200 mines, industrial, and large agricultural customers. It also supplies bulk electricity to the primary distributors, which are municipalities, the Ministry of Regional and Local Government and Housing (MRLGH) for rural and peri-urban areas, and the privately owned Northern Electricity (NE), which is responsible for electricity supply in the densely populated northern regions of the country by virtue of a contract with the GRN. The mining firm Namdeb distributes to some domestic and commercial customers in Oranjemund. Some Namibian fringe area customers are served by Zambia's national utility ZESCO, and South Africa's national utility ESKOM, and NamPower serves some fringe area customers in Angola.

Although the existing power sector functions reasonably well, the GRN is taking steps to restructure. Distribution is the weakest area in the power sector, and not surprisingly is the focus of restructuring efforts, which may lead to consolidation of distribution activities to improve performance and accelerate rural electrification. Other features of the restructuring and reform program contemplated include:

- Passage of an Electricity Act (the Act), to provide a sound legal basis for the power sector and its development.
- Establishment of an Electricity Control Board (ECB), which will be responsible for regulating the electricity industry.
- Possible privatization of NamPower.

National Policy Objectives For Or Affecting The Power Sector

National policy is expressed in the Energy White Paper, which was officially approved during 1998. The main goals driving the policy are:

- Effective governance
- Security of supply
- Social uplift
- Investment and growth
- Economic competitiveness and efficiency
- Sustainability

The key policies affecting the power sector include:

- Supply reliable, competitively priced energy to productive sectors of the economy.
- Improve sector efficiency through electricity supply industry restructuring.
- Implement a modern and appropriate legal and regulatory framework through the Act and the creation of the ECB.
- Introduce an institutional system, with both regulatory and policy making functions, to monitor and control electricity price developments.
- Ensure that the ECB adequately protects both consumers and licensees.
- Base electricity tariff structures and prices on sound economic principles, generally reflecting the long-run marginal cost of supply.
- Establish the necessary legal, regulatory, fiscal, and environmental frameworks to create a favorable climate for private investment.
- Continue rural electrification programs using transparent planning and evaluation criteria for new projects. Connect 12,000 additional rural households to the grid by 2000, and at least 25% (vs. 10% today) of all rural households by 2010 (and 95% of all urban households, vs. 75% today).

- Achieve security of energy supply through diversification of economically competitive and reliable sources, with particular emphasis on Namibian resources, with due consideration of risks. By 2010, supply 100% of peak demand and at least 75% of electric energy demand from internal sources.
- Establish new high voltage connections to neighboring countries to increase regional electricity trade.
- Ensure that the legal, regulatory, and institutional frameworks are in harmony with the SAPP agreements.
- Ensure positive and committed Namibian participation in the SAPP.
- Promote the use of economically viable renewable energy technologies as a complement to grid electrification, to improve energy provision to rural areas.
- Base decisions on large-scale energy projects taking into account the full environmental and social costs of the projects.

Legislation And Regulation

Prior to independence in 1990, Namibia's power sector was governed by South African electricity acts. Little replacement legislation has been put in place to date. The MME regulates the sector, but permits NamPower to operate at an arms-length distance from the GRN, under direction of the GRN-appointed Board of Directors and the terms of the performance agreement.

The Local Authorities Act of 1992 states that a municipal council or town council shall have the power (which may be delegated) to supply electricity to the residents of their respective areas.

The GRN has drafted an Electricity Act (which apparently is in near-final form) to provide the legal basis for power sector development. The primary function of the Act is to establish the ECB, which will regulate the power sector. The Act summarizes the responsibilities and authority of the ECB. A separate draft Electric Regulations document provides an initial set of regulations which supplement and extend the text of the Act.

The ECB will make recommendations to the Minister of the MME regarding licenses for generation, transmission, and distribution of electricity and tariffs; settle disputes between licensees and end users or each other; perform inspections; advise the Minister on power sector matters; establish administrative, technical, and miscellaneous regulations; and establish pricing policies, principles, and tariff regulations.

The intent is to create a sound legal and regulatory framework. For example, the draft regulations are explicit regarding the objectives of tariff policy: economic efficiency, cost-reflective prices, financial strength of the power sector, fair and equitable tariffs, marginal cost pricing, etc.. However, the Act leaves a great deal of arbitrary discretion in the hands of the Minister of MME, so the Minister's performance will be critical in achieving the goals of the regulatory system.

Tariffs

NamPower tariffs are differentiated by customer class and are generally cost based.

The current Performance Agreement between the GRN and NamPower states that "The approach to tariffs will be determined by the ... long run marginal cost principle of tariff pricing". By NamPower's calculations current tariffs are slightly below but close to long run marginal cost. The Performance Agreement also states that the Minister's consent to any tariff increase should be obtained when the average price increase for a period is above inflation. In practice this means that NamPower can increase tariffs without consent so long as the increase is not more than inflation.

The average tariff level for fiscal 1998 (period ending June 30, 1998) was about 17 Namibian cents per KWH. This amounts to 3.6 US cents per KWH at the exchange rate of 4.85 Namibian dollars (N$) per US dollar prevailing in February, 1998, or 2.9 US cents per KWH at the current exchange rate of about 6. This tariff level has been sufficient to maintain NamPower's financial strength (see section below) because the firm is efficiently run, generation costs are relatively low due to low cost hydro from the Ruacana plant, favorable power purchase contracts with South Africa's ESKOM, and a preponderance of large loads, somewhat tempered by the low population density.

Each municipality sets its own tariffs, so there is a range. Among the larger municipalities the tariff levels for residential service range from 6 – 46% higher than NamPower's for the same service for several reasons: fewer economies of scale, less attention paid to electricity since it is only one of many services they provide, and the common practice of using electricity revenues to subsidize other services.

Northern Electricity's charges for 200 KWH per month of residential electric service are 6% higher than NamPower's, for 900 KWH per month they are 21% higher, and for commercial and industrial service they are higher still.

Financial Condition Of Power Sector Entities

As a result of its efficient operation and adequate tariff levels, NamPower is financially sound. At the end of fiscal 1998 it had no long-term debt and over a billion Namibian dollars in short term investments. These investments generated 154 million N$ in income in 1998. Some long-term financing was arranged in fiscal 1998, on concessional terms, to provide part of the financing for the 400 KV line from South Africa. Drawdown commences this fiscal year.

Periodic revaluation of assets and NamPower's depreciation policy, which in effect are accommodated in the tariff policy, contribute to its financial strength.

NamPower's challenge will be to maintain its strength in the face of increasing demands for capital investment: the 400 KV interconnection, the Kudu or Epupa generation projects, routine capital improvements to its facilities, improvements necessary to provide supply to major new loads, and its contributions to rural electrification. Net income relies

heavily on the interest on investments, without which return on assets would be undesirably low.

NE's financial performance was approximately breakeven in its first year (1997), but it has dramatically improved billing, collections, and customer service, which offers the prospect of improved financial performance in the future.

Making comparisons of NamPower and NE with municipalities is difficult. The municipalities with larger or longer established electricity departments are able to maintain and extend their networks and provide acceptable service to their customers while cross-subsidizing other municipal services with electric revenues. Smaller or newer electric departments there tend to have problems with both technical and commercial issues, making the financing of necessary investment and even routine operational activities difficult.

In addition to the problems noted for the smaller municipalities, the MRLGH has the added difficulty that local authorities are responsible for commercial operations, while financial responsibility remains with the MRLGH. Furthermore, in non-commercial rural areas the distribution of electricity is largely not financially viable due to low levels of consumption, low customer density, and high operating costs. Funding from the GRN is inadequate to compensate for these problems, with resulting deterioration of the existing network and inability to undertake service extension to the desired degree.

The above technical, commercial, and financial problems help explain the restructuring focus on distribution.

Energy Sector Private Investment Potential

Namibia has a favorable climate for foreign private investment in general. There are no important restrictions on foreign ownership or profit repatriation by foreigners, the infrastructure (roads, power, telephones, etc.) is basically satisfactory, and the economic and financial conditions are conducive to private investment. All the people we met with gave the impression that investors are very welcome and will be treated responsibly. Potential major foreign investors and financing organizations have indicated confidence in the country and a serious interest in projects. Namibia's primary constraint to increased investment is the size of its market, with only 1.6 million people in the country.

The Foreign Investment Act created the Investment Center, charged with facilitating the promotion and administration of foreign investments. It also provides for liberal foreign investment conditions, equal treatment of foreign and local investors, all sectors of the economy being open to foreign investment, no local participation requirements, full protection of investments, and the granting of a Certificate of Status Investment, which provides additional benefits. The Export Processing Zone (EPZ) Act established a set of tax and other incentives for firms engaged in activities (especially manufacturing) directed at export. There are other tax incentives available as well.

NamPower's healthy financial condition probably enhances the potential for private investment in the power sector, which may come in several areas:

- NamPower is a private limited company owned by the GRN. The Minister of Finance recently declared the possibility of selling at least part of NamPower to private investors.
- The privately owned NE already operates the distribution system in northern Namibia, but leases rather than owns the physical assets.
- The restructuring of distribution is likely to result in consolidation and some form of privatization of the resulting distributors.
- Serious negotiations have already been conducted for the development of the 750 – 1,500 Kudu power plant as an IPP. The key barrier presently is agreeing on price for the plant's output. The development has the strong backing of the GRN and NamPower, for several reasons:
  - It would permit development of the offshore Kudu gas field, which could serve as an engine for general economic development in southern Namibia.
  - It would nearly eliminate Namibia's current dependence on imports from South Africa to supply more than half the national electrical energy consumption.
  - It would provide a source of export earnings to the owners, which would include NamPower.

A team headed by Shell has the concession for the Kudu gas field, which will be developed using private funds. Shell is also a participant in the consortium seeking to develop the Kudu power plant.

Primary Energy Supply And Production

In 1996 the MME estimated that commercial final energy consumption in Namibia amounted to about 35,000 terajoules (TJ), of which about 6,050 TJ was electricity, about 1,750 was coal, and 27,300 TJ was petroleum products. Traditional energy resources (wood, charcoal, animal waste) are obviously harder to gauge precisely, but are estimated at about 8,800 TJ. Assuming this is correct, petroleum products accounted for 62% of net energy consumption in 1996, up from 52% in 1991.

Liquid Fuels

Namibia's upstream liquid fuels sector is relatively undeveloped. Offshore exploration by five private consortia since 1990 has revealed the presence of oil-prone source rocks and various sandstones, but no reserves have been established. Namibia is still relatively unexplored.

Namcor, the oil and gas parastatal, is empowered to operate widely in the petroleum sector, including exploration and production, refining, and liquid fuels marketing. It has limited its activities thus far to promotion of Namibian acreage, including data gathering and marketing, technical management of exploration activities, and advising the MME.

Namibia imports 100% of its liquid fuel requirements from foreign refining centers. with about 60 – 70% coming from South Africa.

The MME regulates the sector and fixes prices for gasoline and diesel. but the downstream distribution is carried on by five private oil companies.

Natural Gas

The initial offshore exploratory activities identified the Kudu gas field, whose reserves have been extended to about 20+ trillion standard cubic feet (SCF) (upside estimate) by the successful completion of a fifth exploratory well. Further exploratory drilling and eventual production may increase those estimates. Other fields also may be identified through further exploration.

The Kudu gas field reserves alone would be sufficient to supply the Kudu power plant over its lifetime and power and industrial demands in the Cape Town area. Larger scale gas field and transport development should decrease unit costs and make gas economically competitive for more applications.

Namibia currently does not have a downstream gas industry. The GRN views the development of the Kudu field as a probable economic catalyst for development in Namibia, especially in the Oranjemund area.

Coal

Coal is used by the power plant at Van Eck and by the Tsumeb Corporation mine, the only two significant users in the country. Although a small offshore bituminous coal field has been located, it has yet to be developed and at present Namibia imports 100% of its coal. This is also true of the Aranos basin east of Mariental, which contains an estimated 350 million tons of high quality metallurgical coal.

Renewable Energy

The traditional energy sources are all renewable, although it is unclear whether current usage rates are sustainable. In 1991 the installed capacity of photovoltaic systems was about 500 kilowatts. There are an estimated 30,000 windmills in the country used for water pumping, but the trend is to move towards solar or diesel pumps due to limited wind speeds over much of the country.

Apart from biomass, the major renewable resource is the hydro potential on the Kunene River, bordering Angola. The existing Ruacana plant delivered 992 GWH in 1998, almost half of the national generation (including imports) and substantially above the 610 GWH in 1997 due to higher river flow.

Several projects have been proposed for the Kunene below Ruacana. The Epupa site has been the most studied. A 360 MW plant delivering an average of about 1,700 GWH per year could be placed there. Environmental concerns, especially over the displacement of local communities by the reservoir, have created significant opposition to the project.

Existing And Planned Power Systems

Summary Of Structure Of Power Sector

The MME is responsible for energy policy and master planning. NamPower, the vertically integrated national electric utility, is responsible for essentially all of the generation and transmission in the country. About half the annual energy is imported from South Africa, with most of the Namibian generation coming from the Ruacana hydro plant.

NamPower distributes retail electricity to about 2,200 mines, industrial, and large agricultural customers. It also supplies bulk electricity to the primary distributors, which are municipalities, the MRLGH for rural and peri-urban areas, and NE, which is responsible for electricity supply in the densely populated northern regions of the country by virtue of a contract with the GRN. The mining firm Namdeb distributes to some domestic and commercial customers in Oranjemund. Some Namibian fringe area customers are served by Zambia's national utility ZESCO, and South Africa's national utility ESKOM, and NamPower serves some fringe area customers in Angola.

A reform and restructuring program currently under way may lead to consolidation of distribution activities. With or without the program, IPPs are also likely to enter the sector.

Current And Future Demand

Electricity demand post-independence was fairly stable from 1990-1994, at about 1,500 GWH per fiscal year. A large decrease in demand from the mining sector was nearly balanced by an increase from municipal customers. Figure F-1 summarizes historical energy demand statistics. Figure F-2 summarizes historical peak demand statistics.

Figures F-1 and F-2 also present three forecasts of future demand, taken from the "Study for the Electricity Master Plan of Namibia" report (the Master Plan) done for the MME and issued in September 1998. Each forecast is built up from separate forecasts for different components of final demand, including nine municipalities, the remaining municipalities and towns, individual mining operations both existing and planned, any remaining industry not included in the mining or municipalities, water pumping, any remaining government and parastatals not included in the municipalities, and several categories of rural demand. Export sales were not included. The forecasts accounted for increase in population, urbanization, rural electrification programs, and economic growth rates of 5% for the high forecast, 3.5% for the middle, and 2% for the low. The study used the Contribution to Load Factor methodology to forecast peak demand based on the energy demand forecasts.

Namibia's demand forecasts are highly sensitive to the addition of large individual loads, especially mines. These are large scale operations requiring major investments, and it is rarely certain whether they will develop on the schedule hoped for, or for that matter at all. The forecasts incorporate different assumptions regarding whether or not certain

mining projects will materialize. For example, the power requirements (a total in three phases of about 570 MW at 85% load factor) of the Haib copper mine were included only in the high forecast, starting in the year 2000. More numerous mine closures and reductions were included in the low forecast.

The energy demand forecast covers the entire country, including areas presently served by ESKOM and ZESCO, but excludes transmission and distribution losses. The peak demand forecast includes those losses.

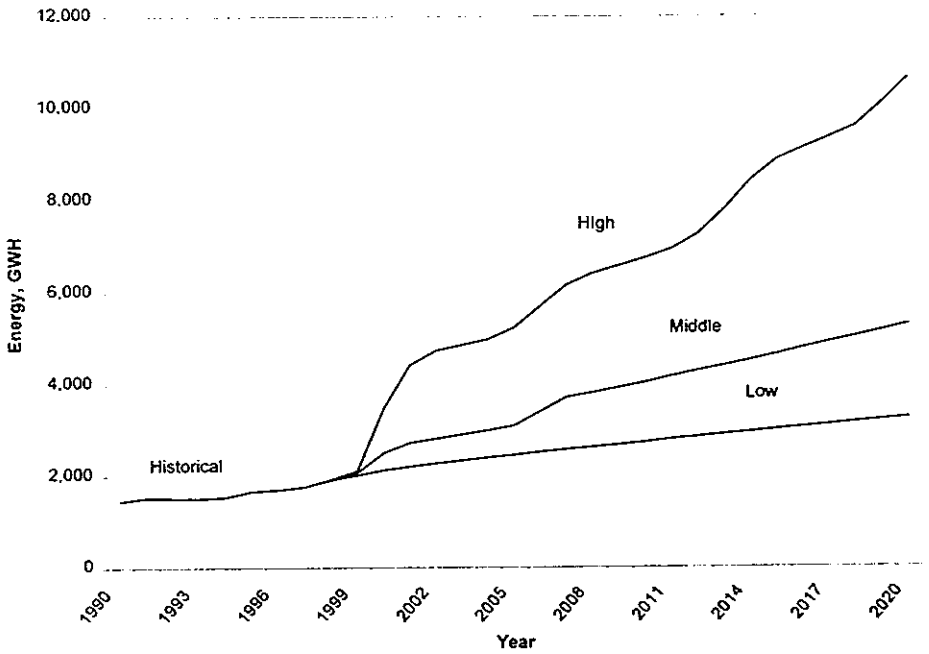

Figure E-1. Historical And Forecast Energy Demand

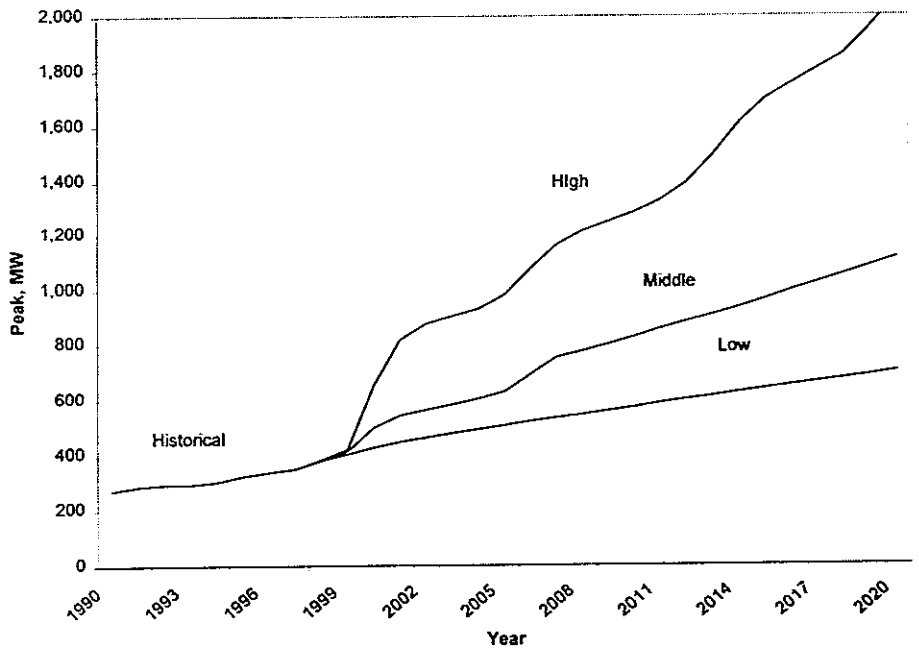

Figure E-2. Historical And Forecast Peak Demand

Existing Electric Power System

Generation

The 240 MW run-of-river Ruacana hydro plant provides most of Namibia's domestic power generation. The Kunene River flow is highly variable and the plant has only a small regulating reservoir, so the plant on average is capable of full output 30% of the time, zero output 10% of the time, and variable output averaging 40% of rating 60% of the time. The plant has three 83 MW turbines, providing a maximum output of 249 MW, but is rated at 3 x 80 = 240 MW.

The 120 MW coal fired Van Eck steam power plant near Windhoek once was Namibia's primary source of generation, but the commissioning of Ruacana and the high voltage transmission link to ESKOM in South Africa have relegated Van Eck to a backup mode of operation.

Each of the four 30 MW air-cooled units has a heat rate of about 15,000 BTU/KWH. The plant's coal is imported from South Africa by ship to Walvis Bay and then by rail. The transportation charges make the coal far more expensive than the mine-mouth coal used in most ESKOM plants. Based on 1996 coal costs and then-prevailing exchange rates, the fuel cost of generation was 3.65 US cents per KWH.

The 4 x 6 = 24 MW diesel-fired Paratus combustion turbine power plant near Walvis Bay is more expensive than Van Eck, and rarely operates.

In an average water year Ruacana's output is about half of Namibia's current level of energy demand. Imports from ESKOM over the 220 KV interconnection provide the remainder, except for occasional operation of Van Eck and (less frequently) Paratus. ESKOM also provides power to fringe customers in the Oranjemund area, which is not connected directly to the NamPower grid . ZESCO also supplies a small amount to non-NamPower grid connected fringe customers in the eastern Caprivi. A three MW diesel located in Katima Mulilo also helps serve that area.

Transmission And Transmission Interconnections

Except for some hydro, and the as yet undeveloped Kudu gas field, Namibia and western South Africa are without natural resources to support power production. In addition to hydro and pumped storage plants, area generating plants include the Koeberg nuclear plant, the NamPower plants noted above, two combustion turbine plants using fuel oil, and some municipal plants. This generation is not adequate to meet the demand in the area, which must rely on imports from eastern South Africa. The largest demand center in the west is Cape Town and the transmission system is dominated by several lines linking the eastern system with the Cape Town area.

The NamPower system has a 220 KV backbone running roughly the length of the country and connecting to the ESKOM system at Aggeneis, with a spur extending to Walvis Bay. A 330 KV line connects Ruacana to Omburu. Lower voltage spurs connect to the areas

away from the backbone. A 400 KV line from the Aries is under construction, eventually to extend to Gerus in the north. The NamPower system is characterized by long lines serving relatively small loads. As a result, for economic reasons it is designed on an N – 0 basis, meaning that outages of single lines can cause significant customer outages.

Distribution

Some of the large loads are served directly from the transmission system. The NamPower transmission system includes over 11,000 KM of lines 66 KV and below, much of which could be categorized as sub-transmission or even distribution lines. These lines provide service to the outlying areas, serving some commercial farms and a few communities, but serve primarily to connect to municipalities, the MRLGH, and NE, which distribute to end users. NamPower and the larger or older municipal electric departments provide satisfactory technical performance with respect to reliability and losses, but the technical performance of some the other distributors falls short of that standard. The technical performance of these distributors varies more or less in line with their financial resources. Many distribution networks will be 20 – 30 years in the near future, reaching an age where major rehabilitation and strengthening will be required and adding to financial demands which are not necessarily properly addressed today.

Plans For Future System

Generation projects

There are only two generation projects under serious consideration: the Kudu natural gas fired combustion turbine based combined cycle plant near Oranjemund, and development of the hydro potential of the lower Kunene River at Epupa or another site.

The Master Plan deemed those the only realistic alternatives because those two projects rely on Namibian resources. There are no other natural resources within Namibia feasible for large scale power generation, and the high cost of imported coal and liquid fuels render power plants using those fuels uneconomic in comparison.

Transmission interconnections, which provide access to generation in other countries, are discussed in the subsection below. The Master Plan treated the 400 KV line to Aries as a third viable generation expansion alternative, but it is in fact well under construction and should be complete from Aries to Auas (near Windhoek) by May, 2000.

Kudu

The Kudu gas field lies about 150 kilometers off the southern shore of Namibia, in a water depth of about 170 meters. The reserves have been extended to about 20+ trillion SCF (upside estimate) by the successful completion of a fifth exploratory well. These reserves are more than sufficient to supply a 750 – 1500 MW combined cycle power plant over its lifetime. Substantial work has been done on the design and economics of those size plants, which would be located near Oranjemund.

At 750 MW, the plant would produce more than double Namibia's current peak demand. At 90% capacity factor it would produce 5,900 GWH per year, about triple the country's current annual energy demand.

The Master Plan assumes a cost of US$ 406 million for the plant, including related transmission, and a plant efficiency of 50% on a higher heating value basis.

Epupa

Epupa is a preferred site on the lower Kunene. The Master Plan assumes 360 MW plant capacity, about 1,700 GWH annual energy, and a cost of about US$ 700 million including transmission. Environmental concerns, especially over the displacement of local communities by the reservoir, have created significant opposition to the project.

Transmission And Interconnection Projects

The 400 KV line from Auas to Aries will increase transfer capability by 500 MW. No other major interconnections are planned at his time. NamPower plans to extend the network to accommodate the new 400 KV line, new generators, and new loads, provide for reactive support, and improve reliability. Equipment added includes the lines themselves, transformers, switch bays, capacitors and reactors, and related equipment. Planned transmission projects include:

- 400 KV Auas to Gerus
- 400 KV Kokerboom to Kudu (if Kudu power plant is built)
- 400 KV Kudu to Aggeneis (if Kudu power plant is built at 1,500 MW)
- 400 KV Kudu to Juno (if Kudu power plant is built at 1,500 MW)
- 400 KV Gerus to Epupa (if Epupa hydro plant is built)
- 220 KV Harib to Haib mine (if Haib mine is built)
- 220 KV Van Eck to Walmund
- 132 KV Okatope to Ruacana
- 132 KV Auas to Gobabis

Distribution Projects

The primary challenge in distribution is to extend service to thousands of rural households in line with the national objective of connecting 12,000 additional rural households to the grid by 2000, and at least 25% (vs. 10% today) of all rural households by 2010 (and 95% of all urban households, vs. 75% today).

Electricity Trade

Due to the high cost of its own generation at Van Eck and Paratus, NamPower imports nearly all of the excess of Namibia's demand over Ruacana's output. At times the existing 220 KV interconnection to Aggeneis in South Africa is fully loaded. As

Namibian demand grows, imports must also grow unless the major power plants noted above are built. The 400 KV interconnection to Aries now under construction will increase transfer capacity by about 500 MW, providing the capability to increase imports in the event that the new plants are not built, or are not available due to outages.

NamPower's purchases from ESKOM dominate its electricity trade. It also makes small sales to ESKOM, and small amounts of trade flow in both directions as neighboring utilities serve fringe customers. Table F-1 shows the amounts in fiscal 1997 and 1998. Imports went down in 1998 because Ruacana generation increased due to favorable water conditions.

The ESKOM trade is conducted under the Southern African Power Pool agreement. The imports fall into categories of system energy, firm energy, and firm power. The Master Plan reports that under current conditions the tariff construction is quite favorable for NamPower, because the higher cost firm power and energy are a relatively small fraction of total deliveries.

Table E-1. Electricity Trade, GWH

	1998	1997
Purchases From:		
ESKOM	1,192	1,319
ZESCO	21	1
Total	1,213	1,320
Sales To:		
ESKOM	21	1
Botswana	1	0
Angola	1	0
Total	23	1
Total Trade	1,236	1,321
Units Into System (1)	2,211	1,949
Import %	55	68

(1) Namibian generation plus imports

Donor Activities

World Bank

Namibia joined the World Bank, International Finance Corporation (IFC), and the Multilateral Investment Guarantee Agency (MIGA) in 1990. Current World Bank involvement in Namibia focuses on providing technical assistance to support the government's efforts to reduce poverty, build local capacity, and enhance management of water resources. There are no major World Bank programs in energy.

African Development Bank

Namibia became a member of the Bank Group in May 1991. The social and transport sectors historically have been the major beneficiaries, but the African Development Bank is now providing a loan of about US$ 28 million to support the development of the 400 KV interconnection to South Africa.

Other Donor Activities In The Energy Sector

Germany, the Nordic countries, the European Union, and the United States are the largest donors. Most of the programs address issues such as education, health, agriculture, fisheries, and water. Energy has not been a major focus of any of the programs except that of Norway. Norway has supported grid extension to smaller villages, solar power, rural electrification, petroleum exploration, the Epupa feasibility study, and training.

Zambia

Overview

Zambia has a population of 10.0 million (5% of the SADC total) and a 1997 GDP of US$ 5.8 billion (3% of SADC total). Zambia's economy is heavily dependent on the mining of copper, cobalt, and zinc, which account for about 75 percent of the country's export earnings. A collapse in copper prices, oil price shocks, and statist economic policies in the early 1970s had a devastating effect on Zambian economy, with per capita income falling almost 5 percent annually between 1974 and 1990. However, growth has averaged 5% per year since 1995.

Recognizing that Zambia's future lies in diversifying and expanding its economic base and by increasing agricultural production, in 1992 the government initiated a series of market-oriented economic reforms aimed at reducing state participation in and control of economic activity, such as decontrolling prices, ending some parastatal monopolies, and many others. Despite the impressive pace of reforms, their impact has been limited due to a combination of problems: continued poor performance of the copper mines, falling copper prices, a series of droughts, and aid shortfalls related to donors' concerns about economic management and governance issues.

Zambia has no known petroleum or natural gas resources. Coal from the Maamba mine supplies about 17% of Zambia's consumption of commercial fuels, but production has been declining due to supply problems at the mine. Hydro generation dominates the electricity sector, producing nearly 100% of annual generation with an exportable surplus in most years. Mining provides about two-thirds of national electricity consumption. As-yet undeveloped hydro potential is roughly triple the amount of existing generation. Zambia's central location in the Southern African grid makes electricity trade and transmission issues particularly important to its power sector.

Compared to other Southern African countries, Zambia overall has come perhaps further along the path of reform and privatization. However, the generally weak economy and lack of resources have prevented it from achieving as much as the ambitious nature of its policies and plans.

Institutional Framework

Structure

The Ministry of Mines and Water Development (MEWD) is the focal point of energy activities in the country, responsible for developing and implementing policy and for the overall development of the energy sector. Within MEWD, the Department of Energy (DOE) is responsible for facilitating the formulation and implementation of energy policy

through data collection and processing, setting standards, forecasting trends of production and consumption, and other activities. The Energy Regulatory Board (ERB) is responsible for the regulation of the entities of the energy sector, primarily through licensing and tariff setting.

The main power sector organization is the Zambia Electricity Supply Corporation (ZESCO), which provides virtually all of Zambia's generation and most of the transmission and distribution. ZESCO is 100% owned by the Government of Zambia (GOZ). In the northern copper mining area, the Copperbelt Energy Corporation (CEC), a consortium including CINERGY from the US and National Grid from the United Kingdom, owns and operates the sub-transmission grid and a segment of the interconnection to the Democratic Republic of the Congo (DRC), for which it receives 10% of the Southern African Power Pool wheeling charges collected by ZESCO. CEC receives power under a bulk supply agreement with ZESCO, then delivers it to the large mining loads in the region, and redelivers to ZESCO to distribute to several communities in the area. The Zambia Consolidated Copper Mines company (ZCCM) handles distribution within its mining facilities. ZESCO performs most of the distribution throughout the rest of the country, but in a demonstration a French firm will operate the distribution in west Lusaka as a commercially viable business.

The Zambian economy as a whole and the power sector in particular are engaged in a process of reform. The Zambia Privatization Agency's (ZPA's) goal is to sell of 260 enterprises, including the largest entities in the economy. has sold off 230 of about 260 entities scheduled for privatization. ZESCO and ZCCM are in the remaining 30, which include most of the other large entities as well. The Zambia Investment Center encourages and facilitates private investment, which is permitted in all sectors of the economy. Exchange controls and other features that discourage foreign investment have been lifted.

National Policy Objectives For Or Affecting The Power Sector

The MEWD undertook a consultative process in 1993 through which a National Energy Policy was developed, and ultimately approved as a formal document by the GOZ in 1994. Its general objective is to promote optimum supply and utilization of energy, especially indigenous forms, to facilitate the socio-economic development of the country and maintenance of a safe and healthy environment. It notes the need for a viable institutional structure to ensure attaining the objectives. Specific policy elements include:

Electricity

- Restructuring the electricity industry to improve service delivery through:
  - Liberalization so that other companies can get involved in the electricity business.
  - Ensuring that the operations of ZESCO are, in the short term, commercialized.
  - Immediate privatization of the distribution function of ZESCO.
- Improving accessibility to electricity.

- Promoting electrification of productive areas and social institutions (schools. clinics).
- Developing the hydro potential to take advantage of the strategic location of the country in the sub-region by:
  - Giving priority to the construction of Kafue gorge lower power station considering that some infrastructure is already in place.
  - Ascertaining the available hydro potential on rivers located in high rainfall areas. e.g. Luapula river.
  - Promoting interconnection with neighboring countries in order to increase security of supply and secure markets for power export.
  - Developing other sites like Kariba North Extension, Itezhitezhi, Batoka, etc. depending on the market and such developments should take into account environmental impacts.
  - Ensuring the existence of up to date electricity Master Plans.
- Review existing legislation on electricity in order to bring it into conformity with the new macro-economic environment.
- Promote the technological development and wider application of new and renewable sources of energy (NRSE), and information dissemination and education and training about NRSE.
- Promote efficient energy use practices in all sectors of the economy.
- Substitute, wherever possible, local energy resources for imported ones.

Tariff Policy

- Pricing should reflect both the cost and the true economic value of a commodity and thereby provide the right signals to consumers.
- Ensure that electricity prices take account of all the economic costs. The pricing formula should be based on the long run marginal cost method which takes into account the following:
  - Replacement cost.
  - Operational costs.
  - Incentive for efficiency, reliability, safety, and environmental standards.
  - Profit.

Institutional

- Implement the necessary institutional reforms, including establishing organizations or assigning responsibilities to existing organizations:
  - MEWD
  - DOE
  - ERB
- Amend, enact, or repeal legislation to achieve these changes.
- To the extent possible, put energy sector investment in the hands of the private sector.
- Seek donor support to render assistance in:
  - Improving management skills.
  - Institutional capacity building.
  - Investment in energy infrastructure expansion or rehabilitation.

Legislation And Regulation

For the most part, the changes to legislation called for in the National Energy Policy have been accomplished, along with other legislation that will further the GOZ's objectives for the power sector.

- The Energy Act (1995) establishes the responsibilities of the MEWD and the DOE.
- The Electricity Act (1995) provides for the regulation of the generation, transmission, distribution, and supply of electricity.
- The Energy Regulation Act (1995) establishes the ERB and provides for licensing and its other powers.
- The Privatization Act (1992) establishes the ZPA and provides for its procedures and powers.
- The Investment Act (1993) establishes the Investment Center and Board, to promote, coordinate GOZ policies on, and facilitate investment in Zambia, so as to provide a one-stop support facility to investors, and provides for its procedures and powers.
- The Exchange Control Act, which restricted mobility of hard currency, was scrapped in 1994 and now there is no exchange for anyone (residents or non-residents) doing business control in Zambia.

The Board of Directors of the ERB was appointed in 1997 and its Secretariat established in 1998. Its responsibilities include tariffs, licensing, development of technical standards, and procedures for regulation, among others. It has the mandate to regulate the entire energy sector, including electricity, petroleum, coal, wood fuel, and NRSE.

The intent clearly expressed in the National Energy Policy is to create a sound legal and regulatory framework. However, the Energy Regulation Act leaves a great deal of arbitrary discretion in the hands of the Minister of MEWD, so the Minister's performance will be critical in achieving the goals of the regulatory system. It also provides for self-funding mechanism for the ERB, but at present the ERB relies primarily on grants from the GOZ. Finally, it is now four years since the Energy Regulation Act was passed, and the ERB is still in a start-up mode. Although this creates opportunities for assistance in institution building, it also highlights the problems Zambia has in directing resources to important activities.

Tariffs

Tariffs are differentiated by customer class and depending on class include non-metered supply restricted by load limiter, residential tariffs with energy-only charges, commercial tariffs with energy-only charges, special tariffs with energy-only charges for several categories of social services (water pumping, schools, street lighting, etc.), and tariffs for large customers incorporating both demand and energy charges. The average price to retail customers is about 3 US cents per KWH.

ZESCO asked for a tariff increase in 1998, which the ERB did not approve. In April of this year the Economic Association of Zambia and the Zambia Chambers of Commerce and Industry urged the ERB not to approve another ZESCO tariff increase request.

Although GOZ policy favors full cost-based tariffs, for ZESCO it may be difficult to determine the appropriate basis for the costs used in tariff calculations, for reasons noted below. This uncertainty could contribute to an unwillingness to raise tariffs in the face of opposition.

- Accounting for many years of the high inflation.
- The poor condition of the physical assets.

Financial Condition Of Power Sector Entities

ZESCO's average time from billing to receiving payment is 240 days. The deteriorating condition of the generation, transmission, and distribution equipment is demonstrated by the need for the donor-financed Power Rehabilitation Project. These factors indicate both that ZESCO is weak financially and that it badly needs to commercialize its operations.

Part of the reason for unpaid and late bills is that CEC has been withholding much of what it owes ZESCO because ZCCM, another government owned organization at present, has not been paying CEC.

Energy Sector Private Investment Potential

Zambia started relatively early on the process of reform and restructuring of its economy, and has made substantial progress. The legislation noted above, including the Electricity Act, forms the foundation for the participation of private investors in the power sector.

Also, in general a favorable legal climate for foreign investment has been established, with respect to exchange controls, foreign participation, and so on. Prices have been decontrolled, subsidies eliminated, and crop marketing liberalized.

The Zambia Investment Center was established in 1993 with the mandate to coordinate GOZ policies on and facilitate investment in Zambia. It serves as a one-stop support facility to prospective investors. It has a wide range of services and functions, including assisting in dealings with other GOZ agencies. Zambia has a broad range of incentives for investment, such as accelerated depreciation, tax holidays, lower tax rates on exports and farming, reduced duties, and others. Zambia is a signatory to MIGA and other international agreements designed to protect investments.

The ZPA has sold off 230 of about 260 entities scheduled for privatization, which includes all the largest enterprises in the economy.

Power sector privatization is proceeding along several paths:

- The northern sub-transmission system has already been privatized through sale to the CEC.
- Negotiations are in progress to privatize two approximately 20 MW hydro power plants formerly owned by ZCCM.
- ZESCO is in the group of remaining 30 firms scheduled for privatization, which include most of the other large entities as well.
    - At present the focus is on commercialization. The GOZ and ZESCO recognize the need to restructure through unbundling and implementing separate accounting for generation, transmission, and distribution.
    - A French firm will operate the distribution system in Lusaka west
    - The goal is to privatize the distribution function as soon as possible.
    - Ultimately, the entire organization will be privatized.
- Government policy is that to the extent possible further investment in Zambia will be private.
- The DOE has prepared a list of hydro and transmission projects for which it will be seeking private funds, including Kafue Gorge Lower.
- It is hoped that the interconnection to Tanzania can be financed as a private project.

Documents were signed to privatize Maamba Collieries, the only operating coal mine in Zambia, through of 80% of the shares to Benicon Limited of South Africa. Completion formalities are in progress. Total package value was Kwacha 32 billion, or about US$ 25 million at the exchange rate prevailing at the time. Layoff of 450 (of 1,050) employees is expected.

Primary Energy Supply And Production

In 1996 the DOE estimated that commercial final energy consumption in Namibia amounted to about 49,500 terajoules (TJ), of which about 23,200 TJ was electricity, about 2,600 was coal, and 23,700 TJ was petroleum products. Traditional energy resources (wood and charcoal) are obviously harder to gauge precisely, but was estimated at about 141,100 TJ. Assuming this is correct, traditional fuels amounted to 74% of total energy demand. Petroleum products and electricity were 12% each.

Liquid Fuels

100% of Zambia's liquid fuels are imported, almost all coming in the form of crude oil and other products through the 1,700 kilometer TAZAMA pipeline from Dar es Salaam, Tanzania to Ndola and the INDENI refinery. There are no known reserves of petroleum in Zambia.

Both the pipeline and refinery would benefit from commercialization. The refinery is on the list of firms to be privatized. An increasing number of private firms now participate in the distribution of petroleum products.

Natural Gas

There are no known reserves of natural gas in Zambia, and none is imported.

Coal

The volume of coal production from Maamba, the only existing mine, has declined from 742,000 tonnes in 1975 to 188,000 tonnes in 1996. The decline is attributed to production constraints due to poor maintenance of equipment. The mining industry consumes most of the coal produced. In the early 1990s exports reached 65,000 tonnes, but have declined to under 10,000 tonnes/year since 1995. ZCCM has been importing relatively small amounts of coke and coking coal from South Africa.

The Maamba mine has proven of 30 million tonnes. Other deposits have been identified, but reserve estimates are tentative. Probable reserves are believed to be in the region of several hundred million tonnes.

The Maamba mine's design capacity is 1.2 million tonnes per year. Rehabilitation and improved maintenance and operation could increase current production, which through substitution could reduce petroleum imports, one of the GOZ's policy objectives for energy.

Renewable Energy

The traditional energy sources are all renewable, although it is unclear whether current usage rates are sustainable. Apart from biomass, the major renewable resource is the hydro potential on the Zambezi, Kafue, Luapula, and to a lesser extent other rivers. Existing generation is almost 100% hydro, and provides more electrical generation than the nation consumes.

ZESCO has identified potential hydro sites with estimated capacities exceeding 6,000 MW, including 4,400 MW on the Zambezi along the border with Zimbabwe, where output would presumably have to be shared with Zimbabwe.

One of the GOZ's policy objectives is to reduce Zambia's dependence on firewood and charcoal, primarily because of environmental concerns. This will be addressed primarily through improved forest management, higher efficiency charcoal production, higher efficiency stoves, and substitution of electricity and NRES where feasible. Despite the policy objectives, the forecasts of demand in the same document show consumption of firewood growing at 2.3% per year from 2000 – 2010 and consumption of charcoal growing at 4.1% per year for the same period.

Existing And Planned Power Systems

Summary Of Structure Of Power Sector

The chief governmental organizations are:

- The MEWD, which is responsible for developing and implementing policy and for the overall development of the energy sector.
- The DOE (within the MEWD), which is responsible for facilitating the formulation and implementation of energy policy and other more detail-oriented functions.
- The ERB is responsible for the regulation of the entities of the energy sector, primarily through licensing and tariff setting.

The main power sector organization is the ZESCO, which provides virtually all of Zambia's generation and most of the transmission and distribution. ZESCO is now 100% owned by the GOZ, but it is on the list to be privatized.

In the northern copper mining area, the CEC owns and operates the sub-transmission grid, formerly owned by ZCCM but recently privatized. Several hydro plants owned by ZCCM are also scheduled for privatization.

The ZCCM handles distribution within its mining facilities. ZESCO performs most of the distribution throughout the rest of the country, but in a demonstration a French firm will operate the distribution in west Lusaka as a commercially viable business.

The Zambian power sector is undergoing a process of reform, touching all elements but focusing on implementing the ERB, commercializing ZESCO, and rationalizing the distribution activities.

Current And Future Demand

The mining industry's share of national consumption was 66% in 1995, so its demand is crucial in overall demand. The fall in copper prices has limited prospects for expanding production at the main mines, resulting in lower mining electricity consumption in 1995 than in 1986. Overall consumption grew from 6,216 GWH in 1986 to only 6,393 in 1995, a rate of 0.3% per year. Peak demand is about 1,050 MW.

A DOE study in 1994 produced estimated electrical energy growth rates of about 2% per year. The South African consulting firm SAD-ELEC in 1998 forecast growth rates of 1.5% to 2% from 1997 to 2000 and 2 – 2.5% from 2001 to 2015. From 1995 levels growth rates of 2% and 4% would produce the levels of demand shown in Table G-1.

Table F-1. Forecast Energy Demand

	Energy Demand, GWH	
	Growth Rate, %	
Year	2	4
1995	6,393	6,393
2005	7,058	7,778
2010	7,793	9,463
2015	8,604	11,513
2020	9,500	14,008

Total generation in Zambia during the period 1976 – 1996 averaged 8.620 GWH/year., including the impact of the major problem with Kafue Gorge in 1989 and generally deteriorating generating plant condition over the period. Table G-1 shows that this level of demand is not met until 2015 in the 2% growth case and about 2008 in the 4% growth case.

Existing Electric Power System

Generation

Table G-2 presents data on the existing power plants in Zambia. The ZESCO thermal plants are used to serve isolated communities. The ZCCM thermal plants are on cold standby. Negotiations are in progress with four bidders to privatize the ZCCM hydro units.

Transmission And Transmission Interconnections

The backbone ZESCO transmission system is a 330 KV line running from Kariba in the south to Luano in the north, with a spur east to Pensulo. A 220 KV line connects the backbone to the hydro plant at Victoria Falls. Total line lengths, in kilometers, are about 2,200 at 330 KV, 600 at 220 KV, 200 at 132 KV, 800 at 88 KV, and 5,800 at 66 KV, the main sub-transmission system.

The ZESCO system interconnects with the DRC's national utility SNEL through a single circuit 220 KV connection from Kolwezi in the DRC to Luano in Zambia. For various technical reasons, the interconnection is limited to 240 MW. A double circuit 330 MW link to Zimbabwe's national utility ZESA exists at Kariba, with a capacity of about 1,000 MW.

A 66 KV line extends into Namibia and provides power to the eastern end of the Caprivi strip.

Distribution

Zambia delivers to a total of about 150,000 customers, of which 120,000 are classified as residential and 18,000 as industrial. Distribution voltages are 33 KV and 11 KV. National policy is to improve accessibility by extending the grid where economically viable, developing min-hydro, and using photovoltaic wherever feasible.

Plans For Future System

Generation projects

As noted above, ZESCO has identified potential hydro sites with estimated capacities exceeding 6,000 MW. The preferred options identified in the most recent master planning study are Kafue Gorge Lower (450 – 600 MW, 3,030 GWH/year average, 2,330 GWH/year firm) and Itezhitezhi (80 MW, 510 GWH/year), both on the Kafue river.

A feasibility study has been completed for Kafue Gorge Lower, and the DOE is seeking investors. Estimated project cost is about US$ 750 million, including interest during construction and transmission to the main grid. The levelized cost of production is about 3.5 US cents per KWH if the project is financed as an independent power project.

Table F-2. Power Plants In Zambia

Power Plant	Type	Firm Energy, GWH/Year	Rated Capacity, MW	Initial Year
ZESCO Hydro				
Kariba North	H	4,700	600	1976
Kafue Gorge	H	5,000	900	1972
Victoria Falls	H	775	108	1938
Lusiwasi	H	105	12	1970
Musonda Falls	H	18	5	1960
Chishimba Falls	H	26	6	1960
Lunzua River	H	3	0.75	1960
Subtotal		10,627	1,632	
ZESCO Thermal				
Mwinilunga	D	3	0.68	
Kasempa	D	4	1	
Kaoma	D	4	0.8	
Kapompo	D	3	0.75	
Zambezi	D	3	0.75	
Lukulu	D	3	0.68	
Lundazi	D	6	1.4	
Luangwa	D	1	0.27	
Subtotal		28	6	
ZCCM Hydro				
Lusemfwa	H	96	18	1944
Mulungushi	H	120	20	
Subtotal		216	38	
ZCCM Thermal				
Nkana	S	88	20	
Bancroft	GT	88	20	1972
Luano	GT	175	40	1969
Luanshya	GT	44	10	
Maclaren	GT	44	10	
Kankoyo	GT	44	10	
Subtotal		482	110	
Subtotal Hydro		10,843	1,670	
Subtotal Thermal		510	116	
TOTAL ZAMBIA		11,353	1,786	

The Zambian market has sufficient existing generation to cover its needs for many years. and Kafue Gorge Lower would increase hydro energy generation by about 30% on average. Clearly the project must seek export markets for justification, at least for the next decade or more.

Transmission And Interconnection Projects

Two major new interconnections are being considered. A 700 kilometer 330 KV link from Pensulo to Mbeya in Tanzania would provide about 200 MW of transfer capacity. A feasibility study has been completed. Given the GOZ's policy of no new major investments in the power sector, they are seeking investors for the project. The average retail price in Tanzania is about 10 US cents per KWH, indicating an opportunity for mutually beneficial trade.

The second project is a 430 kilometer 220 KV line from Pensulo to Lilongwe in Malawi, which would provide about 160 MW of transfer capacity. Estimated cost is about US$ 50 million. However, this interconnection in a sense competes with a Malawi – Mozambique interconnection, which may be more favorably viewed in Malawi due to its lower cost, higher capacity, and access to the large and underutilized Mpanda Uncua hydro plant.

The new interconnections would have the added benefit of extending the grid to areas of the country not presently served.

ZESCO, Eskom, and SNEL performed a detailed techno-economic evaluation of reinforcing the present interconnection between Zambia and DRC, to increase the transfer capacity to 1,000 MW, with an objective of moving the power ultimately to South Africa. Three phases of development would increase capacity from the existing 240 MW 1) to 500 MW (250 MW firm), at an estimated cost of US$ 20 million; 2) to 500 MW firm, at an estimated cost of an additional US$ 77 million; and 3) to 1,0000 MW firm, at an estimated cost of an additional US$ 415 million.

ZESCO also plans to upgrade the existing 66 KV line that serves the eastern Caprivi strip in Namibia to 132 KV.

Distribution Projects

The National Energy Policy contained two demand forecasts. The "Base Case" assumed connection of 5,000 new urban household customers per year, but a negligible number of new rural connections. The second case assumed 8,000 new urban household connections per year, and 2,000 new rural connections per year. Either value would be achievable based o historical performance.

Electricity Trade

Zambia has a strong interest in electricity trade for several reasons:

- It has surplus hydro generation which can be sold profitably.
- Its central location makes means that transactions between the DRC and Zimbabwe or South Africa must pass through its system, providing wheeling revenues.
- With its large reservoirs, it can bank energy for others.
- With its heavy dependence on hydro, interconnections provide a measure of protection from severe drought.
- Its new plants are likely to be built to serve the export market, at least initially.

Table G-3 provides data on electricity trade since 1977. Zambia is an active member of SAPP.

Table F-3. Zambia's Electricity Exports

	Exports, GWH		
Year	SNEL	ZESA	Total
1977	0	2,351	2,351
1978	1	2,524	2,525
1979	0	2,734	2,734
1980	0	3,265	3,265
1981	0	3,508	3,508
1982	0	3,757	3,757
1983	-2	3,168	3,166
1984	0	2,810	2,810
1985	0	3,219	3,219
1986	-1	2,575	2,574
1987	0	966	966
1988	-7	1,233	1,226
1989	-486	148	-338
1990	-2	986	984
1991	-37	2,108	2,071
1992	-1,401	95	-1,306
1993	-1,057	855	-202
1994	-903	1,970	1,067
1995	-488	1,468	980
1996	-795	932	137

Donor activities

Many donors are active in Zambia, in part because of a broad range of clear needs and in part because of the GOZ's willingness to undertake constructive reform.

World Bank

The main power sector activity, supported by the World Bank and many other agencies, will be the Power Rehabilitation Project. The World Bank's contribution is USS 75 million, with other donors bringing the total up to about $ 200 million. This project will help make Zambia's electricity supply industry more efficient, reliable, and financially self-sustaining through power infrastructure rehabilitation, capacity building, and policy reform. The project will also improve the quality, reliability, and coverage of electricity to Zambia's industrial and commercial consumers. In addition, the project will include a rehabilitation and development program for the Gwembe-Tonga, an ethnic group that has lived in extreme poverty since being resettled during the construction of the Kariba Dam during the late 1950s. About half the funds devoted to physical equipment will go to generation, with the other half divided between transmission and distribution.

African Development Bank

The African Development Bank has no significant power sector projects in Zambia.

Other Donor Activities in the Energy Sector

The Swedish International Development Cooperation Agency (SIDA) has a multi-faceted program in the power sector. It is supporting capacity building at the ERB (with a focus on electricity, not petroleum), a training center at Kafue Gorge for regional hydro operators, a rural photovoltaic program, and a training program for ZESCO once it has defined how it will be restructured.

Zimbabwe

Overview

Zimbabwe has a population of 12.3 million (6.5% of the SADC total) and its 1997 GDP was $US 7 billion (4% of the SADC total). The country's economy has been under pressure from high inflation and interest rates and a weakened currency, increasing poverty and declining per capita expenditure in social sectors. The low balance of payments position and sharp increases in basic food items had also posed serious challenges to the economy.

Zimbabwe has no petroleum of natural gas resources, but has about 1 percent of the estimated recoverable coal reserves in the region and substantial potential for production of coal-bed methane. Its generation mix is heavily hydro with 1996 production representing about 40% of the total SADC hydro generation. Zimbabwe imported about 20% of its electricity requirements in 1996, making it the largest importer in SADC in absolute terms. There are potential coal-based and hydro generation projects.

Institutional Framework

Structure

The Department of Energy under the Ministry of Transport and Energy is responsible for energy policy in Zimbabwe. International oil companies, private mining companies and the National Railways of Zimbabwe influence activities in the energy sector, particularly with respect to pricing. The Ministry of Mines manages the coal sector, with the Ministry of Transport and Energy acting as a major consumer through Zimbabwe Electricity Supply Authority (ZESA) which operates coal-fired power plants.

National Policy Objectives For Or Affecting The Power Sector

A National Energy Policy document was developed at the Ministry of Transport and Energy in 1995. Its major objectives were:

- To ensure accelerated economic development.
- To facilitate rural development.
- To promote small-medium scale enterprises.
- To ensure environmentally friendly energy development.
- To ensure efficient utilization of energy resources.

The strategies to be employed to achieve these objectives were:

- Limiting energy demand to the extent consistent with maintaining growth through pricing based on economic costs and more efficient use of energy.

- Choosing an appropriate level of reliability of supply.
- Exploiting regional co-operation opportunities to reduce supply costs, subject to political consideration.
- Enhancing rural development through provision of adequate forms of energy.
- Integrated energy planning.
- Balanced energy management.

Legislation and Regulation

The are plans for the development of an Energy Act, but the revision of the existing Electricity Act has taken precedence. This revision is expected to be complete later this year or next. We have not had access to drafts, but conversations with ZESA and the Department of Energy indicate that major areas of reform are at least an accounting separation of generation, transmission and distribution functions, accommodation of independent power producers and open transmission access, and independent regulation. The degree of independence of the regulator is a major area of debate.

Under the existing Electricity Act of 1985, generation, transmission and distribution are done by ZESA, which is 100 percent government-owned. ZESA has formed a subsidiary, Zimbabwe Power Company, for developing new power projects as of the beginning of 1999. This structure is in response to expected requirements of modifications to the Electricity Act. The Zimbabwe Power Company is pursuing the Gokwe North coal-fired power project and is investigating renewable projects greater than one MW.

Environmental regulation is the responsibility of the Ministry of Mines, Environment and Tourism. An Environmental Management Bill has received public review and is currently under consideration. Key features of the bill include the creation of the an Environment and Natural Resources Board with broad authority and independence from the Ministry, the institution of an environmental impact assessment process, and the use of a combination of economic incentives and sanctions. Discussions with the Ministry and environmental non-governmental organizations (NGOs) indicated strong support for the development of renewable resources, increased efficiency of use, rationalization of energy pricing policy and the wide dissemination of information to concerned parties so that informed choices on the energy/environmental issues could be made.

Tariffs

Pricing is to ensure the economically efficient utilization of energy, with Government prerogative to adjust prices according to overriding considerations. Pricing principles differentiate by energy sub-sector, e.g. cost-plus pricing for liquid fuels such as to ensure stable prices and the long term viability of the national oil industry, and long run marginal cost based tariffs for electricity sector. Under the existing Electricity Act, ZESA prepares a cost-of-service study on an annual basis as a justification for tariffs. However, final tariffs are approved by the Government, and the there are significant cross-subsidies from commercial to household customers. Pricing guidelines for coal will be worked out

jointly by the Ministry of Transport and Energy, Ministry of Mines, ZESA, Wankie Colliery Company, and other companies that will be dealing with coal in the future.

Financial Condition Of Power Sector Entities

From 1993 to 1998, ZESA operated profitably without state subsidies. It is quite vulnerable to foreign exchange variations since it imports a high percentage of its requirements. The devaluation of the Zimbabwe dollar in 1998 increased by almost 40% without a corresponding increase in tariffs due to customer and government pressure. This resulted in an unprofitable operating year in 1998.

Energy Sector Private Investment Potential

There are three major obstacles to foreign investment in Zimbabwe—economic decline, battles over land ownership, and involvement in the Congo war. Of the three crises, the economy is the most serious. Annual inflation was over 35% in 1998 and interest rates were well 40%. The value of the Zimbabwe dollar dropped 65%. International financial assistance is critical to economic recovery. However, the IMF has been displeased by many of the government's economic policies, including its latest actions over land, and it does not want to be seen to be supporting Zimbabwe's involvement in the Congo war.

Assuming an economic recovery, there are a number of incentives in place for future investment. The Zimbabwe Investment Center is a one-stop investment promotion agency. They have been involved in the Gokwe project and would be the point of contact for any other privately developed power or mining project.

Companies with foreign shareholdings are entitled to remit 100% of after tax profits to foreign shareholders. Foreign shareholders, in turn, are permitted to disinvest and externalize the proceeds of the disinvestment after a period of two years. Loans from outside Zimbabwe greater than $5 million must be approved by the External Loans Co-ordinating Committee.

Investment in the infrastructure of Export Processing Zones, including industrial power supply, is subject to special tax treatment including:

- income tax profits for five years (taxed at 15% thereafter)
- branch profits tax
- income tax on employees' benefits
- capital gains tax
- non-resident and resident shareholders' tax on dividends
- non-residents' tax on interest, fees, remittances and royalties
- customs duty
- sales tax on goods and services (to be refunded)

Tax incentives for investment in the mining sector include remittability of 100% of after-tax profit, secure mining title, corporate tax of 35%, immediate write-off of all capital expenditure, and operating losses can be carried forward.

Primary Energy Supply And Production

Liquid Fuels

Zimbabwe has no known oil reserves. Exploratory work has been done in the Zambezi valley. All liquid fuels are imported and are brought in by pipeline from Beira, Mozambique to Mutare and are distributed by road and rail.

There is some ethanol production based on sugar. Capacity is approximately 50 million liters per year. Ethanol is mixed with gasoline as a transportation fuel.

Coal And Coal-bed Methane

Coal is one of Zimbabwe's primary energy sources. Coal made up a third of total 1996 energy consumption. High quality coal deposits occur in Hwange, other parts of North Matabeleland, the Zambezi valley and in the South east, adjacent to the Gona-re-Zhou National Park. Zimbabwe has estimated recoverable reserves of 740 million metric tonnes of coal. Its annual production of 2.2 million metric tonnes is all in the Hwange area. There are two mines. The Wankie Colliery produces coal for both the Hwange power plant and the for industrial use from both surface and underground works. The Sengwa Colliery is currently closed, but previously produced metallurgical coal.

Coal-bed methane is not currently utilized. It has been considered as a substitute for the electrolysis process in the Zimbabwe Fertilizer Company plant.

Renewable Energy

The major source of hydropower for Zimbabwe is Zambezi river which has a total potential of 7,200 MW of which 4,200 MW can be developed by Zimbabwe jointly with Zambia. The two countries share a hydroelectric power station on the Kariba dam which was built on the Zambezi river in 1955-1960. Production from the Kariba plant accounted for less than 5 percent of overall energy consumption in 1996.

Sites for mini hydro plants in Zimbabwe have been assessed and over 3,000 MW of potential has been estimated (Department of Energy study on hydroelectric potential of irrigation dams).

Combustible renewables made up 50% of the total 1996 energy balance. The primary users are rural and low income urban households. Demand currently outstrips supply with the resultant deforestation problems.

Residues from forestry and sawmill operations offer a resource that has yet to be used for energy purposes. Concentrated in the Chimanimani region, feasibility studies have been completed for cogeneration facilities to use sawmill waste for steam production for drying kilns and for electricity generation.

More than 200 bio-gas digesters have been installed in Zimbabwe for use with cow dung and pig manure.

Zimbabwe experiences and insolation of 2000 KW/meter^2 per year and is uniform across the country and throughout the year.

Wind speeds average only 3.2 meters/second and vary by season, time-of-day, and area. The resource is unsuitable for power generation, but can be used for water pumping.

Existing And Planned Power Systems

Summary Of Structure Of Power Sector

Ministerial responsibility for the power sector lies with the Department of Energy in the Ministry of Transport and Energy. ZESA is currently responsible for generation, transmission and distribution. The market for power generation will be opened up under the new Electricity Act expected to be approved by the end of the year of early next year. ZESA will be incorporated under the Companies Act. The Electricity Act will establish the office of the regulator who will oversee the operations of all the stakeholders in the power industry.

Current And Future Demand

A customer breakdown is shown in Table H-1. The largest customer (400 MW) is a fertilizer plant owned and operated by the Zimbabwe Fertilizer Corporation that uses an electrolysis process for manufacture.

Table G-1 Electricity Sales

Electricity sold, GWh	1995/96	1994/95
Domestic	1734	1658
Agricultural	691	903
Commercial and lighting	1386	1383
Industrial	3952	3507
Mining	1579	1571
ZESA	23	14
Total electricity sold	**9365**	**9036**

Electricity sales have been growing at a rate of 8 percent per year. Peak demand in 1996 was 1,828 MW. Approximately, 20 percent of Zimbabweans have access to electricity. There is a commitment to increase this to 80 percent in the next two generations. There were 410,000 customers in 1996. SAD-ELEC in South Africa has estimated electricity demand growth in Zimbabwe to be between 4 and 6 percent per year after the year 2000.

Existing Electric Power System

Generation

At present ZESA's internal generation capacity meets 65% of the country's electric energy requirements with the remainder coming from imports from South Africa and Mozambique. Table H-2 shows the generating capacity in Zimbabwe. Kariba South is the only hydro station.

Table G-2 ZESA Generating Capacity

Source of power	Type	Nominal capacity MW	Nominal capacity MW
Hwange	Coal fired	920	856
Munyati	Coal fired	120	60
Harare	Coal fired	135	80
Bulawayo	Coal fired	120	60
Kariba South	Hydro	666	666
Total source of power		1961	1722

The present total capacity is 1,266 MW which was developed as follows:

- 4 x 150 MW generator sets that were installed on the Zambian side and commissioned in 1962. These are known as the North Bank Power Station are shared equally between Zambia and Zimbabwe giving each country a 300 MW share of the station.
- 6 x 122 MW generator sets which were installed on the southern bank (the Zimbabwe side) of the river in 1976-77 and are known as Kariba South Bank Power Station. This later installation brought the Kariba dam's hydro-electric power capacity to 1,332 MW and under the equal share agreement, Zimbabwe owns 666 MW of this capacity.

The Kariba Power Station has recently been affected by drought and the flows into the lake have been progressively low since the early eighties, resulting in a critical fall in levels which almost rendered the station in-operable in 1992/93. In August 1993, the lake level was about one meter above the power station intake level and projections were putting the water to last till November 1993.

The Hwange plant is supplied by the Wankie Colliery. The thermal plants at Munyati and Harare were refurbished in 1995.

Bagasse is burnt to produce electricity at the Triangle sugar mill. Capacity is 15 MW during harvesting season and 5 MW off-season. Most of the production is used at the plant with some sold to ZESA.

Transmission And Transmission Interconnections

ZESA is interconnected with South Africa, Mozambique, Botswana, Zambia and Democratic Republic of Congo by way of Zambia. ZESA has firm power agreements with Mozambique and South Africa. It has emergency power arrangements with Zambia and DRC.

The line capacity of the 400 KV interconnection with South Africa is 1000 MW. However, there are internal constraints in wheeling power through Zimbabwe. Available sources estimate the firm transfer capacity to be no more than 500 MW. Transformer capacity is also 500 MW. ZESA is however presently planning for an upgrading of the most important lines to 400 MW, which would increase the north - south capacity to 1000 MW.

ZESA began importing 400 MW of power from Cahora Bassa at the end of 1997 using the recently completed US$ 850 million 420kV Songo/ Bindura/Dema interconnection with Mozambique. Imports from South Africa were reduced as a result of Mozambican imports. This line is currently energized at 330 KV. Capacity can be increased through increasing operating voltage to 400 KV.

Distribution

Distribution systems are operated by ZESA.

Plans For Future System

Generation Projects

ZESA previously had a System Development Program that tended to emphasize hydro development. This has been abandoned because of financing constraints. The World Bank is currently conducting a study of least-cost options for the ZESA system to be finished in May. A discussion of individual projects follows.

Hwange Extension

This project consists of two new units at the existing Hwange coal fired station (Units 7&8, 660 MW) based on a joint venture agreement was formed between ZESA and the Malaysian company, YTL Corporation. According to Zimbabwe Independent (April 30 1999), the Zimbabwe government has abandoned the sale of Hwange power station to Malaysia's YTL and is currently renegotiating the deal to attract the support of international financiers. The government has already communicated its decision to the International Monetary Fund (IMF) and the World Bank. The future of this project is considered to be highly uncertain.

Gokwe North

A National Power consortium with Zimbabwe Power Company, ZESA's investment subsidiary, and Rio Tinto Zimbabwe has been awarded exclusive negotiating rights by the Government of Zimbabwe to develop a new 1,400 MW coal-fired power station in Gokwe North, situated in north west Zimbabwe. The project is likely to cost around US$ 1.5 billion. National Power is to invest up to US$ 400 million in a majority equity stake of between 60% and 80% in the project and will operate the plant, together with ZESA. The power station will consist of four 350 MW generating units. Three of these are to be operational by the end of 2004, with the fourth unit currently planned to come into commercial operation three years later. The project could produce around a third of the country's power demand.

Batoka Gorge Hydro

This is a 1,600 MW project that would require joint development with Zambia. A recent hydro master plan ranks this project behind the Itezhitezhi project (80 MW) and the Kafue Gorge Lower project (600 MW), both on the Kafue river in Zambia.

Interconnection Projects

Strengthening the interconnection between Zambia and the DRC is planned. This should improve access to DRC power by Zimbabwe. Upgrades to interconnections with Mozambique and South Africa can be accomplished to accommodate increases in trade with those countries. In the case of Mozambique, energizing the existing interconnection at 400 KV will increase capacity. The internal ZESA system and transformer capacity limit the transfer capability of the interconnection with South Africa. ZESA is planning on strengthening internal transmission over the next few years. This with investment in transformer capacity should allow the north-south capacity to be increased to 1000 MW. Such an increase would be consistent with the development of a regional generation project, such as Gokwe North.

Distribution

ZESA is in the process of rehabilitating and expanding the Harare distribution system under funding from the African Development Bank as part of Electricity III. The main components of the project comprise the following:

- Construction and uprating of 132 KV lines.
- Erection of 132/33 and 33/11 KV substations.
- Construction of 11 and 33 KV lines.
- Erection of 11 KV panels.
- Service connections.

Electricity Trade

Zimbabwe is the largest electricity importer in SADC. It is particularly well situated at the center of SAPP to benefit from electricity power transactions. ZESA has bilateral contracts with ESKOM, Hydroelectrica Cahora Bassa (HCB), ZESCO and with SNEL. Table H-3 shows imports prior to 1997. The completion of EDM and ESKOM interconnections has changed the trading patterns shown in the table. The ZESCO and SNEL contracts are primarily for emergency purposes. The existence of SAPP has probably not affected the contracting with ESKOM and HCB because of the unique characteristics of those arrangements. The terms for emergency transactions should be facilitated under SAPP.

	1995/96	1994/95
Bulk imports from		
Electricidade de Moçambique	0	0.8
Eskom	1 096.7	162.8
SNEL	729.7	1 055.8
ZESCO	1 345.1	1 093.0
Bulk exports (wheeling)	0	45.5

Table G-3 Historical Electricity Trade

ZESA representatives were very supportive of electricity trade, particularly as currently low prices have been beneficial to them. However, the importance of job development was also a major concern expressed in other conversations. In this context, the benefits of trade were seen to primarily benefit the exporter. The Gokwe North project, which currently appears the most favored development, would put Zimbabwe in the position of an exporter and would result in substantial job creation in the mining sector.

The Gokwe North project will be an IPP. Even the Hwange plant could become an IPP depending on the outcome of decisions of privatization of ZESA. Such entities are not

defined in the Electricity Act of 1985 and are not included in membership of SAPP. This could become a problem for investors if the revised Electricity Act and/or if revision to SAPP membership criteria are substantially delayed.

The delay of the Electricity Act also leaves the issues of third-party transmission access and independent regulation in some doubt. Delay could result in de facto commitment to projects for which there is less regulatory doubt, regardless of economic merit. This is particularly important as there is likely take some time for the various regulatory bodies to their procedures in the context of a regional market. This will be difficult in any case, without, in parallel, licensing a new facility under a new law.

The current interconnections do not provide a constraint to existing trade. Strengthening of internal transmission and investment in transformer capacity is required to increase north-south transfer capability to South Africa if a regional generation project were to be developed.

Donor Activities

World Bank

The World Bank has 10 active projects in Zimbabwe with commitments totaling US$ 512 million. These funds support projects in the financial, public sector management, agriculture, environment, infrastructure and social sectors.

It is expected to participate in the Gokwe North project and is currently conducting a least-cost planning study of the power sector as a due diligence exercise for current power sector investments.

Its Global Energy Facility, through the United Nations Development Program (UNDP), has been used to sponsor the Solar PV project. The project has resulted in the installation of several thousand solar lighting systems. These installations have been implemented by the Biomass Users' Network, ZESA, and private companies. One of the goals of the project was to build domestic manufacturing capabilities. These have primarily been in the area of batteries and charge controllers.

African Development Bank

The African Development Bank is currently the major source of financing for the Electricity III project.

Other Donor Activities in the Energy Sector

Demonstrating Increased Resource Use Efficiency in the Sugar Industry of Southern Africa through Environmentally Sustainable Energy Production.

The Common Fund for Commodities is funding a demonstration of the feasibility of co-cropping sweet sorghum with sugar cane (utilizing fallow land) for the production of energy. Several sites owned by the Triangle Sugar Company have been used to demonstrate ethanol production and cogeneration applications.