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Baseline Study on the Electric Power Sector in Southern and Eastern Africa

Final Report

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Baseline Study on the Electric Power Sector in Southern and Eastern Africa

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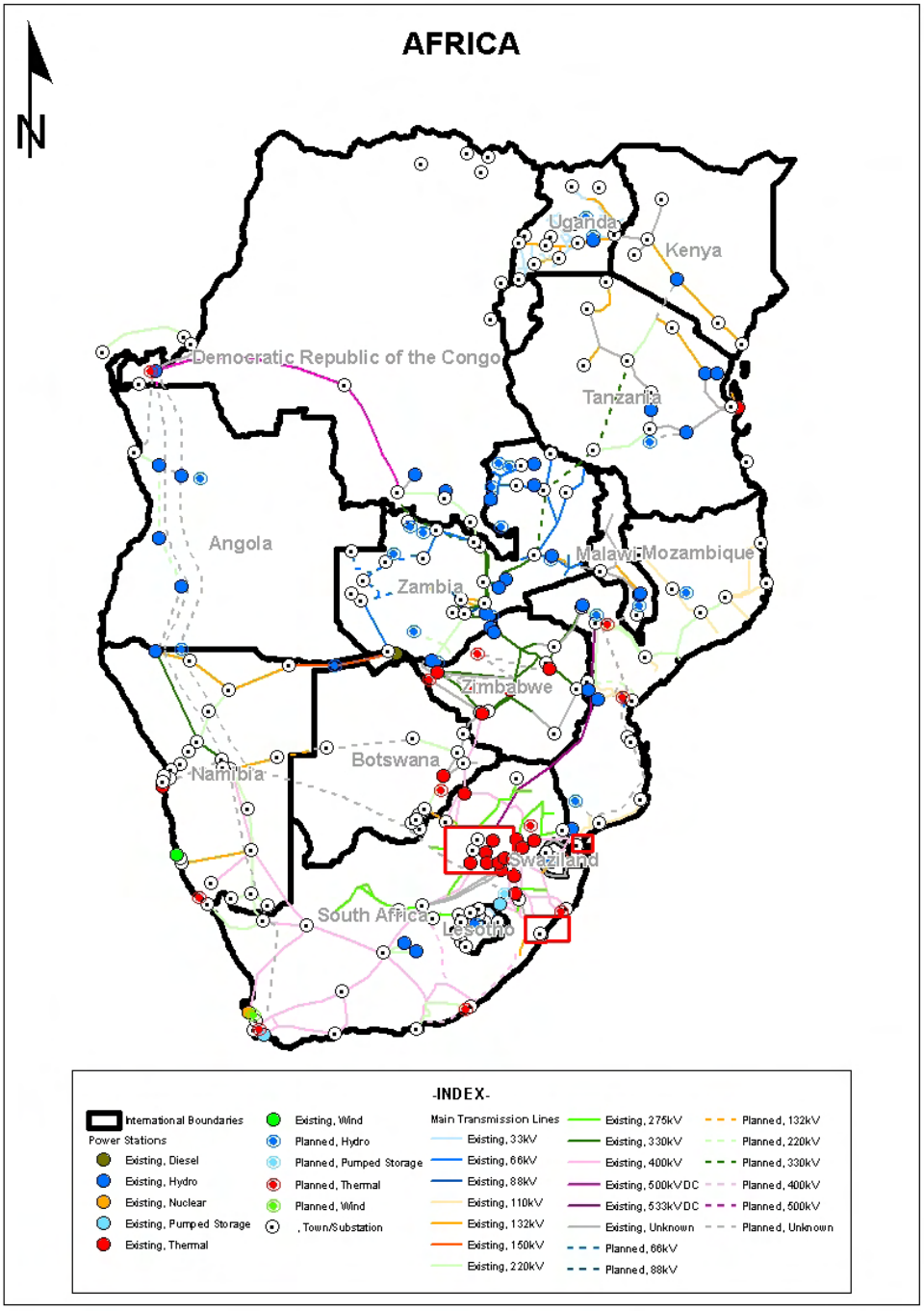
List of Abbreviations

AfDB	African Development Bank
AFUR	African Forum for Utility Regulators
ann.	Annum (year)
BOOT	Build Own Operate Transfer
BPC	Botswana Power Corporation
C,R&W	Combustibles, renewables and waste
DBSA	Development Bank of Southern Africa
DRC	Democratic Republic of Congo
EAPP	East Africa Power Pool
ECB	Electricity Control Board
EDEL	Empresa de Electricidade de Luanda
EDI	Electricity distribution industry
EDM	Electricidade de Mocambique
EEHC	Egyptian electricity utility
EEPCO	Ethiopian electricity utility
EIA	Energy Information Administration
ELECTROGAZ	Rwandan electricity utility
ENE	Empresa Nacional de Electricidade
EPC	Engineering Procurement and Construction (contract)
ERA	Electricity Regulatory Authority
ERB	Electricity Regulatory Board
ESCOM	Malawi power utility
ESI	Electricity supply industry
ESKOM	South African power utility
GWh	Gigawatt-hour
HCB	Hidroelectrica de Cahora Bassa
HVDC	High voltage direct current
IEA	International Energy Agency
IPP	Independent Power Producer
JICA	Japan International Cooperation Agency
KenGen	Kenya Generating Company
KPLC	Kenya Power and Lighting Company
kV	Kilo-volt
kVA	Kilo-volt Ampere
kVarh	Kilo-volt Ampere reactive hour
kWh	Kilowatt-hour
LEA	Lesotho Electricity Authority
LEC	Lesotho Electricity Corporation
MOTRACO	RSA-Swaziland-Mozambique transmission company
Mozal	Mozambique aluminium smelter
MW	Megawatt
NamPower	Namibian power utility
NEC	Sudanese electricity utility
NECO	National Electricity Council

NEPAD	New Partnership for Africa's Development
NER	National Energy Regulator
PPA	Power Purchase Agreement
PSP	Private Sector Participation
RED	Regional Electricity Distributor
REGIDESO	Burundi electricity utility
RERA	Regional Electricity Regulator Association of Southern Africa
Resid.	Residential
RSA	Republic of South Africa
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SEB	Swaziland Electricity Board
SINELAC	Rwanda-Burundi-DRC electricity utility
SNEL	Societe Nationale d'Electricite
STAP	Short Term Action Plan (NEPAD)
STEM	Short-term energy market
TANESCO	Tanzanian Electricity Supply Commission
TFC	Total Final Consumption
TOE	Ton oil equivalent
Trans/Dist.	Transmission and distribution
TPES	Total Primary Energy Supply
TWh	Terrawatt-hour
UEB	Uganda Electricity Board
UEDCL	Uganda Electricity Distribution Company Limited
UEGCL	Uganda Electricity Generation Company Limited
UETCL	Uganda Electricity Transmission Company Limited
UMEME	Uganda distribution concessionaire
US$	United States Dollar
USC	United States cents
WESTCOR	Company developing western transmission corridor
ZEDC	Zimbabwe Distribution Company
ZERC	Zimbabwe Electricity Regulatory Commission
ZESA	Zimbabwe Electricity Supply Authority
ZESCO	Zambia Electricity Supply Commission
ZETC	Zimbabwe Electricity Transmission Company
ZPC	Zimbabwe Power Company

Southern Africa Electricity Interconnections



Source: *Various utilities, SAPP*

A. INTRODUCTION

A.1 Background & Objectives

JICA appointed Africon to carry out a review of the energy situation of 14 Southern and East African countries, focusing on electricity. This report is aimed at informing JICA decision making in the course of supporting regional economic infrastructure projects in Africa under NEPAD.

A.2 Structure of the Report

Section B of this report provides brief background on some of the multi-lateral institutions active in Southern and East Africa. They are important from an infrastructure and regulatory perspective. As the region becomes integrated, infrastructure is increasingly planned on a multilateral basis. Equally, regulators are exchanging ideas and standardising approaches with their regional peers.

Section C of the report considers the status and issues surrounding interconnector projects specified by JICA (DRC-Zambia, Zambia/Zimbabwe-Namibia and Malawi-Mozambique). Since it is of a similar status and nature, the planned Zambia-Tanzania-Kenya interconnector is discussed as well.

Section D of the report presents energy and electricity profiles of the specified countries. The section commences with an explanation of the sequence the country information is presented in. The introduction to the section records the data sources used. It also presents summary (country-comparative) information. The rest of section D contains the country profiles. They have been separated by dividers for ease of reference.

A.3 Information Base Year

Except where indicated otherwise, all of the information shown in the report is for the calendar year 2004. This is the latest year for which multi-country information is available from sources such as the IEA. Where information for other periods is presented, the applicable period is appropriately indicated.

A.4 Completeness of Information

The information presented in this report is often quite dynamic. Depending on the sources used, what is presented here may be slightly dated (especially in the case of secondary information sources). Where information was contradictory, the authors applied their best judgment. There are also some cases where information is still awaited. These sections are marked accordingly in the main text.

B. MULTI-LATERAL INSTITUTIONS PROFILE

B.1 Power Pools

The principle of a power pool is for neighbouring electricity utilities to plan and supply electricity in the most reliable, economical way to meet their combined load. Power pools now exist over the whole Africa, and the only country in this report that is not a member of any pool is Uganda.

B.1.1 Southern African Power Pool

SAPP is the second oldest of the pools, established in August 1995. The original motivation behind SAPP was to interconnect the hydropower network in the north of SADC with the thermal network in the south, in so-doing diversifying the energy mix and improving regional security of supply.

SAPP was established by way of an inter-governmental agreement. The pool is voluntary. It plays an information sharing and regional coordination role (through various sub-committees), but member utilities are ultimately individually responsible for investment decisions and investment. Membership of the pool does not imply 'contractual' undertaking to carry out the regional/pool plans.

The Sub-committees are:

- Environmental, dealing with issues around regional environmental standards.
- Operating, focusing on regional standards of operation. Work has included preparing the SAPP Operating Guidelines, establishing the Co-ordination Centre(in Harare), establishing Trading platforms, producing minimum requirements for Telecommunications, installing Automatic Generation Control (AGC) and establishing principles for Frequency Control Performance.
- Planning, addressing issues such as information on future demand, capacity and new plant, Standard Systems and Practices, Training and Development, Wheeling Charges and Accreditation of Capacity. The Planning Sub-Committee is responsible for producing the regional power plan. SAPP has an investment programme made up three sub-categories, namely short-trem generation rehabilitation and expansion projects, longer-term (post 2010) generation expansion projects and interconnectors to expand the SAPP grid. These projects are all mentioned under the respective country analyses (for generation), in this section (WESTCOR) or in section C (the other interconnectors).

SAPP is a regional body resorting under SADC, reporting to the Infrastructure unit of SADC. SADC itself maintains an energy desk, but this function largely entails acting as a conduit for information between the SADC Ministers Conference and SAPP.

SAPP is a 'co-operative' pool, i.e. based on regional objectives and members' common interests. All utilities participating in SAPP have equal rights and obligations, and have agreed to act in solidarity without taking advantage of one another. Members have undertaken to share information and knowledge, be politically neutral, develop common planning and operating criteria and procedures and to accept wheeling on behalf of other members when this is technically feasible. SAPP is gradually converting itself to a 'competitive' pool, i.e. where members/participants buy and sell in competition with one another on various electricity trading platforms.

SAPP membership is made up of Botswana Power Corporation (BPC); Electricidade de Mocambique (EDM); Angola's Empresa Nacional de Electricidade (ENE); Electricity Supply Commission of Malawi (Escom); South Africa's Eskom; Lesotho Electricity Corporation (LEC); Namibia's NamPower; Swaziland Electricity Board (SEB); the Democratic Republic of Congo's (DRC) Societe Nationale

d'Electricite (SNEL); Tanzania Electric Supply Company (Tanesco); Zimbabwe Electricity Supply Authority (ZESA) and Zambia Electricity Supply Corporation (ZESCO). SAPP membership is presently restricted to national electricity utilities, although Hidroelectrica de Cahora Bassa (HCB) was granted temporary observer status to the three SAPP Sub-Committees (Planning, Operation and Environmental) in April 1998.

Power trade continues to increase steadily annually at an average of 20%/annum. The value of the electricity traded in 1999 was over $150 million. A short-term energy market (STEM), which started live trading in April 2001, utilises the Internet to conduct trades. The STEM is a spot market of non-firm electricity contracts.

B.1.1.1 MOTRACO

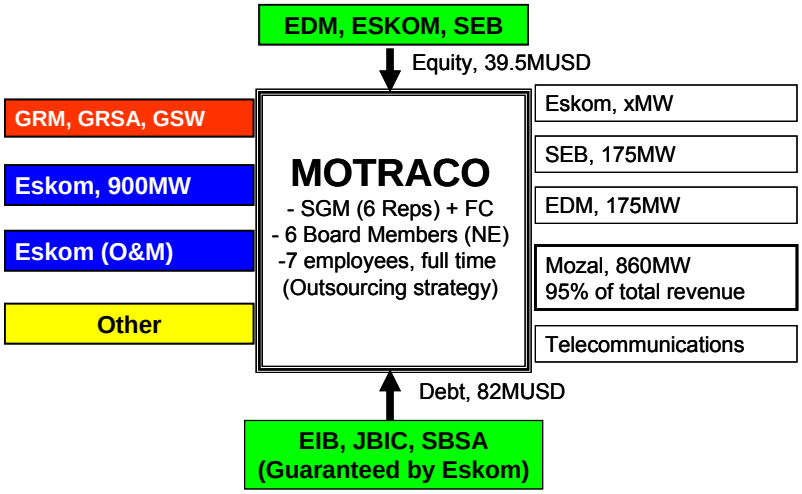
In the mid-1990s, Alusaf (owned by Billiton) decided to replicate its successful aluminium smelter projects in Richards Bay in post-conflict Mozambique. The smelter, known as Mozal, would require significant energy inputs. Intergovernmental agreements were put in place for the development of hydroelectric potential (low cost and reliable generation) and associated high voltage transmission lines in Mozambique. Alusaf agreed an electricity tariff with Eskom in 1997, however, Eskom did not have a licence to sell electricity in Mozambique and EDM did not have sufficient transmission capacity to supply the smelter.

It was decided to set up a Special Purpose Vehicle (SPV) to supply Mozal with electricity from Cahora Bassa through Eskom, Companhia de Transmissão de Moçambique, or Mozambique Transmission Company (MOTRACO), which was registered in Mozambique. The Government of Mozambique approved the MOTRACO project with certain fiscal benefits. Two 400 kV transmission lines were built, one running through Swaziland.

Concession contracts were entered into between MOTRACO and each of governments of Mozambique, South Africa and Swaziland for the:

- Contruction and ownership of transmission lines,
- Importation of energy for direct sales to Mozal
- Transmission of energy on behalf of EDM, SEB and ESKOM,
- Establishment of a fibre optic cable network on its transmission lines to ensure the reliability of electricity supply to the aluminium smelter.

Project funding is illustrated in the figure below.



Source: Presentation "MOTRACO: A Role Model for Regional Cooperation and Integration", presented at SADC REIC Conference, Windhoek, Namibia, September 2005

B.1.2 East African Power Pool

The EAPP was established in February 2005, with very much the same motivation as for the establishment of SAPP. EAPP's seven members are the following utilities: REGIDESO of Burundi, SNEL of DR Congo, EEHC of Egypt, EEPCO of Ethiopia, KenGen and KPLC of Kenya, ELECTROGAZ of Rwanda, NEC of Sudan and SINELAC of Congo-Rwanda-Burundi.

With respect to infrastructure construction, EAPP's major focus is on establishing power pool interconnections. In the short to medium term, these include Uganda-Kenya, Rwanda-Burundi-Eastern DRC and Zambia-Tanzania-Kenya. In the longer term, these are Kenya-Ethiopia, Ethiopia-Sudan and Ethiopia-Djibouti.

B.2 Regulatory Institutions

B.2.1 Regional Electricity Regulator Association of Southern Africa (RERA)

Organisation, Membership and Mandate

The Regional Electricity Regulators Association of Southern Africa (RERA) is a formal association of independent electricity regulators. RERA has the following three strategic objectives:

- Capacity building and information sharing among members
- Facilitation of harmonized electricity supply industry (ESI) policy, legislation and regulations, focusing on cross-border issues
- Regional regulatory cooperation to improve the economic efficiency of electricity interconnections and electricity trade among members.

The current members of RERA are the Electricity Control Board of Namibia (ECB), National Energy Regulator of South Africa (NER), National Electricity Council of Malawi (NECO), Energy Regulation Board of Zambia (ERB) and Lesotho Electricity Authority (LEA).

B.2.2 African Utility Regulators Forum (AFUR)

The African Forum for Utility Regulation aims to support the development of effective utility regulation in Africa. It was established in September 2000 as an informal arrangement to facilitate the exchange of information and lessons of experience between African regulators, and to support capacity building efforts in the region.

From the electricity fraternity in Southern and Eastern Africa, the following are members: Electricity Regulatory Board (Kenya), Electricity Council (Malawi), National Directorate of Energy (Mozambique), Electricity Control Board (Namibia), National Energy Regulator (South Africa), Electricity Regulatory Authority (Uganda), Energy Regulatory Board (Zambia) and the Department of Energy (Zimbabwe).

C. REVIEW OF SELECTED INTERCONNECTOR PROJECTS

C.1 Interconnector Projects

Recent examples of successful regional interconnector projects are:

- MOTRACO: Mozambique's Electricidade de Mocambique (EDM) and Eskom, and the company was established to construct the power supply infrastructure from South Africa to the Mozambique Aluminum plant (Mozal). One of the two 400kV transmission runs through Swaziland. The Motraco project entailed the construction of two new substations in Swaziland, and the upgrading four existing substations. The Motraco 400kV transmission network was completed in 2004.
- RSA-Namibia Interconnector: 400kV transmission line interconnecting the South African transmission grid with the Kokerboom sub-station (Karasburg) in the south of Namibia. This project was carried out under a utility-to-utility agreement.

With the exception of the Zambia-Namibia-Zimbabwe line, the interconnector projects discussed below are all key projects in the power pool development plans.

C.2 SAPP Interconnector Projects

The DRC-Zambia and Mozambique-Malawi interconnector projects are both key to the SAPP transmission expansion and strengthening strategy. To that should be added the Western Corridor (DRC-Angola-Botswana-RSA) and the Zambia-Tanzania interconnector. The Zambia/Zimbabwe-Namibia interconnector has a more local focus, serving Namibia's specific needs. All five of these interconnectors are listed as NEPAD Short Term Action Plan (STAP) priority projects.

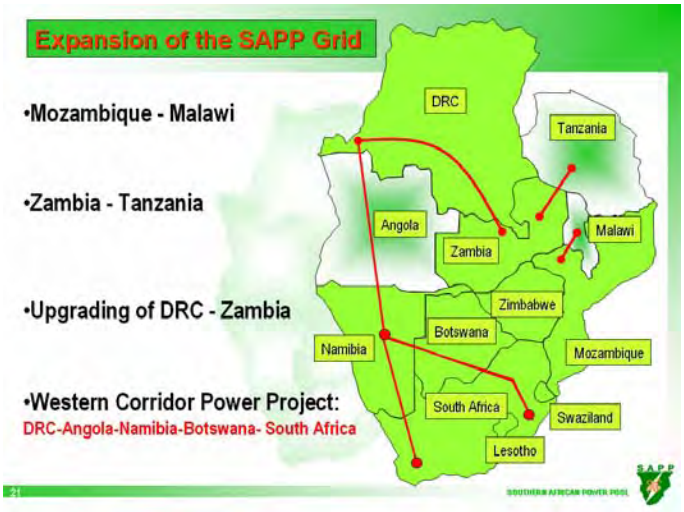


Figure 1 *SAPP Interconnector Projects*

Source: *SAPP presentation to Regional Electricity Investment Conference, September 2005, Namibia*

C.3 WESTCOR

C.3.1 Description

The project will comprise the construction of a 3,500MW hydroelectric dam (Inga III), a transmission line and a telecommunications line. The project is estimated to cost about US$7.0 billion.

C.3.2 Project Justification

WESTCOR is a SADC project conceived through the combined initiative of the SADC Secretariat and the power utilities of Angola, Botswana, DRC, Namibia and South Africa. The project's aim is to harness the large water resources of the Congo River at Inga, to produce and supply electric power, initially for the five countries involved but ultimately to the whole SADC subregion.

C.3.3 Assessment

The Westcor Joint Venture Company was formally registered and launched in September 2005. Each utility owns 20% of the share capital and has deposited the first owners' equity funds into the company bank account.

WESTCOR is currently carrying out feasibility studies on Inga III, new hydro capacity in Angola and the transmission line (HVDC) itself.

C.4 DRC-Zambia

C.4.1 Description

The project entails the construction of a 330kV transmission line from Kolwezi in the DRC to Solwezi in Zambia. The line is an integral part of the rehabilitation of Inga I and II in the DRC, and will contribute to improving evacuation from Inga and alleviating congestion on the 220kV Kolwezi-Luano (Zambia) line.

C.4.2 Project Justification

Inga I and II have installed capacities of 351 MW and 1,424MW respectively, but are presently producing at less than 40% of that. The power produced is consumed locally and also evacuated by interconnected transmission networks to Zambia, Zimbabwe and South Africa (through Kolwezi-Luano), and to Congo Brazzaville (Kinshasa-Brazzaville).

C.4.3 Assessment

The Inga feasibility study is estimated in the order of US$10 million. The physical rehabilitation and construction projects are assessed to amount to US$452 million, probably excluding Kolwezi-Solwezi. In none of the cost breakdowns publicly available is the Kolwezi-Solwezi line shown separately. It is may be in excess of US$200 million.

There have been some procurement problems around appointing a contractor to rehabilitate Inga I and II, as well as to secure additional funding. Inga III, with an output of between 3,500MW and 4,500MW, would be the next stage to develop. This is the project supported by WESTCOR. The AfDB is supporting a process whereby all four Inga projects (i.e. including Grand Inga) are evaluated and optimal sequence of development is decided on before selecting to support Inga III or Grand Inga.

There are a number of role players involved, including the DRC Government, SNEL, WESTCOR and SAPP. Financiers who have indicated interest so far are AfDB and the World Bank. The main immediate issue is to find additional resources to cover the study-financing gap. There are various initiatives ongoing (roundtables) to facilitate dialogue between all key existing and potential stakeholders, to include, inter alia, potential consumers, investors and financiers. The Kolwezi-Solwezi transmission line is tied up in the discussions surrounding the Inga site development. This is likely to take some time yet to resolve.

The feasibility study for Kolwezi-Solwezi has not yet been done. There appears to have been some movement on the Zambia side regarding procuring funding (also from JBIC), but not yet on the DRC side.

C.5 Zambia-Namibia-Zimbabwe

C.5.1 Description

This project entails the upgrading of the existing 348km transmission line from Kafue (Zambia) to Livingstone (Zambia) from 220kV to 330kV, and the construction of a new 230km 220kV transmission line from Livingstone (Zambia) to Katima Mulilo (Namibia).

The scope of the Kafue-Livingstone 220kV to 330kV line upgrade project includes the following:

- Uprate 189km Kafue West/Town-Muzuma line to 330kV
- Install 1x330/220kV Auto transformer at Muzuma
- Uprate 159km Muzuma- Vic falls line to 330kV
- Install 2x330/220kV Auto-Transformers at Vic falls S/S
- Install Switch Reactor, 1x35MVAr SVC at Muzuma
- Install 330kV line bays at Kafue West, Muzuma and Victoria Falls Substations.

The scope of second line from Livingstone to Katima Mulilo is also as follows:

- Construction of 230km of 220kV transmission line from Victoria Falls substation to Sesheke substation and up to the Zambia – Namibian border
- Construction of 220kV line bay at Victoria Falls Substation
- Construction of 2 x 220kV line bays at Sesheke substation.

C.5.2 Project Justification

The initial part of the project was to facilitate the export of 200MW to Namibia by the year 2008. This would also require the upgrade of the Kafue-Livingstone 220kV transmission line to 330kV voltage level. NamPower indicated that they would further require increasing their imports to 400MW. To facilitate this another 220kV transmission line would have to be constructed parallel to the one currently being constructed, as well as the construction of an HVDC link between Katima Mulilo and Rundu/Otjikoto in Namibia.

C.5.3 Assessment

The cost of upgrading the Kafue-Livingstone 220kV transmission line is estimated at US$30 million. The construction of the second 220kV line between Livingstone will cost approximately US$16 million. This therefore gives an approximate total project cost of US$46 million.

The feasibility study for the project should be complete by the end of 2007. The major outstanding issue for this project to commence would be arranging the funding. Project preparation funding from the NEPAD-Infrastructure Project Preparation Facility (NEPAD-IPPF) of USD500 000 was approved at the end of 2006. This funding is to support the Governments of Zambia, Tanzania, and Kenya in engaging a transaction advisor to assist the three governments to institute a successful solicitation process to facilitate the attraction of private sector participants and the attainment of Financial and Legal Closure for the Project.

C.6 Malawi-Mozambique

C.6.1 Description

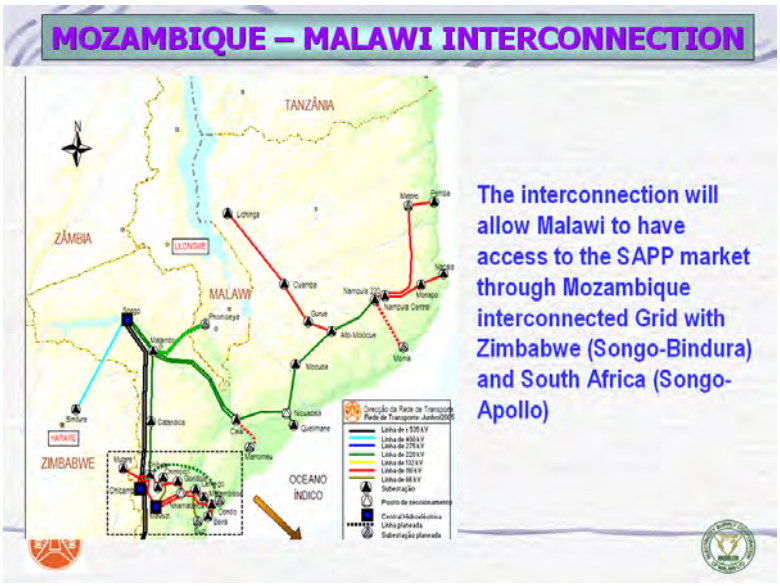
The project involves the construction of a new 219km 330kV (or 400kV) transmission interconnector from Matambo (Mozambique) to Blantyre/Phombeya (Malawi), but initially energised at 220kV. The project will also include the rehabilitation of the Tedzani hydropower plant in Malawi and construction of a new substation at Phombeya in Malawi. This interconnector represents an essential link

in the SAPP and will link Malawi to the SAPP grid. It will contribute to energy trade in the region, and therefore to regional integration. Establishing this project will facilitate the north-south flow of energy through the Power Pool, contributing to energy trade in the region.

C.6.2 Project Justification

The power systems of Malawi and Mozambique show some significant differences in terms of costs and availability, which constitute the prerequisites for making an interconnection beneficial to both parties. While development of additional hydropower is found to be costly in Malawi, the power supply situation in the country is now critical. Mozambique has a vast hydropower capacity that may be used for meeting the increasing demand in Malawi. Meanwhile, Malawi is not electrically interconnected to any of its neighbours.

Figure 2 Mozambique-Malawi Interconnector



Source: ESCOM presentation to Regional Electricity Investment Conference, September 2005, Namibia

C.6.3 Assessment

The project cost is estimated in the order of US$90 million. The World Bank is likely to fund US$ 33 million of the project cost, including goods, works, related services and consulting services to be procured under this project. Components under the proposed World Bank project include:

- About 120 km of new 220 kV Transmission Line, including a river crossing; 220 kV substations (extension of existing substation), SCADA equipment and Protection Systems.
- Supply of equipment and tools for operation and maintenance of Transmission Systems.
- Consultancy services for technical studies and training related to - power system planning; feasibility studies for new transmission links and rehabilitation of existing transmission and distribution system; transmission system operation and maintenance procedures; preparation of specifications and bidding documents for transmission, distribution and operation and maintenance equipment; supervision of transmission and

distribution works; carrying out of EIA and preparation of environment management and resettlement plans.

(Source: World Bank General Procurement Notice dated 15 December 2006, Project ID P069258)

Although the basic feasibility has been demonstrated, the project is stalling at the implementation stage due to bilateral disagreement. The PPA (specifically pricing) and financing plan remain major issues. A system operating and maintenance agreement still has to be concluded between EDM and ESCOM, as well as a wheeling agreement. NEPAD, SADC and DBSA are facilitating a pricing discussion between the two utilities. A funding request still has to be submitted (the project cost is estimated at US$90 mil). It is projected that this project will be funded early in 2007.

C.7 Zambia-Tanzania-Kenya

C.7.1 Description

The project entails constructing a new 330kV transmission interconnector from Pensulo (Zambia) to Mwakibete (Tanzania) and on to Kenya.

The project started in 1995 as Zambia-Tanzania Interconnector, supported by the utilities of Zambia, Tanzania and South Africa who carried out a feasibility assessment. Project cost was then estimated at US$153 million (1998), to construct a 700km 330kV transmission line, transferring 200MW.

In 2001 the project was extended to include a Tanzania-Kenya Power Line (260km, 330kV, 340MW), as well as the reinforcement of the internal transmission network in Tanzania. The project subsequently became the Zambia-Tanzania-Kenya power interconnector.

C.7.2 Project Justification

This project has as its objective to interconnect SAPP and EAPP. It also has an important future role in evacuating power from the Inga complex.

C.7.3 Assessment

The total project cost is now estimated to amount to some US$659 million.

It appears that some technical, economic, financial and environmental studies have been completed. A transaction advisor was engaged to provide the financial, technical and legal services. The advisor proposed a plan leading to the appointment of an EPC contractor and financial close by April 2007. The following mode of implementation has been agreed:

- A Public-Private Partnership, through a Project Company with majoring Public share-holding
- A BOOT with assets to be transferred to the three governments at the end of the concession
- A Project Company which will be a Power Transporter and not a Power Trader

A draft request for proposal package has been completed. However, requests for proposals have apparently not yet been advertised and this deadline therefore will not be met.

In the mean time, progress has been made on the Arusha-Nairobi interconnector, with the construction contract becoming effective June 2006.

D. COUNTRY PROFILES

This section of the report reviews the energy situation of each of the selected countries, starting with an overview of the energy situation as a whole but concentrating on the electricity sub-sector. The profiles each have a standard format:

Energy Sector Policy briefly recaps the major policy thrusts of each country. The presentation has not been standardised (i.e. the same descriptive formula is not followed) – mostly because in very few cases was the actual policy document available. Most of this section in each case is derived from secondary sources of information.

Energy Supply & Demand aims at providing the energy 'big picture'. The tables under this section show the national energy balances in million tonne oil equivalent (MTOE), expressed as TPES (total primary energy supply) at the supply end and TFC (total final consumption) at the consumption end. The data used is mostly from the International Energy Agency (IEA). In the case of small countries, the IEA does not track energy balances and in these cases an abbreviated energy balance table is presented as calculated from data from the Energy Information Administration of the USA. Where EIA data is used, only supply is shown, and importantly, excluding 'combustibles, renewables and waste' – a significant contributor to the energy profile in the whole Africa.

Electricity Legal and Regulatory Framework is divided into three sections: the administrative framework (Electricity Act, responsible Ministry and independent regulator), a brief description of the parastatal utilities, and a description of any private participation in the electricity sector.

Table 1 Status of Electricity Reform

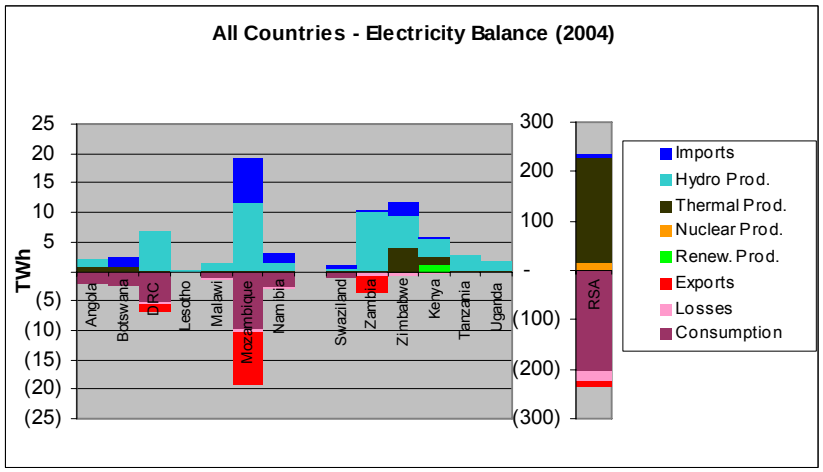
Country	Electricity Act?	Independent Regulator?	Integrated utility unbundled?	PSP in generation?	PSP in distribution?
Angola	GEA '95		Not yet	Allowed	Allowed
Botswana	-	No	No	No	Yes
DRC	-	No	No	No	No
Lesotho	EA '97	LEA	Not yet	Allowed	Allowed
Malawi	EA '98	NECO	Not yet	Not yet	Not yet
Mozambique	EA '97	Proposed	Proposed	Yes	No
Namibia	EA '00	ECB	In progress	Allowed	No
South Africa	EA '87	NER	Not yet	Allowed	No
Swaziland	Not yet	No	No	Not yet	No
Zambia	EA '95	ERB	Yes	Allowed	Allowed
Zimbabwe	EA '02	ZERC	Yes	No	No
Kenya	EPA '97	ERB	Yes	Yes	No
Tanzania	EA '?	No	No	Yes	No
Uganda	EA '99	ERA	Yes	Yes	Yes

Electricity Demand and Supply demonstrates the amount of electricity produced and imported vs exported and consumed per country. The graphs shown are based on information from the EIA.

As shown in the following figure, the absolute levels of electricity production and consumption differ markedly over the 14 selected countries. It demonstrates the dominance of South Africa in the production and consumption mix. It shows that

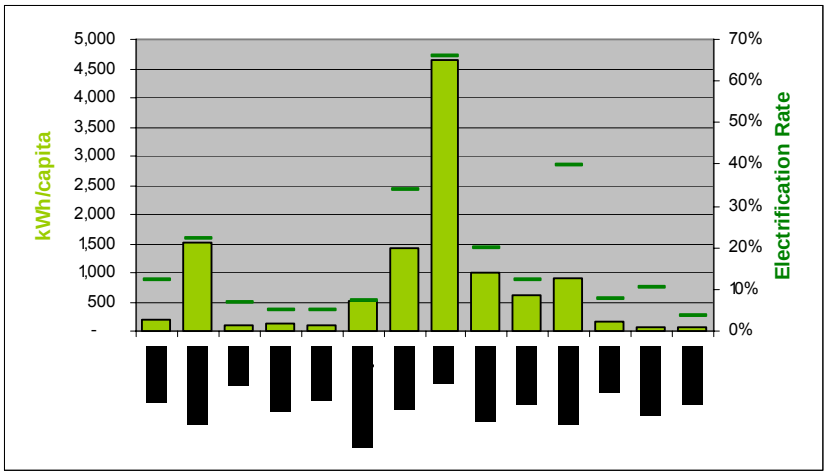
electricity trade (imports and exports) only make up a fraction of the electricity volumes.

Figure 3 Electricity Balance per Country (2004)y



Converting the absolute electricity consumption numbers into consumption per capita, reduces the variance across countries somewhat. – as shown in the following graph. This graph also presents the World Bank's most recent estimate on national household electrification rates.

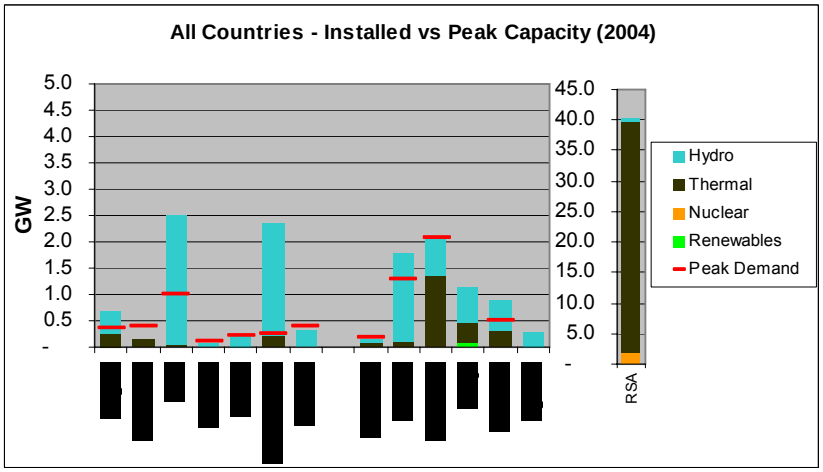
Figure 4 Electricity Consumption per Capita and Electrification Rate (estimated 2006)



The major data sources used for this report were the following:

The installed capacity per country follows a similar pattern to Figure 3. The South Africa numbers have been cut off in the graph to make the comparison between the other countries more useful. The absence of a red line indicates that the 2004 peak demand was not available for that country.

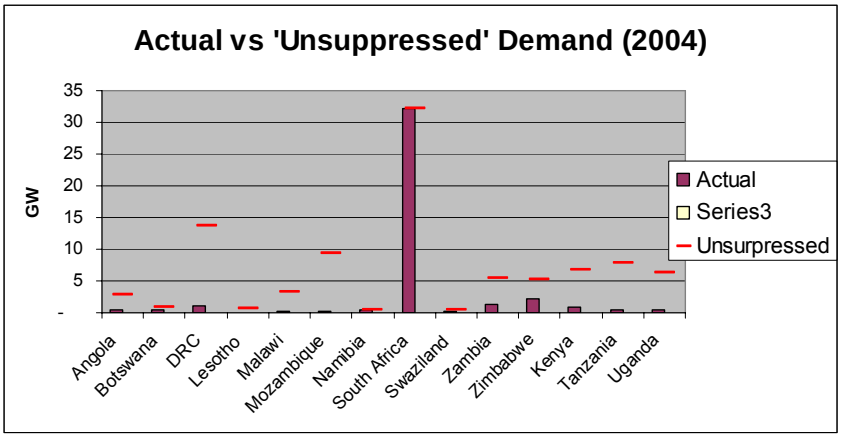
Figure 5 Installed Capacity vs Peak Demand per Country (2004)



The above figure indicates the peak electricity demand per country in 2004. JICA has asked the question of what the total unsuppressed demand could look like. To calculate such a number requires some important assumptions to be made. The following figure indicates what the peak demands could be assuming the following:

- Electricity is consumed by households and the productive economy
- For household consumption:
  - The household electrification is at least 50%, except those countries which already exceed this rate
  - The household consumption rate is at least 50% of the South African rate, except where actual consumption levels already exceed this
- For consumption by the productive economy:
  - The GDP per capita is at least 50% of the South African rate, except where the rate already exceeds this level
  - The electricity intensity (i.e. kWh/GDP) is at least 50% of the South African rate, except where the intensity already exceeds this level
- The load factor is at least 65%, except where this level is already exceeded
- Electricity losses are already factored into the 2004 peak demand.

Figure 6 Estimate of Unsuppressed Peak Demand per Country (2004)



Under the scenario sketched above, the DRC, Malawi, Mozambique, Tanzania and Uganda represent more than a ten-fold increase in demand. Angola, Lesotho, Zambia and Kenya approximately a five-fold increase. The demand in Botswana, Swaziland and Zimbabwe would double. In Namibia and South Africa, the actual and unsuppressed loads are similar.

Electricity Infrastructure is divided into generation and transmission/distribution infrastructure. The generation description commences in each case with a brief overview of the primary energy resources available in a country. It then graphically demonstrates how these resources have been utilised (thermal, hydro, etc.) in terms of installed capacity (MW). The historic data shown is that of the EIA, the last year being 2004 in each case.

This is compared with information received from the two power pools and other *ad hoc* information sources, also for 2004, presented as available and (non available but) installed capacity. Refer to the green (available) and orange (installed) bar on, for example Figure 9. For most countries, the historic EIA data and power pool information matches closely. Where this is not the case, the main reason would be timing differences, or the inclusion of information in the EIA data that a power pool would not be interested in (such as a generating plant that is not on the grid and therefore not a candidate for regional trade).

These capacity vs demand graphs also graphically demonstrate the projected growth in peak demand (in most cases as estimated by the respective power pools). – refer the red line in Figure 9. Here, care needs to be taken when comparing the red line (peak demand) with installed capacity: if a country is an electricity exporter (e.g. DRC) the capacity will substantially exceed demand, and vice versa in the case of an importer.

The generation section concludes in each case with a table of projects. These are as identified by the power pools. The comments attached to individual projects are derived from a recent survey by the African Development Bank of power pool projects and issues, as well as own knowledge on some of the projects.

The transmission/distribution section is mostly a narrative description of the infrastructures in place. In some cases a country map is shown. However, the reader is referred to the comprehensive map at the start of this report whenever spatial information is required. Transmission projects are not dealt with in this section, since most of these projects are already addressed in section C.

Rural electrification information has mostly been obtained from secondary sources.

Tariff information was obtained from the utilities themselves. There is a wide range of dates that tariffs became applicable. In all cases, these have been converted into the US$ rate in the year the tariff became effective.

Utility performance was assessed based on a standard template. The main source of information was the latest annual report of the respective utility – where available.

"Each country profile is concluded with a table highlighting the challenges to the respective electricity sector. The challenges are noted under standard categories:

- 'Policy/Legal & Regulatory Framework' refers to the structure of the domestic electricity market, whether vertically integrated or unbundled, whether competition is allowed, etc.
- 'Electricity Supply' refers to security of supply and infrastructure-related issues
- 'Utility' refers to the efficiency and financial status of the major supplier/s
- 'Market' refers to the status of electrification."

D.1 Angola

D.1.1 Energy Sector Policy

The IEA carried out the Angola Energy Review, completed in September 2006. The review concluded that the country is blessed with substantial oil and gas reserves which make it the second largest oil producer in sub-Saharan Africa and a major player in world oil markets. On the other hand, following twenty five years of civil war, many citizens still do not have access to the reliable energy they need for their daily lives.

The review focused on those energy sub-sectors likely to play the largest role in meeting domestic demand for modern energy services, notably electricity and domestic demand for oil products. Given the extremely large role biomass currently plays in meeting the bulk of household energy needs, this sub-sector is also featured, with emphasis on improving the sustainability of biomass use.

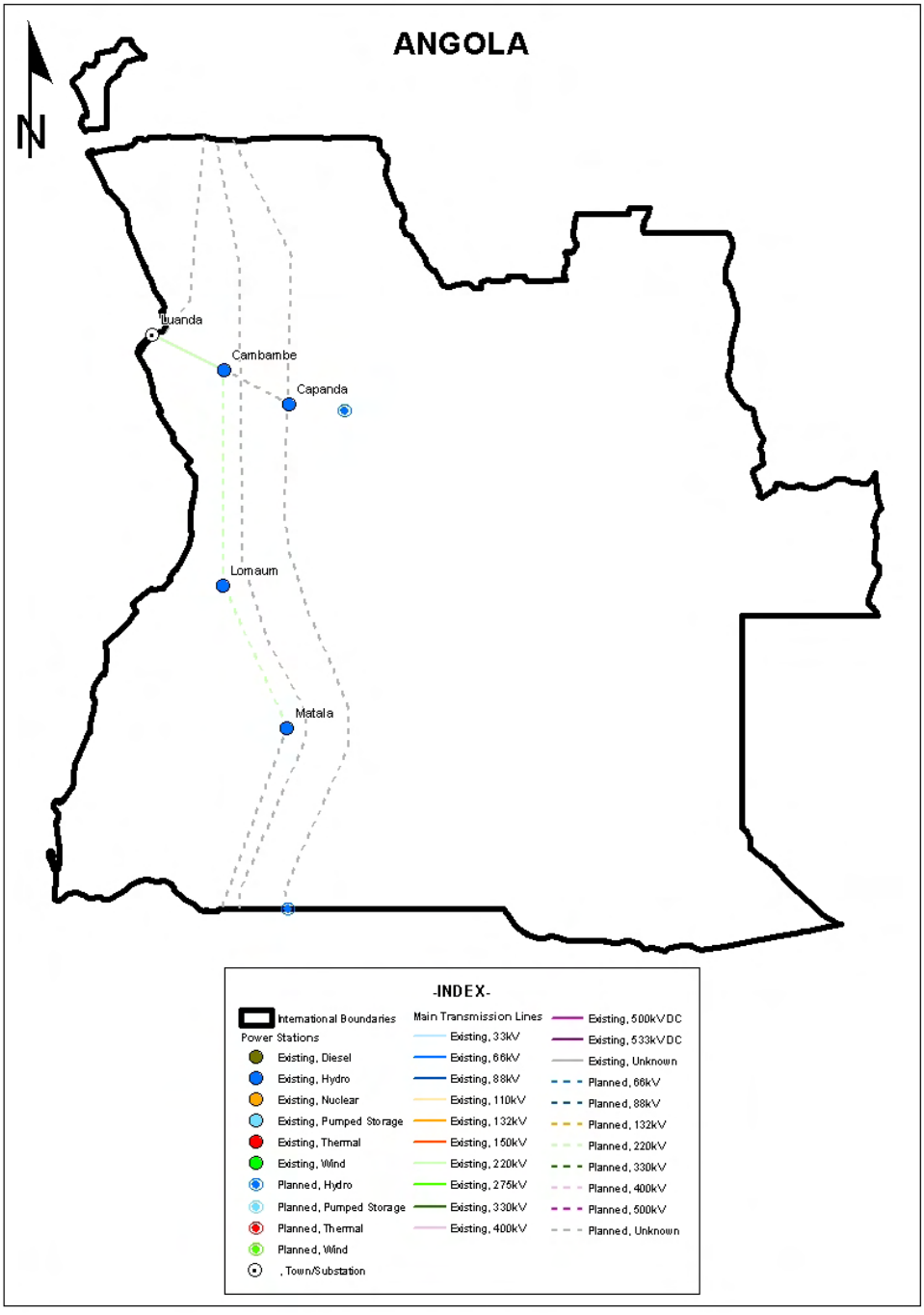
Electricity is the leading indicator of growing prosperity and the principal driver of a modern society. The electricity sector requires significant investment but is currently not able to generate sufficient funds. Not only do tariffs not cover costs, but collection rates on bills are low. While raising tariffs is important, simply raising tariffs may in fact aggravate the non-payment problem if higher tariffs are not accompanied by better service and by efforts to improve billing and collection.

It is therefore recommended that, as a priority, collection rates of electricity bills be improved before new tariffs are established in the electricity sector. Priority investment is needed to improve information systems in the sector, at least the implementation of reliable metering throughout the system. A rational rate structure, metering systems and more effective collections are essential to building a viable national electricity business.

The Review recognises the importance to the Angolan economy of revenues from the upstream oil sector. The Review recommends that the upstream oil sector be further strengthened by ensuring that the regulatory framework provides sufficient stability for the effective execution of existing contracts and the continued attraction of foreign investment. The Review also encourages the Angolan government to continue its efforts to improve transparency in the management of oil revenues.

But the downstream supply of oil products to citizens across the country presents even greater challenges. Oil product prices are fixed below cost and are uniform throughout the country, thus giving few incentives to private companies to engage in their distribution and sale. The only incentive to shipping oil products across the country is to smuggle them into a neighboring country where prices are higher. This is a direct loss to the Angolan treasury and the Angolan people. The Review therefore advises the Angolan authorities to continue their efforts to liberalise product prices, which ideally should reflect world levels plus the cost of transportation. Investment in transportation and oil product storage infrastructure is also a priority.

The Review further notes that in contrast to the oil sector, the gas sector in Angola is underdeveloped. Opportunities are being missed. To encourage vibrant development it will be particularly important for the government to present a clear gas development strategy which will inform potential investors what their rights and obligations are in participating in the development of the gas industry. Effective implementation of the government's policy to reduce flaring not only makes eco-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Planned, 132kV
Planned, 220kV
Planned, 330kV
Planned, 400kV
Planned, 500kV
Planned, Unknown

nomic sense but will also bring significant environmental benefits. Taking advantage of that gas requires that investors understand the rules of the road.

The Review also highlighted household needs leading to the widespread usage of biomass as the primary fuel for heating and cooking. Some 80% of Angolans rely on biomass for most of their energy needs. But as the woman on the cover of the book knows better than any, gathering wood consumes a great deal of time and energy that could be put to other productive purpose. In addition, the production of charcoal contributes substantially to deforestation. It is suggested that problems such as pollution and health-hazards linked to such a high level of biomass consumption be tackled within the wider framework of household energy needs, in particular by recognising firewood and charcoal use as a response to the lack of energy alternatives. More people die in the world because of smoke inhalation from traditional biomass than die of malaria. Rationalising traditional biomass use is one area requiring very close coordination between all government departments.

The final recommendation is that it is quite impossible to develop sound government policy without reliable statistics. Throughout the Angolan economy, the quality and overall coverage of statistics needs considerable improvement.

D.1.2 Energy Supply & Demand

As the table below illustrates, Angola's total energy supply is 9.5 million tons of oil equivalent. Of this total, 66% is supplied by biomass, 22% by oil, 1% by hydropower and 11% by gas and petroleum products. It should be noted that a significant amount of local energy production is exported (94% of crude oil production).

By far the largest consumption is residential consumption of combustibles, renewables and waste – in raw form (60%). Transport consumes 17% of energy supplies, and industry 14%.

Table 2 Angola Energy Balance (2004, thousand TOEs)

Source	Crude Oil	Petrol. Products	Natural Gas	Hydro	C, R & W	Electricity	Total
Production	50,481	-	612	128	6,136	-	57,358
Imports	-	1,011	-	-	-	-	1,011
Exports	-47,577	-508	-	-	-	-	-48,084
Stock Change	-796	-	-	-	-	-	-796
TPES	2,108	503	612	128	6,136	-	9,488
Transform/Loss	-2,108	1,588	-	-128	-1,591	155	-2,085
TFC	-	2,091	612	-	4.544	155	7,402
Industry	-	264	612	-	108	48	1,034
Transport	-	1,268	-	-	-	-	1,268
Resid./Other	-	400	-	-	4,436	106	4,942

Source: International Energy Agency
Note: TPES = Total Primary Energy Supply; TFC = Total Final Consumption

D.1.3 Electricity Legal and Regulatory Framework

The electricity sub-sector is governed by the General Electricity Act, passed in 1995, and enacted in July 1995 (Act number 14-A/96).

The ESI presently operates under several Acts of Parliament. The most important is the General Electricity Act, passed in 1995, and enacted in July 1995 (Act number 14-A/96). The Act sets out the tariff system and pricing principles, establishes the National Energy Fund to facilitate the electrification of the country, and sets up a 'concessionaire' system for regulating the entry of the private sector into the ESI.

D.1.3.1 Administrative and Regulatory Institutions

The State, through the Ministry of Energy and Water (MINEA) acts as the energy regulator and has the stated obligation of providing a level playing field for both public and private sector suppliers of electricity in the country. The intention is to benefit consumers in the long run by providing a competitive regulatory environment within which the most efficient companies will succeed.

The General Electricity Act enabled the establishment of an electricity regulator, the Institute for Electricity Regulation (IRSE). IRSE was expected to become operational during 2005.

The State's control of the public interest is secured through a system of concessions and licences, with conditions attached to these. The State is also responsible for determining and controlling prices and tariff increases. The government is busy reforming the tariff structures in order to eliminate subsidies in the sector. According to the IMF, the setting of prices was a haphazard affair, and is in need of regulation.

D.1.3.2 Electricity Utilities

There are currently two main power utilities in Angola, ENE (Empresa Nacional de Electricidade) and EDEL (Empresa de Electricidade de Luanda). ENE is a vertically-integrated state owned enterprise, responsible for the delivery of power throughout Angola with the exception of the greater Luanda area (controlled by EDEL as distribution utility). ENE operates three different power systems - the northern, central and southern systems. ENE further operates minor isolated networks in Cabinda, Malange, Uige, Moxico, KwanzaSul and Bie provinces. Local authorities operate isolated power systems in four provinces (Lunda Sul, Cunene, Cuando Cubango and Zaire).

The two existing utilities, ENE and ENEL are wholly owned by the state. The utilities are governed by the Public Enterprises Act (Act 9/95). In principle, the Act states that all Public Enterprises should be autonomous, both financially and administratively, and be run on commercially viable lines.

It is expected that both of these entities will be strengthened and reorganised over the next few years, although there are no plans at this stage to privatise either of the utilities. The first phase is to concentrate on restructuring ENE in preparation for the liberalisation of the electricity market. ENE and EDEL will be reorganised to operate as commercial companies with both financial and administrative autonomy, with the express objective of contributing to capital formation in the economy.

ENE is to be given the main responsibility to manage the implementation of the National Power System Plan, including the rehabilitation of the existing electricity system. A key area of focus in this regard will be responsibility for planning and implementing the rehabilitation and expansion of the National Transmission Grid.

EDEL will continue to be responsible for the distribution of electricity to the Greater Luanda area. EDEL will also be strengthened, primarily to manage the rehabilitation of the distribution system and the expansion of the distribution network to incorporate illegally-connected users.

Outside of these two, the General Electricity Act states that the responsibility for electricity distribution and supply at local levels rests with municipal authorities. These municipal authorities may delegate this function to either the public utilities or private commercial utilities.

D.1.3.3 Private Sector Participation

The electricity reform programme does not provide for the privatisation of ENE and EDEL in the near future.

The Act opens the sector to independent producers and distributors, either individually or in co-operation with existing utilities. Private sector participation in the expansion of Angola's electricity generating capacity is a priority for the Ministry.

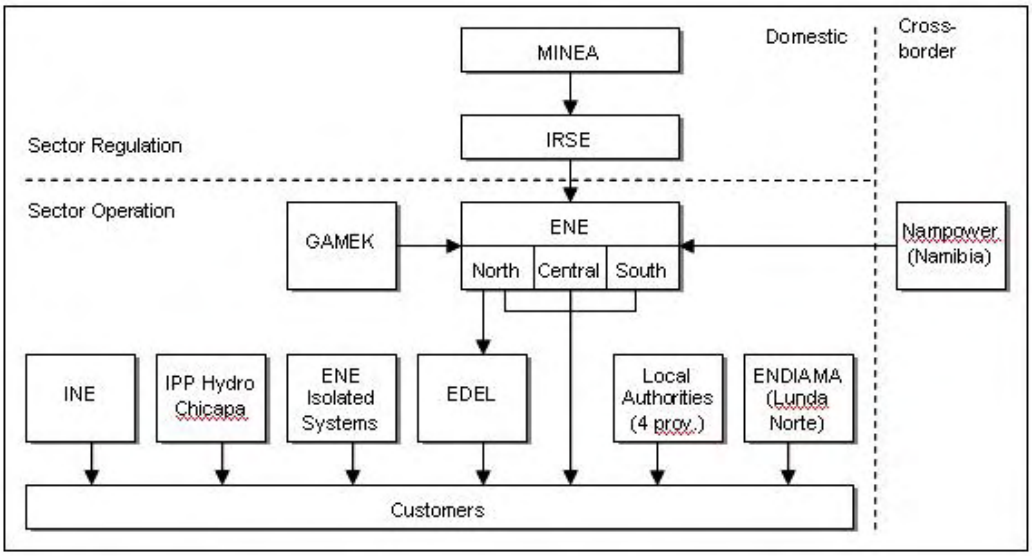
The Ministry states that they do not exclude issuing concessions to private operators for the rehabilitation of our hydroelectric power dams. Private companies and individuals operate a large number of diesel generators throughout the country (due to considerable problems with reliability and quality of supply).

GAMEK, a project company established for development of hydropower resources on the Kwanza River, operates the recently commissioned Capanda hydroelectric plant (present capacity 260 MW, envisaged final capacity 520 MW).

In April 2003 the government invited interested private sector participants to a round table conference to discuss entry into the power distribution sector. The Chief Executive officers of the state-owned EDEL and ENE power suppliers also attended the meeting where interested private operators were consulted on the needs of the country. As an outcome of this meeting, private operators are expected to develop projects in:

- Low-tension power supply
- Rehabilitation and expansion of the public network
- Connection of new installations, including fitting up of meters, reading and billing
- Attending to failures.

Figure 7 Angola Electricity Angola Electricity Supply Sector

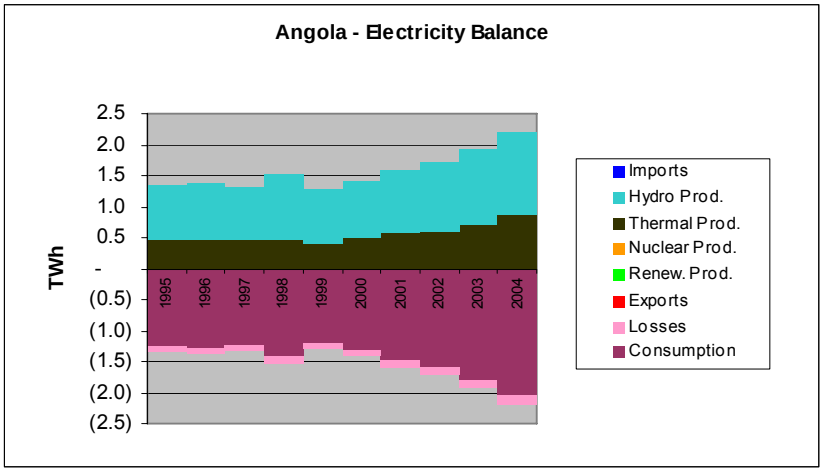


Source: SAPP

D.1.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is slightly more than 2TWh. The household electrification rate is approximately 12% and consumption per capita 182kWh/ann. More than 60% of electricity supplied is by means of hydropower. No electricity is exported or imported (Angola is not interconnected with neighbouring countries).

Figure 8 Angola Electricity Consumption & Supply (TWh/ann)



Source: Energy Information Administration

D.1.5 Electricity Infrastructure

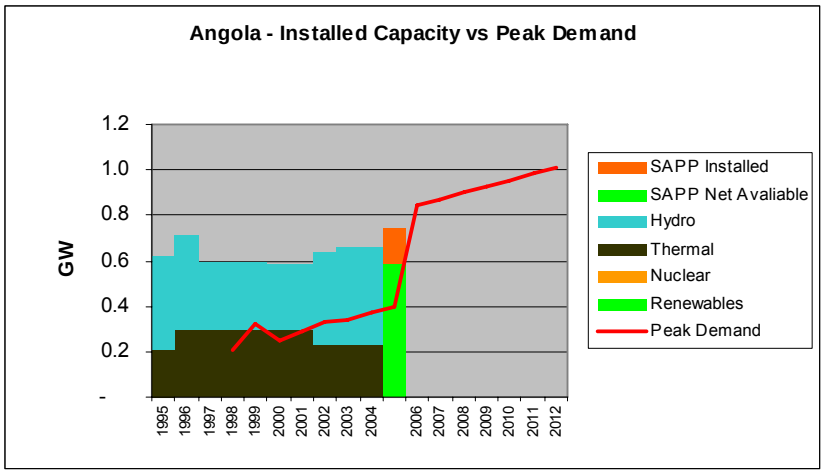
D.1.5.1 Generation (Existing & Expansion Plan)

Angola has abundant natural energy resources. It has 5% of the continent's crude oil reserves and produces 10% of the continent's output. Of the 7.4GW economically-exploitable hydro capacity, only some 6% is currently utilised.

Angola's installed power capacity is 742MW according to SAPP (of which 590MW is available), and 665MW according to the EIA. About two thirds is hydropower and the balance from thermal power stations. A number of hydro stations are in the process of being rehabilitated (Cambambe, Matala, Biópio) or in need of rehabilitation (Lomaum, Mabubas). Two stations are being built (Capanda) or about to be built (Chicapa).

SAPP projects Angola's power demand will increase from 846MW in 2006 to 1,010 MW in 2012. This represents an increase of 19.4% over this period, or 3.2% per annum.

Figure 9 Angola Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

The system in Angola is in need of serious repair after years of neglect and war. According to ENE, the total rehabilitation of the entire electricity system requires an estimated investment of about US$1 billion, of which US$334 million is for generation, US$236 million for transmission and US$75 million for substations.

Reportedly Russia's Alrosa diamond company has come forward proposing a hydroelectric power plant on the Chicapa River to provide power for the enlargement of the Catoca mine, the fourth largest kimberlitic diamond mine in the world. In addition, Sonangol, the state oil company, is apparently planning a gas-fired power station in Luanda.

D.1.5.2 Transmission & Distribution

Three regional production and transmission systems have been developed from the hydropower facilities located on the country's three main rivers, namely the Kwanza, Catumbela and Kunene Rivers, located in the north, centre and south of the country respectively. The three systems are not integrated at present (there is no national grid). The government plans to create a national grid, linking the three regional electricity sectors, and establishing linkages with neighbouring countries. The additional generating capacity from the rehabilitation and greenfields projects, together with the national grid system could enable Angola to become an exporter of electricity to neighbouring countries.

The northern system, based on the Cambambe hydropower station, provides electricity to the northern provinces of the country, namely Luanda, Bengo, Kwanza Norte, Kwanza Sul and Malange. The system could also be extended to Uige in the future.

The northern transmission network is limited to the 220kV line linking the Cambambe dam to Luanda and the 60kV line from Luanda to Kifangondo. The former was built in 1963 and designed for a maximum 200MW active power transit. It is operating under precarious conditions, as a result of sabotage and lack of maintenance during the war. Frequent interruptions occur in the supply of the Luanda region, amounting to some 500 to 600 hours per year on average.

A second 220kV line was built in 1984 linking Cambambe and Luanda via Viana, also with a 200MW maximum transit capacity. Unfortunately, this line has almost never been in operation and was completely destroyed by sabotage in the late 1980s. Two other HV transmission lines connect Cambambe respectively to the eastern cities of Ndalatando and Malanje and to Gabela and Sumbe in the south.

They were also partly destroyed several times and have been out of order since 1993.

The Mabubas hydropower station with a capacity of 17.8MW was partially destroyed during the war and is in need of rehabilitation. There is also roughly 140MW of supporting thermal capacity through a combination of gas turbines and diesel generators.

The central power system is based on the Lomaum and Biopio hydropower stations, with capacities of 35MW and 14.4MW respectively. The central system supplies power to the provinces of Benguela, Huambo and Bie, although this infrastructure was badly damaged during the war and is a priority area for reconstruction. There is a further thermal capacity of 49.8MW of gas and diesel capacity.

The southern system is based on the Matala hydropower station, which has an installed capacity of 40.8MW. It supplies the provinces of Huila and Namibe, and there is a complementary capacity of 16.5MW of diesel generators.

In addition to these three main systems there is an additional 30MW of small hydro and thermal capacity in the country.

Apart from a few small 33kV and 11kV cross-border connections in the south to NamPower (Namibia), Angola's power system is presently isolated from the Southern African Power Pool (SAPP) regional grid.

D.1.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 3 Planned/Proposed Angola Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Capanda	Generation	Hydro	260MW	Operational in 2007.	-
Cambambe II	Generation	Hydro	260MW	2011	-
DRC - Angola	Transmission		400kV	TBA	Part of Westcor
Angola - Namibia	Transmission		400kV	TBA	Part of Westcor

Sources: SAPP, AfDB

D.1.6 Rural Electrification

This review has not discovered a formal rural electrification policy and plan. However, in December 2005, the Deputy Minister of Petroleum & Energy announced an ambitious scheme to supply solar energy to rural populations over the coming 15 years, based predominantly on solar power.

Under the 220 million US dollars renewal energy scheme, 1,300 villages across the country would be equipped with 15 solar generating plants each. The project aims to guarantee access to energy, giving better quality of life to people in remoter parts of the country.

D.1.7 Electricity Tariffs

The tariff for the most unsophisticated household is US$c 2.44/kWh, assuming consumption within the laid-down limits.

Table 4 ENE Tariffs (effective 1 May 2004)

Customer	Unit	Value Kz	Value US$ cents (nominal)
Low Voltage:			
Domestic	/kWh	3.35	5.76
Domestic Social Tariff*	/kWh	1.42	2.44
Industrial	/kWh	3.07	5.28
Commercial and Service	/kWh	3.41	5.86
Public Lighting	/kWh	2.46	4.23
Medium Voltage (1kV < 30kV):			
Industrial	/kW**	171.51	294.84
	/kWh	1.44	2.48
Commercial and Service	/kW**	192.66	331.20
	/kWh	1.62	2.78

Notes: ** For the first 50kWh for consumption < 200kWh//month*

*** Maximum measurement in last three months, power factor ≥0.8. A sliding scale is introduced for power factor <0.8*

Source: www.ene.co.ao

D.1.8 Utility Performance

The annual reports and financial statements for ENE and EDEL were not available for this review. However, ENE publishes some operational statistics.

The 2004 IEA statistics show that electricity producers consumed about 5% of their production themselves. Technical losses amounted to 14.5%.

Table 5 ENE Utility Performance (US$ 2005)

Item	Unit	Value
Production:		
Electricity produced & acquired	GWh	2,649
Electricity billed	GWh	1,843
Peak demand	MW	397.2
Technical Efficiencies:		
Plant availability	%	60.4%
Thermal Heat Rate	%	NA
Trans/Dist Technical Losses	%	14.5%
Interruption Index	%	NA
Commercial Efficiencies :		
Distribution Non-Technical Loss	%	16.2%
Distribution Collection Rate	%	63.0%
Operational Efficiencies:		
Staff	No	4,250
Customers	No	143,937
Generation capacity - installed	GW	0.843
Customer/Staff	No/No	33.9
Staff/Capacity	No/MW	5.0
Financial Performance:		
Turnover	US$ mill	NA

Item	Unit	Value
Cost of Supply	US$ mill	NA
Other Costs	US$ mill	NA
Profit pre Tax	US$ mill	NA
Asset Base	US$ mill	NA
ROA (pre-tax)	%	NA
Equity vs Debt	%:%	NA
Debt Coverage Ratio	%	NA

D.1.9 Challenges

Table 6 Challenges in Angolan Electricity Sub-sector

Category	Challenge
Policy/Legal & Regulatory Framework	Intentions of sector liberalisation are not converted into action Current framework for IPP development (offtaker can develop own IPP) means generation planning will be piecemeal Rules for Private sector participation are not clear The establishment of IRSE (regulator) should be pursued Technical planning, design and operational standards are unsystematic or non-existent
Electricity Supply	National electricity master planning needs to be formalised and institutionalised Rehabilitation of generation, construction of transmission lines and extension of distribution networks are priorities Establishment of a national grid needs to be pursued There is scope for consolidation (or at least reorganisation) of islanded distributors following on a national grid initiative Interconnection with DRC and Namibia should proceed (and is likely to be driven by the WESTCOR initiative) There is a large skills shortage in the electricity industry
Utility	Tariffs appear not to be cost-reflective Collection rates are low Technical and non-technical losses are high Perception of low service reliability Financial information not available, but the utilities are perceived to be loss-making and generally inefficient
Market	Domestic access to electricity about 12%

D.2 Botswana

D.2.1 Energy Sector Policy

The economic development framework, as set out in the five-year National Development Plan (NDP), has led to clearly defined targets and budgeting for the implementation of energy sector objectives. An electrification target of 90% has been set for 2018. The government aims for a diversified supply, development and management of indigenous resources to increase self-sufficiency and sustainable development, and performance of energy related activities in an environmentally sound manner. National electrification programmes are in place.

D.2.2 Energy Supply & Demand

As the table below illustrates, Botswana's total energy supply is 1.87 million tons of oil equivalent. Of this total, petroleum products account for 40%, coal for 30% and biomass for 24%.

On the consumption side, domestic use makes up 41%, transport 39% and industrial 19%. Nearly a third of total energy consumption is household consumption of raw combustibles, renewables and waste.

Table 7 Botswana Energy Balance (2004, thousand TOEs)

Source	Coal	Petrol. Products	Geo-thermal, Solar, etc.	C, R & W	Electricity	Total
Production	552	-	1	456	-	1,008
Imports	11	742	-	-	104	858
Exports	-	-	-	-	-	-
Stock Change	-	-	-	-	-	-
TEPS	563	742	1	456	104	1,866
Transform/Loss	-435	-18	-	-	-71	-382
TFC	127	724	1	456	176	1,483
Industry	95	95	-	--	95	285
Transport	-	579	-	-	-	579
Resid./Other	33	46	1	456	80	615

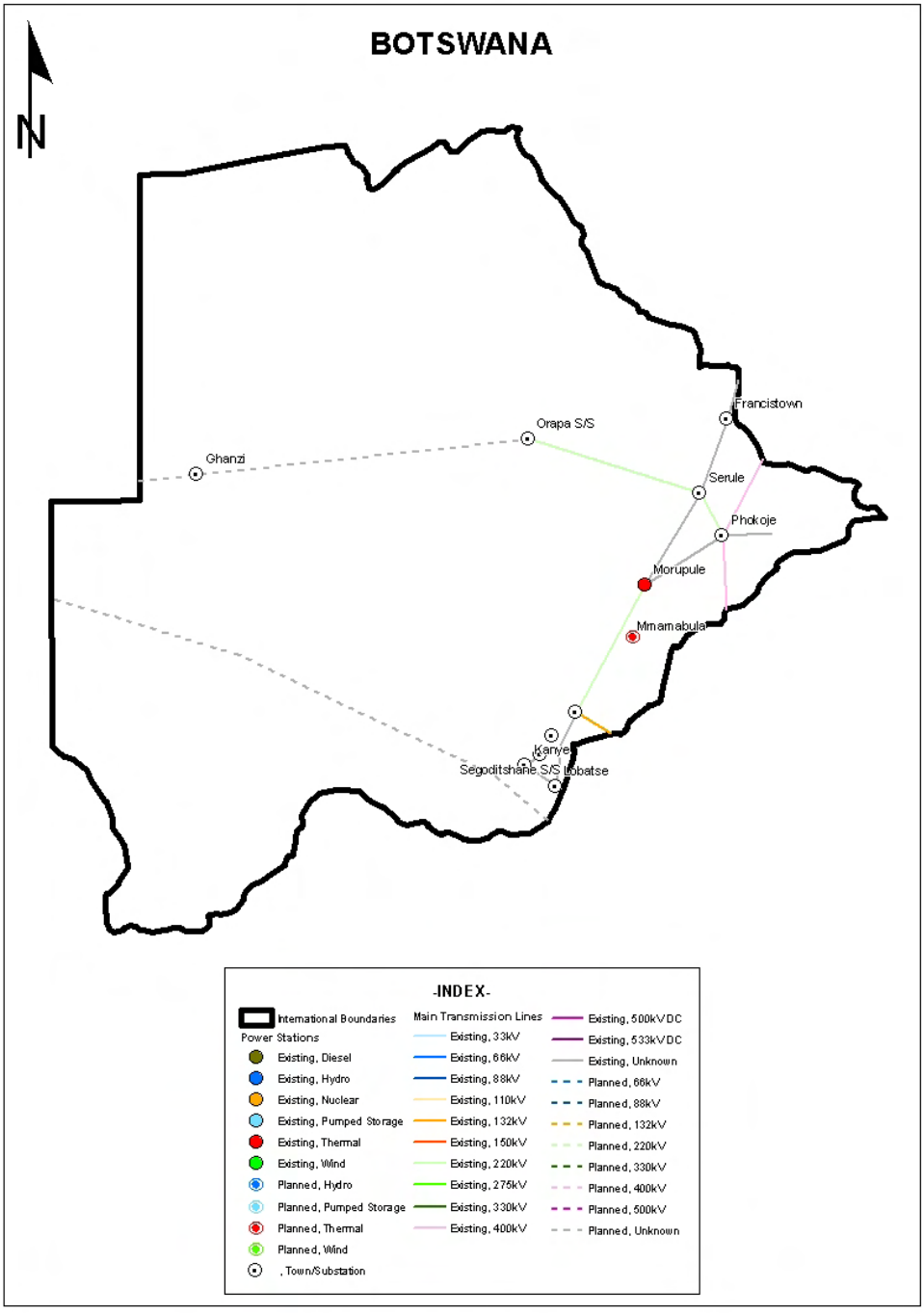
Source: International Energy Agency

Note: TPES = Total Primary Energy Supply; TFC = Total Final Consumption

D.2.3 Electricity Legal and Regulatory Framework

An Electricity Supply Industry (ESI) Restructuring Project was completed in 2003. The project entailed a status assessment of existing operations, the evaluation of options (models) and the formulation of recommendations for the possible restructuring of the ESI within both the prevailing national (e.g. privatisation agenda) and regional contexts.

Based on these results, in January 2004, the Private Sector Unit of the World Bank issued a request for expression of interest for consultancy services, to review and advise on appropriate regulatory reforms for infrastructure-utilities in Botswana. The consultant will assist the Botswana Government to review existing policy, regulatory and legislative frameworks of the utility sectors, assess the market and operating environment of the sectors, identify required regulatory reforms and advise on the appropriate regulatory regimes. The consultant will be required to prepare an implementation plan that will provide guidelines for the establishment of regulatory agencies and propose mechanisms for future private sector participation. The World Bank will oversee the study in consultation with the Government of Botswana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Planned, 220kV
Planned, 330kV
Planned, 400kV
Planned, 500kV
Planned, Unknown

and Botswana's the Public Enterprises Evaluation and Privatisation Agency (PEEPA). The newly-formed PEEPA is responsible for the overall privatisation implementation strategy and specific strategies for reforming public enterprises and Government Departments.

D.2.3.1 Administrative and Regulatory Institutions

The Ministry of Minerals, Energy and Water Affairs (MMEWA) has overall responsibility for the power sector in Botswana. It also acts as regulator. It is not clear what the Act is under which these powers are executed. Through the Public Enterprise Evaluation and Privatization Agency, (PEEPA), the Government appointed a Consultant to review and advice on 'Appropriate Regulatory Reforms for Infrastructure and Utility Sectors in Botswana'.

D.2.3.2 Electricity Utilities

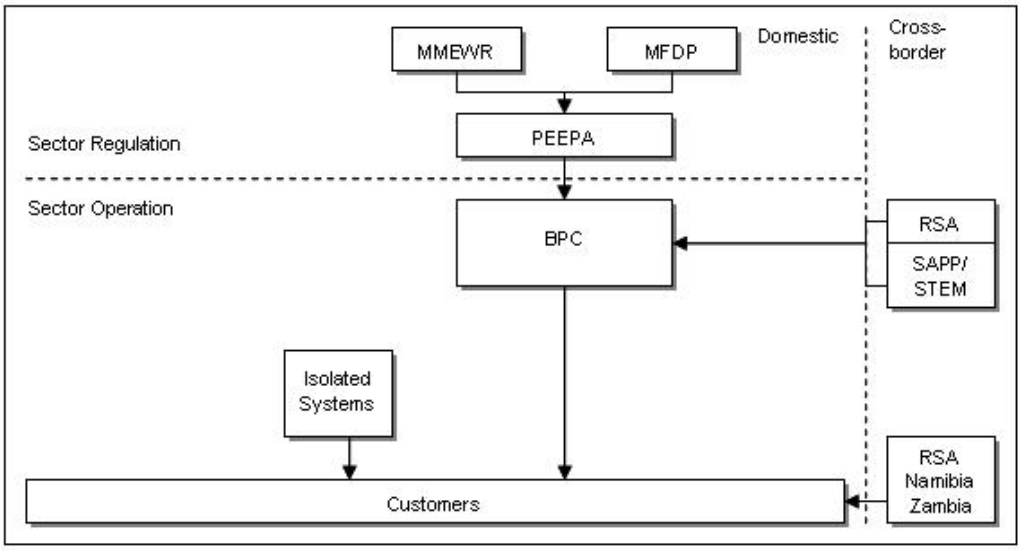
The Botswana Power Corporation (BPC) reports to the Ministry and is responsible for the generation, transmission and distribution of electricity in Botswana, under the provisions of the Botswana Power Corporation Act. Under the provisions of this act, the BPC is responsible for making electricity available to as many people as possible and thereby improving the nation's standard of living. It is also obliged to make electricity available to its customers at the lowest possible price. The Botswana Power Corporation Act states that the BPC must conduct its affairs on sound commercial lines, so it can ensure reasonable financial profitability in order to be able to make provision for a reasonable proportion of capital expenditure for the expansion of the Corporation's activities and improvement of its service. Department of Electrical and Mechanical Services (DEMS), under the Ministry of Works, operates isolated diesel generators to supply government institutions such as schools, clinics and offices.

D.2.3.3 Private Sector Participation

There is no major private sector participation in the Botswana electricity supply industry as yet, although this situation is likely to be influenced by the regulatory reforms project mentioned above.

A small Independent Power Producer (IPP), Bemco, supplies the town of Ghanzi in Western Botswana. BPC has a three year contract to buy power from Bemco.

Figure 10 Botswana Electricity Supply Sector

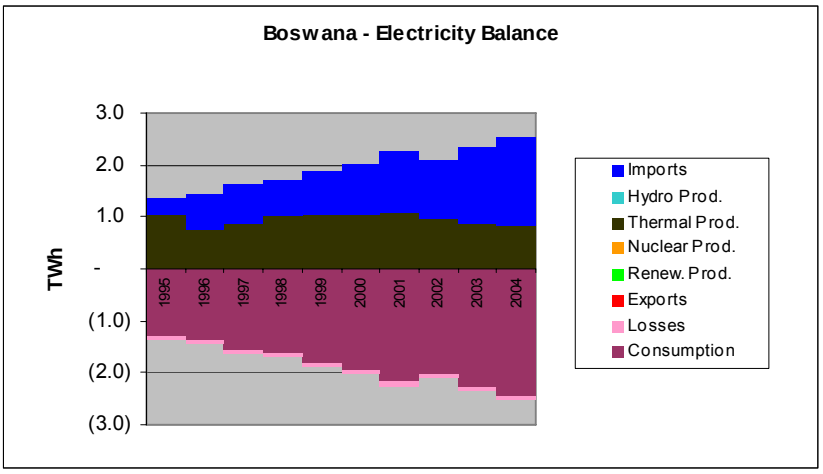


Source: SAPP

D.2.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is about 2.5TWh. The household electrification rate is approximately 22% and consumption per capita 1,506kWh/ann. Two thirds of electricity consumed is imported - from Eskom, ZESA and ZESCO. As of December 2001, BPC has been trading in the SAPP's Short Term Energy Market (STEM) with significant savings being realised. Up to 25% of the country's daily energy requirements are being met through STEM, About 70% of Botswana's electricity is imported, mainly form, Eskom of RSA, the Short Term Energy Market (STEM) of the SAPP and Hidroelctrica De Cahora Bassa (HCB) of Mozambique through regional interconnections to meet demand surges.

Figure 11 Botswana Electricity Consumption & Supply (TWh/ann)



Source: Energy Information Administration

D.2.5 Electricity Infrastructure

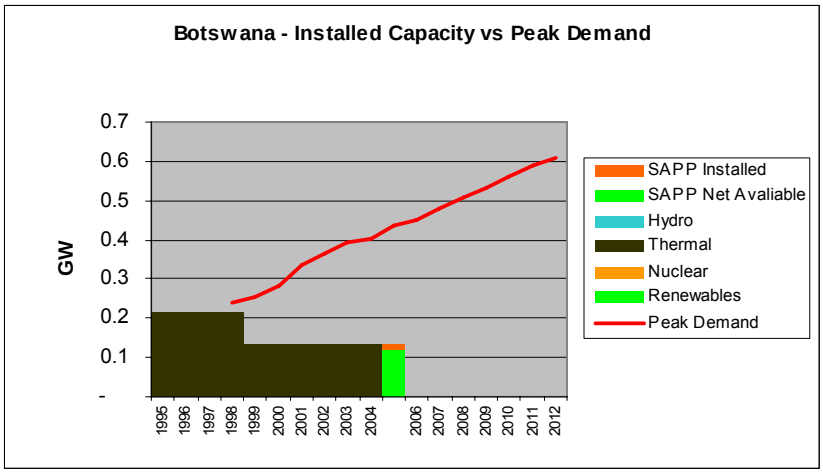
D.2.5.1 Generation (Existing & Expansion Plan)

Botswana has limited coal reserves (3% of the continent's reserves excluding South Africa). It also has no other hydro-carbon (crude and natural gas) resources, and very limited hydro resources. This makes the country dependent on imported electricity.

Botswana's current installed power capacity is 132MW, of which 120MW is available capacity. The bulk of domestic electricity production is generated by the BPC's Morupule coal-fired station. Morupule consists of four 33 MW units, with a total capacity of 132 MW. Using coal mined at Morupule, the power station operates as a base load station and is at the core of the national grid system.

A small diesel-operated Independent Power Producer (IPP), 700 km to the west of Gaborone, supplies the remote cattle-farming town of Ghanzi. However, the transmission connector with neighbouring Namibia, which is currently under construction, will replace this generation plant.

Figure 12 Botswana Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

According to the SAPP, Botswana's power demands are forecast to grow from 452MW in 2006 to 609MW in 2012. This represents an increase of 34.7% over the period or an annual average increase of 5.8%. It is government's policy to continue importing power providing it remains cheaper than developing local generation sources. BPC is nevertheless undertaking a feasibility study for the expansion of the Morupule Power Station, given that surplus power for the region is projected to run out in 2007-2010.

D.2.5.2 Transmission & Distribution

Botswana's national electricity grid, which once consisted of a separate northern grid (mainly 220kV and 66kV network) and a southern 132kV transmission, 33kV distribution and 11kV reticulation grid is now interlinked with a 220kV transmission line from Morupule to Segoditshane substation just north of Gaborone. The networks were originally based on the older Selebi-Phikwe and Gaborone Power Stations. This infrastructure has since been boosted, with the upgrading of the 132kV line from Segoditshane to Thamaga, and a second line from Morupule to the southern area. In the north, an additional 220kV line from Phokoje has been initiated, to firm up supplies from this major substation. BPC is an Operating Member of the Southern African Power Pool (SAPP). Botswana is interconnected with Zimbabwe and South Africa. The 220kV interconnection with ZESA (Zimbabwe) has a transfer capability of 117 MW. The three 132kV interconnections with Eskom (South Africa) have a transfer capability of 210MW (3X70). In addition, the 400/220kV Phokoje Substation allows a strong (567 MW) interconnection with the regional transmission system between Zimbabwe and South Africa, with the line crossing Botswana. A number of other smaller cross-border connections exist with South Africa, Namibia and Zambia

The Phokoje substation, the only 400kV substation in Botswana, interconnects the 400kV Matimba (South Africa) - Insukamini (Zimbabwe) line to the Botswana grid and allows the country to extend its purchases of electricity from the Southern African Power Pool (SAPP) by feeding into BPC's 220kV system at Selebi Phikwe. It has enabled BPC to enter into new supply agreements with Eskom of South Africa that allows the Morupule thermal power station to operate as a base load power station.

In 2002, BPC signed agreements with the Namibian utility, NamPower, whereby Namibia would also supply electricity to the country, via a 132kV transmission line to Ghanzi in the north-west of Botswana. This means that Botswana will have some electricity connection to all its neighbours, including Zambia to which it is connected via a 66kV line at Kasane.

With the mining sector accounting for 52% of BPC's electricity sales, security of supply to the Debswana Jwaneng diamond mine has been improved. A new 160km power line has been built from Segoditshane substation in Gaborone to the substation at Jwaneng via a new substation at Thamaga about 50 km to the west of Gaborone. Thamaga will initially operate at 132kV without the installation of power transformers. However, over the longer term the plan is for a substation to replace the current Gaborone substation as a major switching centre of BPC's southern transmission grid. This will increase the grid's flexibility and system capacity. BPC has also been constructing lines from Zimbabwe into Pandamatenga in the north of the country. This is mainly for agricultural activities.

In addition to the 400/220kV Phokoje substation, the BPC grid has six substations with a 220kV maximum voltage and another eight substations whose maximum voltage is 132kV.

The primary distribution voltage through the major towns, large villages and centralized power systems in rural areas is 11kV.

The network of High Voltage lines is some 2,250km in length and a further 4,624km of medium voltage transmission make up the total network:

Table 8 Botswana Transmission and Distribution Network (2001)

Item	Unit	Value
Transmission	kV	220, 132
Distribution	kV	66, 33, 11
LV	V	380,220
HV Circuit	Km	2,250
MV Circuit	Km	4,624

Source: International Energy Agency 2001

D.2.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 9 Planned/Proposed Botswana Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Mmamabula	Generation	Thermal	3600 MW	2015	-
Morupule Expansion	Generation	Thermal	Increase to 532 MW	2009/2010	Current installed capacity 4x33MW Project start date 2007
Namibia – Botswana – South Africa	Transmission		400kV	TBA	Part of Westcor

Sources: SAPP, AfDB

D.2.6 Rural Electrification

Continued provision of electricity to rural areas is one of the measures that the Botswana Government has undertaken to improve the general standard of living in rural communities.

Funded by the Botswana Government and managed by Botswana Power Corporation, 96 previously un-electrified villages were connected to the national or cross-border power grids up to 2004. On-going initiatives under the Rural Electrification Project aim to connect additional villages to the national grid, with government policy to electrify 14 to 15 villages per annum.

Initially the Rural Electrification programme required 100% Government funding. For 1996/97 and 1997/98 funding was on a 50/50 basis between the Government and BPC. During 1998/99 BPC agreed to fully finance those projects promising an Internal Rate of Return (IRR) of 6% and above, with the Government participating in financing projects with Internal Rates of Return lower than 6% to bring them to the acceptable rate of return so as to ensure that BPC recovers its investment within a 20 year period.

The rural electrification programme further focuses photo-voltaic systems to households outside the grid reach. The five-year National Rural Photovoltaic Electrification Programme was announced in the 2005-2006 budget. The aim of the project is to improve access to energy services in rural areas and promote the use of renewable energy. Government had previously dabbled in solar-based projects though with little success. The most ambitious of these was the forerunner project to the current one, administered through the Rural Industries Promotions Company (RIPCO) and it ran from 1997-2001. JICA was involved in the development of the Botswana Photovoltaic Master Plan, which included some pilot projects. The programme is managed by BPC's Rural Division.

D.2.7 Electricity Tariffs

The official BPC tariff schedule could not yet be located. However, it is reported that electricity tariffs in Botswana are the highest in the southern African region and its high tariffs have been blamed for the re-location of certain energy-intensive industries to neighbouring countries.

D.2.8 Utility Performance

The financial and operational performance of BPC in 2005/6 may be summarized as follows:

Table 10 BPC Utility Performance (US$2006)

Item	Unit	Value
Production:		
Electricity produced & acquired	GWh	2,917
Electricity billed	GWh	2,626
Peak demand	MW	434
Technical Efficiencies:		
Plant Availability		NA
Thermal Heat Rate	%	NA
Trans/Dist Losses	%	10.6%
Interruption Index	%	NA
Commercial Efficiencies :		
Distribution Non-Technical Loss	%	0.0%
Distribution Collection Rate	%	97%
Operational Efficiencies:		
Staff	No	2,091
Customers	No	151,800
Generation capacity – installed	MW	132
Staff/Customer	No/No	73
Staff/Capacity	No/MW	16
Financial Performance:		
Turnover	US$ mill	125.0
Profit	US$ mill	21.1
Asset Base	US$ mill	628.0

Item	Unit	Value
ROA	%	-0.1%
Equity vs Debt	%:%	13:1
Debt Coverage Ratio	%	10

D.2.9 Challenges

Table 11 Challenges in Botswana Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	PEEPA restructuring study has apparently not made any definitive findings yet, including establishment of independent regulator Private sector participation rules are not clear IPP opportunities (rules) are not defined
Electricity Supply	Energy security concern exists, with large share of demand met by SAPP imports Own generation projects are rightfully prioritised in the short term Rural electrification is a priority High tariffs discourage energy-intensive investment
Utility	Technical losses are relatively high BPC is commercially well-managed
Market	Domestic access to electricity about 37%, including 18% rural

D.3 Democratic Republic of Congo

D.3.1 Energy Sector Policy

The approach in the energy sector is two-pronged. First there seems to be an acceptance that there is a need for outside intervention in the power sector, and in particular for both equity and management skills to be put in place. There is no specific indication as yet as to how this will be achieved.

The second area that is of great concern to the donors and authorities is that of ensuring that rural communities are provided with access to power. Given that the DRC is roughly the size of Western Europe minus Scandinavia, it would seem that conventional methodologies might not be the correct approach.

The national energy policy will also aim at increasing electricity exports with a view to obtaining the necessary financial resources for rural and semi-urban electrification and improving the national electricity access rate. The policy will be based on the following pillars:

- Hydroelectricity as the main source of energy;
- The launching of a rural electrification plan;
- The rehabilitation and extension of the national electricity network.

Concerning the development of the Inga Site and due to problems with existing works, the Government's vision is as follows:

- Rehabilitation of existing works (Inga I and II);
- Strengthening of Inga I and II with a third site (Inga III), whose supply and demand are proven; and
- Development of the rest of the site (Grand Inga), with the final objective of integrating all works on the Inga Site.

The following steps are urgently required in the power sector:

- Tapping high-tension lines to supply power to towns and villages located alongside the Inga-Katanga transmission lines;
- Improvement of the transmission (pylons and cables) and distribution network carrying electricity from Inga to centres of consumption; and
- Installation of hydroelectric generators in the principal rivers and establishing a network connecting these plants.

D.3.2 Energy Supply & Demand

As the table below illustrates, the DRC's total energy supply is 16.56 million tons of oil equivalent. Of this total, 92% is supplied by biomass and similar products, with hydropower and petroleum products accounting for 3% each and coal 1% of the total.

Domestic consumption accounts for nearly 80% of total energy consumption, and of that, nearly all is raw combustible, renewable and waste materials. Industry accounts for 21% of consumption. The limited national roads infrastructure explains the relatively small consumption (2%) by the transport sector.

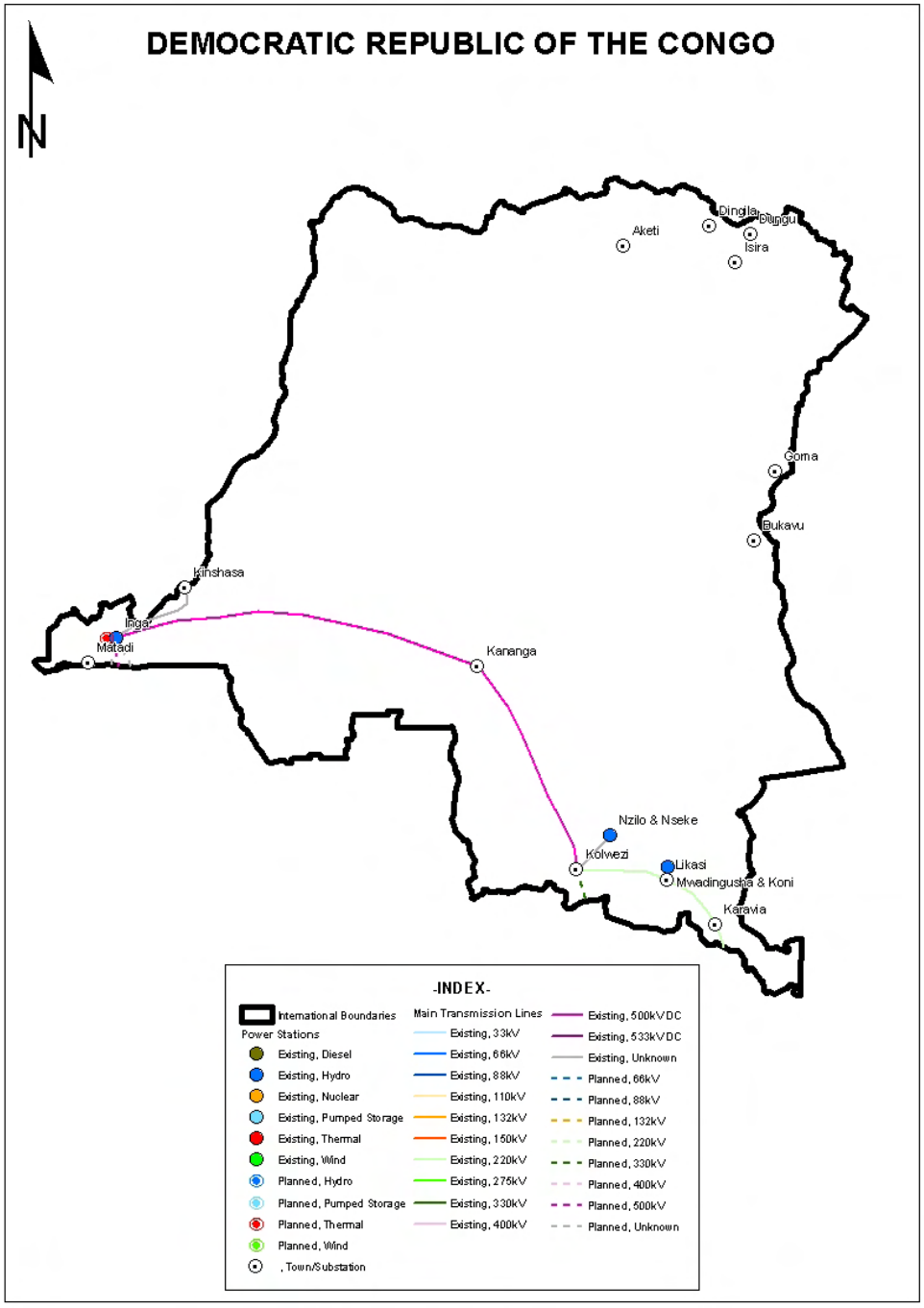

DEMOCRATIC REPUBLIC OF THE CONGO
N
Dingila
Bunia
Aketi
Isira
Goma
Bukavu
Kinshasa
Inga
Matadi
Kananga
Nzilo & Nseke
Kolwezi
Likasi
Mwadingusha & Koni
Karavia
-INDEX-
International Boundaries
Power Stations
Existing, Diesel
Existing, Hydro
Existing, Nuclear
Existing, Pumped Storage
Existing, Thermal
Existing, Wind
Planned, Hydro
Planned, Pumped Storage
Planned, Thermal
Planned, Wind
, Town/Substation
Main Transmission Lines
Existing, 33kV
Existing, 66kV
Existing, 88kV
Existing, 110kV
Existing, 132kV
Existing, 150kV
Existing, 220kV
Existing, 275kV
Existing, 330kV
Existing, 400kV
Existing, 500kVDC
Existing, 533kVDC
Existing, Unknown
Planned, 66kV
Planned, 88kV
Planned, 132kV
Planned, 220kV
Planned, 330kV
Planned, 400kV
Planned, 500kV
Planned, Unknown

Table 12 DRC Energy Balance (2004, thousand TOEs)

Source	Coal	Crude Oil	Petrol. Products	Hydro	C, R & W	Electricity	Total
Production	65	1,040	-	587	15,310	-	17,002
Imports	173	-	555	-	-	1	728
Exports	-	-1,040	-5	-	-	-125	-1170
Stock Change	-	-	-	-	-	-	
TPES	238	-	548	587	15,310	-125	16,559
Transform/Loss	-37	-	23	-587	-702	319	-984
TFC	201	-	571	-	14,608	194	15,574
Industry	132	-	-	-	3,087	96	3,314
Transport	-	-	285	-	-	-	285
Resid./Other	69	-	256	-	11,521	98	11,944

Source: International Energy Agency
Note: TPES = Total Primary Energy Supply; TFC = Total Final Consumption

D.3.3 Electricity Legal and Regulatory Framework

D.3.3.1 Administrative and Regulatory Institutions

The Ministry of Energy is the responsible Ministry for the electricity sector in the DRC. The government of the DRC has stated that an objective with regard to the infrastructure sector is the modernisation of the legal and regulatory framework for the key sectors, notably energy and water. SNEL's monopoly has become a hindrance to the development of the sector.

Government has resolved to implement sector reforms, the key thrusts of which include divestiture of the State from certain government operations, liberalisation of the sector by opening it to competition and the creation of an enabling institutional, legal, regulatory and commercial environment to attract investors. The Public Enterprises Reform Steering Committee (CODIREP) is preparing an Energy Code (electricity, water and hydrocarbons), within which the following activities will be implemented:

- SNEL restructuring
- Establishment of a National Rural Electrification Agency
- Establishment of an Independent and Autonomous Electricity Regulation Authority
- Development of standards
- Related activities.

Government is also considering public-private partnerships, as well as partnerships between private operators and non-governmental organisations.

D.3.3.2 Electricity Utilities

The State-owned Societe Nationale d'Electricite (SNEL) is responsible for electricity generation, transmission and distribution. SNEL falls under the Ministry of Energy, as a public enterprise. The Ministry has administrative and financial 'tutelage' over SNEL – in the form of the final approval of purchase and sale of immovable assets, debt and loans, tariffs, accounting plan, annual budget and annual accounts.

A division of planning, research and development is specially in charge of defining the needs and prospective projects, and to evaluate their feasibility and planning of implementation. A division in charge of the equipment provides the design,

specifications and other technical information, and finally, a division of purchasing manages the procurement procedures.

D.3.3.3 Private Sector Participation

Within the Ministry of Energy, the Office for Promoting Private Power Investment is responsible for the proposed new power sector strategy. The country is only now embarking on studies to determine the future structure of the sector. As such it is not yet clear whether SNEL will be privatised or unbundled into different units. Apart from a number of smaller hydro power stations in the mining sector and a few thermal stations belonging to private industry, there is currently no major private sector participation in the ESI.

Figure 13 DRC Electricity Supply Sector
Source: SAPP

Source: SAPP

D.3.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 5.1TWh. The household electrification rate is approximately 7% and consumption per capita 90kWh/ann. All electricity is supplied domestically by means of hydropower. A substantial percentage of DRC production is exported (nearly 20%).

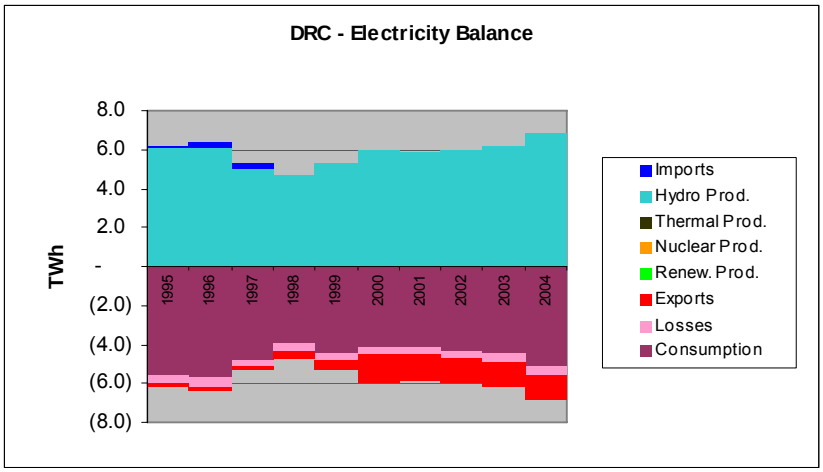


Figure 14 DRC Electricity Consumption & Supply

Source: Energy Information Administration

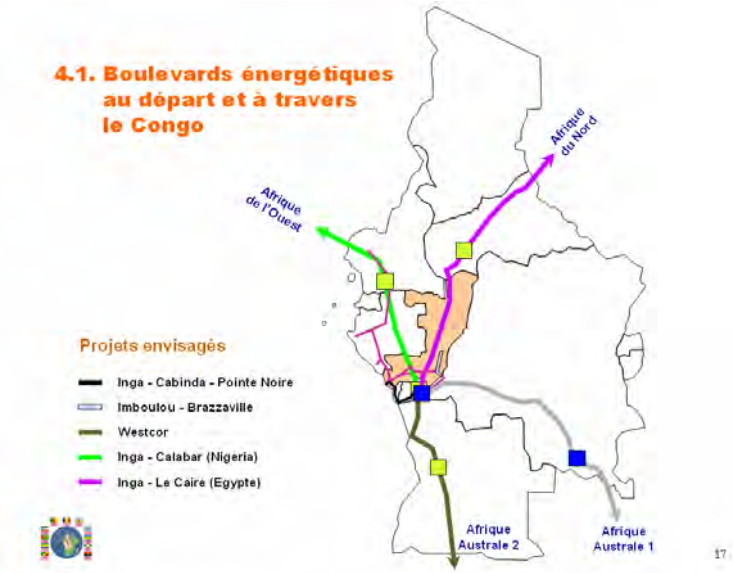
D.3.5 Electricity Infrastructure

D.3.5.1 Generation (Existing & Expansion Plan)

The DRC has some useful coal reserves (6% of the continent's supply, excluding South Africa), it has limited other hydro-carbon reserves. However, the country is vastly endowed with hydro resources. The World Energy Council estimates this at 47.8GW economically exploitable capacity, with a further 40.5GW 'technically' exploitable. Of the economically-exploitable capacity in the continent, the DRC holds nearly 40%. The current level of hydroelectric output is equivalent to about 3% of this potential.

SNEL has 16 hydro plants. Its largest stations are Inga I (351MW) and Inga II (1,424 MW). The effective capacity at SNEL's hydro plants has recently been less than half their rated level, owing to problems in maintenance and refurbishment. Inga III, with a capacity of roughly 3,500MW is in the planning stage, and supported by WESTCOR.

Figure 15 Electricity 'Highways' from Inga



Source: Presentation by EAPP to Inga Roundtable, December 2006, Johannesburg

D.3.5.2 The Inga Projects

Inga is located approximately 250km from the DRC capital of Kinshasa. Inga, operated by the DRC's Societe Nationale d'Electricite (SNEL), provides power to Kinshasa and other portions of western DRC. Inga also provides power to the neighboring Republic of Congo's (Congo) power grid along a 220kV connection. The interconnection supplies nearly one-third of the electricity consumed in Congo.

Inga also exports power to Southern Africa countries including Zambia, Zimbabwe and South Africa. Power from Inga is transmitted to the Zambian grid along a 500kV direct current (DC) line from Inga to Kolwezi in southern DRC, and a 220kV line from Kolwezi to Kitwe in northern Zambia. Zambia and the DRC are to upgrade their current 220kV regional interconnection to a much higher transmission level to allow other SADC countries to tap Inga's energy supplies.

Zambia's Copperbelt Energy Corporation (CEC) and DRC's SNEL will undertake the upgrading project that includes construction of a new 220kV line between Chingola in Zambia and Karavia near the southern Congolese city of Lubumbashi. CEC officials stated that in addition to the new transmission line, the two countries would also repair the current 220kV line to significantly raise the amount of hydropower that can be transmitted from DRC to Southern African countries.

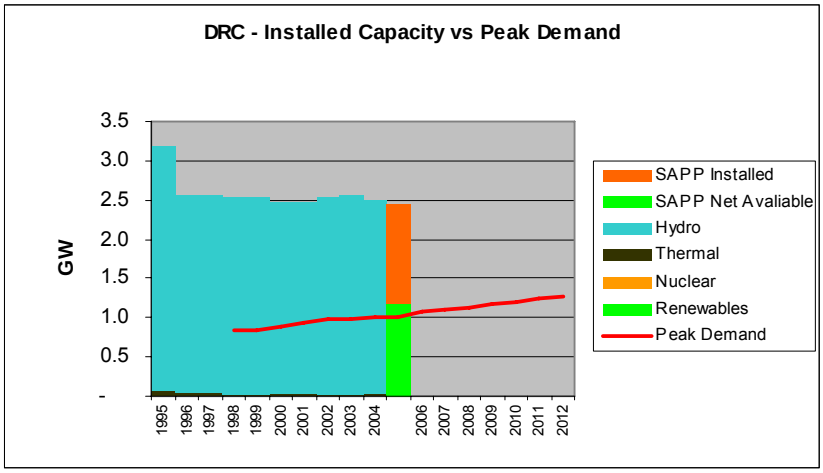
Inga I and II: Inga I was commissioned in 1972 and has a capacity of 351MW. Currently, only two of the six units are operational, and current capacity is around half of installed capacity. Some 100MW of power is currently exported to South Africa. The Inga I Hydro Power Station is due to be refurbished as part of the Westcor project. Inga II was commissioned in 1982, and has a capacity of 1424MW. Refurbishment of the turbines is currently underway.

Inga III: Inga III, with a projected capacity of between 1,700MW and 3,500MW, and with an estimated cost of US$ 4 billion and the "Great Inga Final Stage" (39,000 MW), are also being piloted by the World Bank, the EDF Group (France), and Lahmeyer (Germany).

The building of Inga III will be carried out by five Southern African Development Community (SADC) members to supply the Westcor Power Project -- formed by South Africa's Eskom, the Botswana Power Corporation, Angola's Empresa Nacional de Electricidade (ENE), NamPower of Namibia and Societe Nationale d'Electricite (SNEL) of the Democratic Republic of Congo.

Inga IV: The Grand Inga (or Inga IV) scheme provides for the installation of up to 52 generators of 750MW each, to possibly supply electricity to West, North and Southern Africa via new long-distance transmission lines. Capacity is rated at around 40,000MW. The construction of a first-stage plant of around 8,000MW is envisaged.

Figure 16 DRC Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

Current installed power capacity in the DRC stands at 2,442MW, of which 1,170MW is available capacity. According to data from the SAPP, the DR-Congo's power demand is set to increase from 1,070MW in 2006 to 1,281MW by 2012. This represents an increase in demand of 19.7% over the period, or annual average demand increase of 3.3%.

D.3.5.3 Transmission & Distribution

Power from the national grid is available to consumers mainly in two regions: Kinshasa and the surrounds of Bas-Zaire in the west, and in Katanga Province in the south of the country. These two regions account for 95% of all electricity distributed in the DRC.

The 220kV transmission line between Katanga and Luano exports up to 200 MW to Zimbabwe and South Africa (wheeled through Zambia). The interconnector currently only allows around 240 MW to transit, but plans are at an advanced stage to upgrade the capacity to 500 MW un-firm / 375 MW firm through additional 330KV and 220kV line construction.

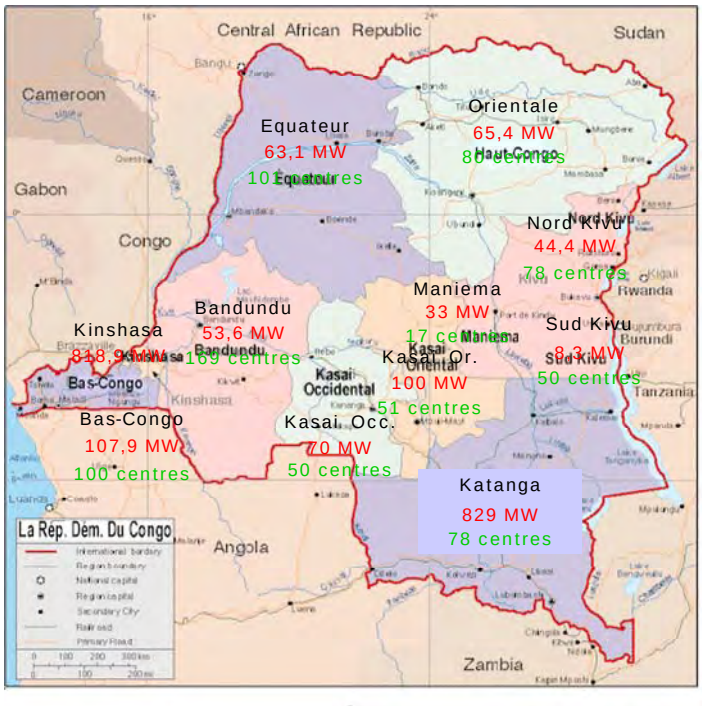
The DRC has also supplied the city of Brazzaville, in Congo-Brazzaville, 6.6 kV, 30 kV and 220 kV line. The transfer capacity of the interconnection is 200 MW, but the current actual power export peak is around 50MW. Discussions are ongoing on connection also to Pointe Noire, and from there to other countries in the Gulf of Guinea and West Africa.

SNEL's organisation provides for 'rural electrification' in its structure. These are concentrated in three areas in the country:

- Katanga (Lubumbashi, Likasi and Kolwezi) with three distribution centres supplied by the Inga-Kolwezi line and four local hydro stations
- Bas Congo (Matadi, Boma, Mbanza-Ngungu, Inkisi, Lemba and Kinzao-Mvete) served from Inga
- Kivu (Bukavu, Goma and Uvira) served from Ruzizi I and II.

The demand throughout the rest of the country is substantial:

Figure 17 SNEL Assessment of Electricity Demand and Investment Required



Province	Coût en Mio USD	Nbre de Centres
Bas - Congo	188	100
Kinshasa	500	1
Bandundu	401	169
Equateur	307	101
Orientale	384	80
Nord Kivu	171	78
Sud Kivu	219	50
Maniema	125	17
Katanga	843	78
Kasaï Occ. & Orient.	628	101
Total	3.770	775

Source: SNEL presentation at Inga Roundtable, October 2006, Johannesburg

SNEL has set itself the following objectives:

- Increasing the rate of electrification in each province
- Reduce the energy development imbalance between provinces
- Guaranteeing the continued supply of electricity to cities and towns
- Promoting the export of electricity as a means to finance rural electrification.

To achieve these targets, it plans to implement a national grid – of as-yet undefined extent.

Table 13 DRC Transmission and Distribution Network (1995)

Item	Unit	Value
Transmission	kV	500, 220, 132, 120, 70, 50
LV	V	380, 220
HV Circuit	km	5,207
LV Circuit	km	11,463
Interconnections		Zambia, Congo, Rwanda, Burundi, Angola

Source: International Energy Agency

D.3.5.4 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 14 Planned/Proposed DRC Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Inga I & II Refurbish	Generation	Hydro	500MW	2007	Firm up feasibility study Funding gap
Inga III	Generation	Hydro	3,500MW	2010	Complete sequencing study WESTCOR feasibility study
Grand Inga Phase 1	Generation	Hydro	6,000MW	2012	Complete sequencing study
Katanga-Luano Interconnector upgrade	Transmission		500 MW unfirm/ 375 MW firm	n/a	Upgrade from present 240 MW transit capacity through additional 330 kV and 220 kV line construction
DRC - Angola	Transmission		400kV	TBA	Part of Westcor

Source: SAPP, AfDB

D.3.6 Rural Electrification

The decades old DRC crisis has taken a savage toll on the standard of living of the population. Grassroots communities have developed survival mechanisms in all essential aspects of life, from safe water supplies to protection against erosion and natural disasters. The government is committed to supporting the following actions:

- Reviving and promoting rural water works and electrification;
- Studying the feasibility of providing electricity to grassroots communities and villages by tapping the Inga-Katanga transmission line;
- Training grassroots communities in disposing of and recycling household waste, reforestation, and efforts to stem erosion;

The Public Enterprises Reform Steering Committee (CODIREP) is preparing an energy code (electricity, water and hydrocarbons), that includes the establishment of a National Rural Electrification Agency. This agency will launch and oversee a rural electrification plan.

D.3.7 Electricity Tariffs

The SNEL tariffs are set out below. The date these tariffs became effective is not clear; and a conversion has therefore not been done.

Table 15 SNEL Tariffs (effective unknown)

Customer	Unit	Value FC	Value US$ cents (nominal)
HV clients	/kW	Customer-specific charge	
	/kWh	Customer-specific charge	
MV Boilers* **	/kWh	NA	36.00
LV Domestic			
Social	/kWh	2.50	Unknown
Residential 1	/kWh	3.56	Unknown
Residential 1	/kWh	5.68	Unknown
LV Commercial & Motive			

Commercial **	/kWh	NA	11.00
Motive **	/kWh	NA	15.00

Notes: ** Special tariff to encourage conversion to electricity*
*** Charged in US$ only*

Source: www.snel.cd

D.3.8 Utility Performance

An annual report or recent annual financial statements for SNEL are not available. The following table records ad hoc information from other sources.

Table 16 SNEL Utility Performance (2004+)

Item	Unit	Value
Production:		
Electricity produced & acquired	GWh	NA
Electricity billed	GWh	NA
Peak demand	MW	1,070
Technical Efficiencies:		
Plant availability	%	NA
Thermal Heat Rate	%	NA
Trans/Dist. Losses	%	NA
Interruption Index	%	NA
Commercial Efficiencies :		
Distribution Non-Technical Loss	%	NA
Distribution Collection Rate	%	NA
Operational Efficiencies:		
Staff	No	5,462
Customers	No	NA
Generation capacity – installed	MW	2,442
Customer /Staff	No/No	NA
Staff/Capacity	No/MW	2.2
Financial Performance:		
Turnover	US$ mill	NA
Profit	US$ mill	NA
Asset Base	US$ mill	NA
ROA	%	NA
Equity vs Debt	%:%	NA
Debt Coverage Ratio	%	NA

D.3.9 Challenges

Table 17 Challenges in DRC Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	Political situation is still the biggest challenge No firm plans for sector liberalisation, regulation and private sector participation
Electricity Supply	No systematic national planning process in place Significant concern and discussions with MFIs over how to develop Inga National grid extension a priority Reinforcement of interconnectors important to support the electricity sector as exporter Various non-Inga hydro projects could be pursued Capacity very low in all institutions
Utility	Utility Reported poor technical, financial and commercial performance, although data not available SNEL needs to be commercialized and liberated from political interference Tariffs appear not to be cost-recovering Possible future unbundling of SNEL creates further uncertainty
Market	Domestic access to electricity about 7% (even though DRC has 60 percent of Africa's hydroelectric potential) Significant electricity potential need to be diverted to domestic demand

D.4 Lesotho

D.4.1 Energy Sector Policy

In the early 1990s, the government commissioned the Lesotho Electricity Master Plan Study (EMP), the rationale being that this document would become the working document for the power sub sector and would allow government to increase connections to the power grid. The final report was complete in 1996 and approved and accepted by government in 1997. In 1999, government decided to revisit the strategy and update it in light of global and regional developments and it implemented a project called Energy Management in Lesotho. The project, started in March 1999 and completed in February 2002, and laid out an energy policy framework including the translation of policy into viable activities. This policy will frame development of the power sector in Lesotho in the foreseeable future.

In the new energy policy the following objectives and statements have been defined:

- Government will ensure that the power sector is operated by commercially viable entities and that the performance of these entities conforms to the codes of practice stipulated in the prevailing regulatory framework.
- Government will ensure that more urban and rural households have access to affordable and reliable electricity services without putting a financial burden on the utilities.
- Government will ensure that consumers pay a service connection charge based on the expected average costs of connecting new customers to the network. The expected average cost will be based on the expected future density of customers in the area. The standard charges should depend on the voltage level and the size of demand sector, and should be affordable.
- Government will ensure that electricity tariffs structures and prices are based on sound economic principles and will make these affordable for basic household energy needs.
- Government will initiate appropriate institutional reforms and create an enabling environment for private sector participation in order to increase the efficiency of the sector.
- Government commits itself to ensuring full participation of local communities in the design, planning and implementation of electrification programmes.

D.4.2 Energy Supply & Demand

The IEA does not publish energy balances for some small countries – including Lesotho. Reconstructing the energy balance from EIA data reveals the following:

Table 18 Lesotho Energy Balance (2004, thousand TOEs)

Source	Coal	Petrol. Products	Hydro	Total
TPES	-	73	90	163

Source: Energy Information Administration

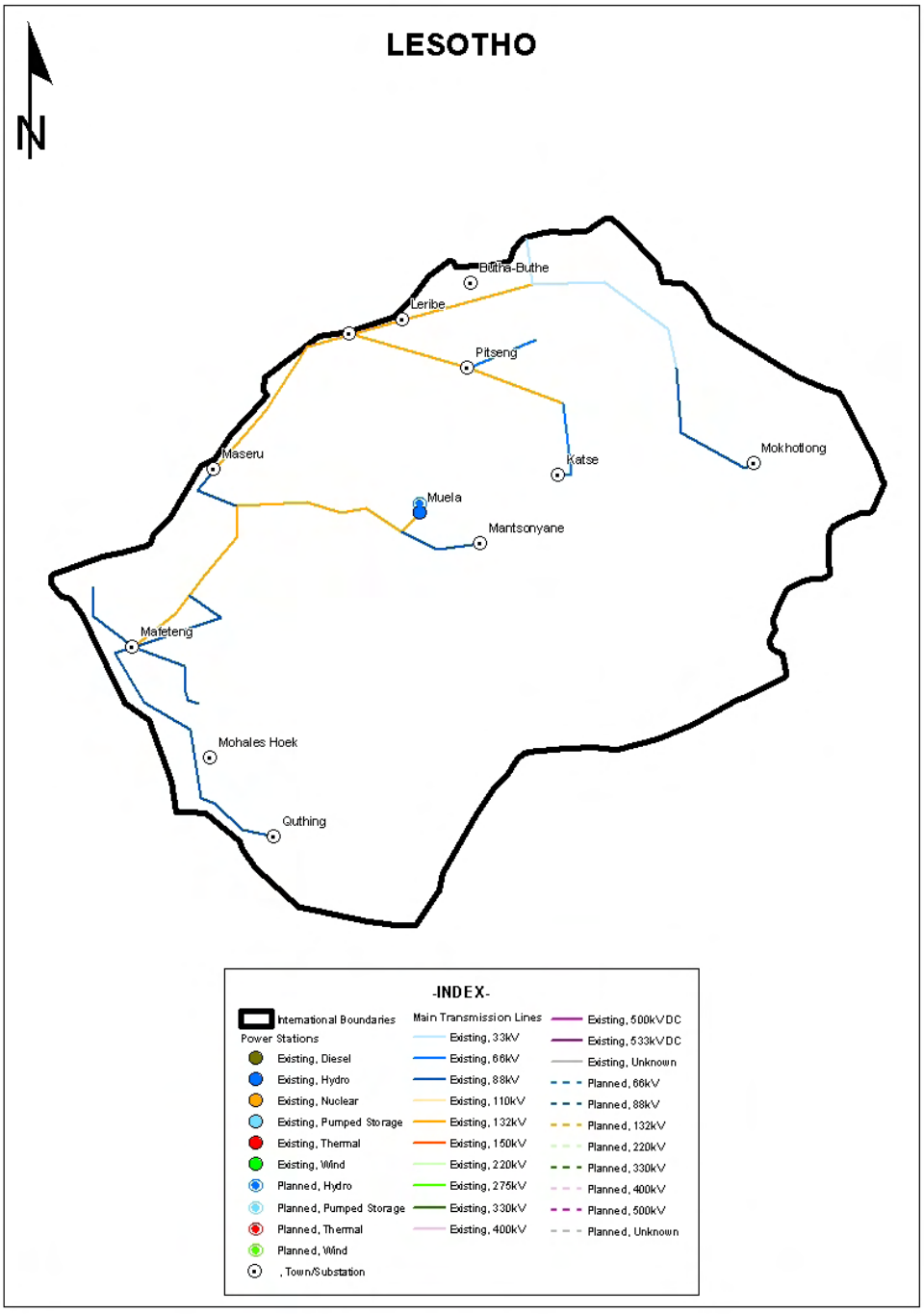
D.4.3 Electricity Legal and Regulatory Framework

D.4.3.1 Administrative and Regulatory Institutions

Governance of the ESI is the responsibility of the Department of Energy (DoE) located in the Ministry of Natural Resources (MNR). The Lesotho Electricity Authority (LEA) is responsible for regulating the ESI sector.

D.4.3.2 Electricity Utilities

The Lesotho Electricity Company was established under the Electricity Act No.7 of 1969, which empowers it to generate, transmit, distribute and supply electricity,



although the LEC has restricted its business to power transmission and distribution in the country. Generation of electricity falls outside the scope of the LEC business and until August 1998, the only source of electricity supply to Lesotho was the power that LEC purchased from the Eskom network in South Africa through two intake points. After the Muela Hydropower Station was commissioned as a part of the Lesotho Highlands Water project (LHDA), LEC started to buy the bulk of its power requirement from the LHDA. The small amount that Muela cannot supply is sourced from the South African utility, Eskom.

The Government of Lesotho is in the process of restructuring the power sector with a view to introducing private sector participation (PSP) into the Lesotho Electricity Company (LEC) and commercializing the operations of he Muela Hydropower Plant. Initially, priority was been given to the privatisation of LEC due to its inherent problems, which included high financial losses, operating inefficiency, non-competitive tariffs and the inability to meet the demand for electricity connections.

Prior to the full privatisation of LEC it has been deemed necessary to turn around the corporation and bring it to the level where it would be operating along sound business principles. To this end, the government appointed the South African consultancy SAD-ELEC to take over the management of the corporation and remain in LEC for a period of eighteen months. SAD-ELEC's contract started in February 2001 and key issues tackled by the new management included financial and operational efficiency of LEC, the connection of 6,000 additional consumers, the streamlining of the functions of the utility and the rightsizing of LEC.

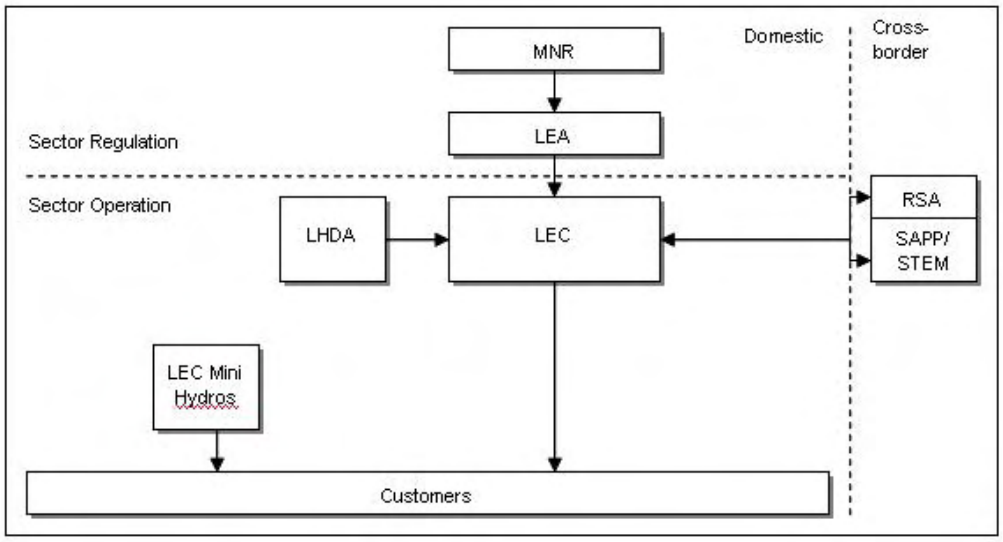
To enable power sector reform to proceed efficiently the government has made various policy decisions including a revised legal framework and the establishment of a regulatory authority. A draft bill for the establishment of a regulatory authority was finalised and tabled before Parliament in November 2000. The Lesotho Electricity Authority (LEA) Act, passed in 2003, caters for the restructuring of the sector in the following ways:

- It allows for several generators to operate in the country;
- It allows for several distributors to operate in the country;
- It allows for several transmission/dispatch operators to do business in the country.

CMS Cameron McKenna, as international legal counsel of a consortium led by KPMG Barents and IPA Energy Consulting, provided advice in relation to the restructuring of the LEC. The project was initially conceived as a private sale of LEC to a strategic investor. In this respect, new legislation to implement and manage the reforms of the electricity sector was gazetted in 2003. The focus of the legislation was the creation of a new regulatory framework and, specifically, the framework for the establishment of an independent regulatory entity, the Lesotho Electricity Authority (LEA).

The proposition for LEC is that Government will grant it a permanent concession over the transmission and distribution assets, with prospective investors to be offered a sale of shares in a corporatised LEC. The criteria for the bidders in the 20-year concession will be a maximum number of connections in 20 years, which are to be made with the capital raised by private strategic investors. At the end of the concession period ownership will revert to Government and a new concession issued for 15 years. The concession will be licensed to construct, expand, modify, maintain and operate the National Control Centre. Government will also embark on a rural electrification programme to address all areas that fall outside the service territory for a concessionaire. A Rural Electrification Fund will be established for this purpose and external grants and local funds put into the Fund. Government approved this transaction structure in February 2004.

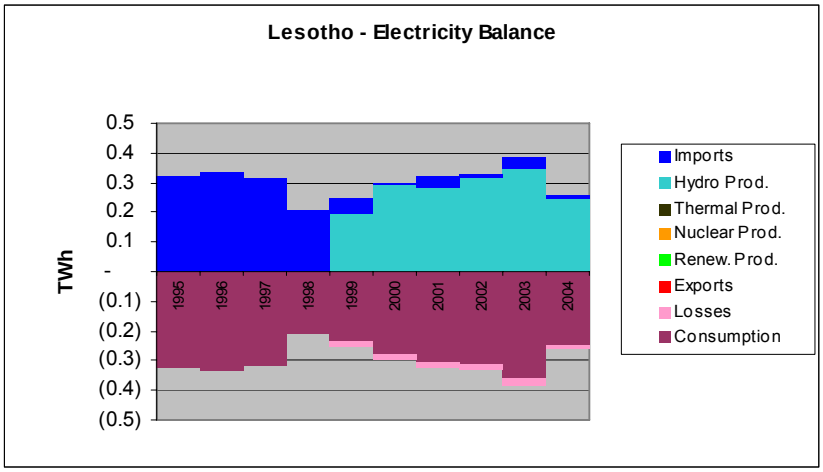
Figure 18: Lesotho Electricity Supply Sector



Source : SAPP

D.4.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 0.24TWh. The household electrification rate is approximately 5% and consumption per capita 120kWh/ann. From the late 1990s, Lesotho has been nearly self-sufficient in electricity, with imports now making up



about 5% of consumption.

Figure 19 Lesotho Electricity Consumption & Supply

Source: Energy Information Administration

D.4.5 Electricity Infrastructure

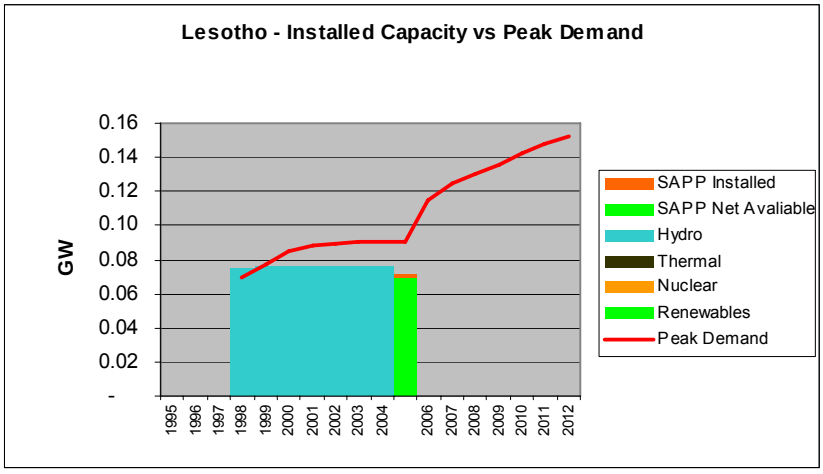
D.4.5.1 Generation (Existing & Expansion Plan)

The only significant energy resource Lesotho has is hydro (about 200MW of technically-exploitable capacity). Current installed capacity is 72MW at Muela. Muela is Lesotho's first hydro-electric power station and is capable of producing sufficient electricity for the entire country.

LEC has four small mini hydro-power stations in the mountains at Semonkong, Tlokoeng, Tsoelike and Mants'onyane. The Tsoelike station is decommissioned. The Tlokoeng station is also in the process of being decommissioned now that the Mokhotlong one is connected to the grid. The plan is to privatise the Semonkong station and then only Mants'onyane will remain with LEC.

Peak demand is currently (2006) 115MW. SAPP projects this to grow to 152MW by 2012. This represents an overall increase of 32.2%, or an annual average increase of 5.4% over this period.

Figure 20 Lesotho Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

D.4.5.2 Transmission & Distribution

Due to the geographical position of the country LEC interconnections are confined to the South African network. The 132kV double circuit LEC transmission system is connected to the 72MW Muela Hydropower Plant in the north and Eskom–Tweespruit in the west. Muela and Eskom are the only major generation resources supplying bulk power into the LEC network. LEC in turn transmits, distributes and supplies power to its customers within a modest national infrastructure.

There are distribution system interconnections with Eskom on the 88kV supply to Letseng diamond mine and Mokhotlong district in the north-east, the 22kV supply to Qachas Nek in the south-east of the country.

The National Control Centre is situated in Maseru and is connected to a large part of the network.

Table 19 LEC Power Line Length in Number of (2005)

Voltage	Kilometers	Substations
132kV	296	8
88kV	81	2
66kV	90	5
33kV	645	25
22kV	1	1
Total	1 113	41

Source: LEC

D.4.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 20 Planned/Proposed Lesotho Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Muela Phase 2	Generation	Hydro	110 MW	2010	
Musanga	Generation	Hydro	230 MW	2010	

Source: *SAPP, AfDB*

D.4.6 Rural Electrification

Government is committed to extending the service areas to all parts of the country. Under the Utilities Reform Project, monies have been put aside for expansion of the grid in Lesotho. Between April 2001 and September 2003, 12,940 users were connected to the power grid by LEC. This connection campaign has attracted more users and there is currently a backlog of over 5,000 applicants and the government is currently seeking the funds to meet this new demand.

The privatisation of LEC will create further demand and it is anticipated that an additional 80,000 connections will be added to the grid over the 20-year concession period by LEC.

In 2004/5, the World Bank and African Development Bank approved the Phase 2 Electrification Project. The consultant was appointed for the design and construction phases in 2003/04 financial year and implementation commenced during the 2004/05 financial year. The major reticulation construction was approximately 75% complete at the end of March 2005. This project will make electricity available to approximately 7,000 households within Lesotho. A component of Phase 2 electrification project funded by the AfDB was approved in March 2005. Implementation would commence in 2005/2006 financial year.

D.4.7 Electricity Tariffs

The most basic tariff charged in Lesotho is US$c 7.92/kWh.

Table 21 *LEC Tariffs (effective 2006)*

Customer	Unit	Value M	Value US$ cents (nominal)
Prepaid			
Domestic	/kWh	0.4900	7.92
General Purpose	/kWh	0.6800	10.99
Special Credit			
Domestic	/kWh	0.4900	7.92
General Purpose	/kWh	0.6800	10.99
Maximum Demand			
Commercial (LV)	/kW	133.3000	2,154.92
	/kWh	0.0819	1.32
Commercial (MV)	/kW	132.6000	2,143.62
	/kWh	0.0740	1.20
Industrial (LV)	/kW	133.3000	2,154.94
	/kWh	0.0819	1.32
Industrial (MV)	/kW	132.6000	2,143.62
	/kWh	0.0740	1.20

Notes: *Including VAT*
Source: *www.lec.co.ls*

D.4.8 Utility Performance

LEC performed as follows in the 2004/5 financial year:

Table 22 LEC Utility Performance (US$ 2005)

Item	Unit	Value
Production:		
Electricity produced & acquired	GWh	446,261
Electricity billed	GWh	356,240
Peak demand	MW	91
Technical Efficiencies:		
Plant availability	%	NA
Thermal Heat Rate	%	NA
Trans/Dist. Losses	%	20%
Interruption Index	%	NA
Commercial Efficiencies :		
Distribution Non-Technical Loss	%	NA
Distribution Collection Rate	%	NA
Operational Efficiencies:		
Staff	No	439
Customers	No	42,396
Generation capacity – installed	MW	3,148
Customer /Staff	No/No	97
Staff/Capacity	No/MW	0.14
Financial Performance:		
Turnover	US$ mill	25.4
Profit	US$ mill	-1.0
Asset Base	US$ mill	93.6
ROA	%	-1.0%
Equity vs Debt	%:%	30:1
Debt Coverage Ratio	%	-4

D.4.9 Challenges

Table 23 Challenges in Lesotho Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	Sector currently being restructured to allow for PSP. Unclear whether concession plan is going ahead
Electricity Supply	Electricity dependency has been largely addressed with Muela, and Muela II will support this trend further Rural electrification a priority. Some links remain to be completed on the national grid Tariffs appear to be cost-reflective
Utility	Utility Losses high (22%) Financial performance remains weak
Market	Domestic access to electricity about 5%

D.5 Malawi

D.5.1 Energy Sector Policy

Cabinet approved the Malawi Energy White Paper in January 2003, defining the desired changes and intended reforms in the energy industry in Malawi, including:

- The drafting and finalisation of the Energy Regulation Bill, the Electricity Bill, the Rural Electrification Bill, and other related bills;
- The proposal to establish the Malawi Energy Regulatory Authority (MERA), to regulate the sector including electricity;

The adoption of the anticipated Regulation Act and the eventual implementation of structural reforms in the sector will pave the way in the foreseeable future for competition in generation of electricity through the issuing of competitive tenders. It is also foreseen that third party access will be encouraged for those private companies who own significant generation capacity into the transmission grid in order to encourage competition.

D.5.2 Energy Supply & Demand

The IEA does not report the energy balance for Malawi, and this has therefore also been reconstructed in simplified format from EIA data.

Table 24 Malawi Energy Balance (2004, thousand TOEs)

Source	Coal	Petrol. Products	Hydro	Total
TPESs	12	279	298	588

Source: Energy Information Administration

D.5.3 Electricity Legal and Regulatory Framework

D.5.3.1 Administrative and Regulatory Institutions

The electricity sector is governed by the Electricity Act of 1998. The Ministry of Natural Resources and Environmental Affairs is the ministry responsible for energy affairs.

The environment has been changing slowly over the last few years, since the decision was first taken to deregulate and privatise the state electricity utility, ESCOM. The Public Enterprises (Privatisation) Act of April 1996 was passed, followed by the incorporation of ESCOM into ESCOM (Ltd.) in 1998. In 1999 the National Electricity Council was established to oversee the regulation of both ESCOM and any new entities that could emerge in the sector. From these developments, the Privatisation Utility and Reform Project was born, with the assistance of the World Bank.

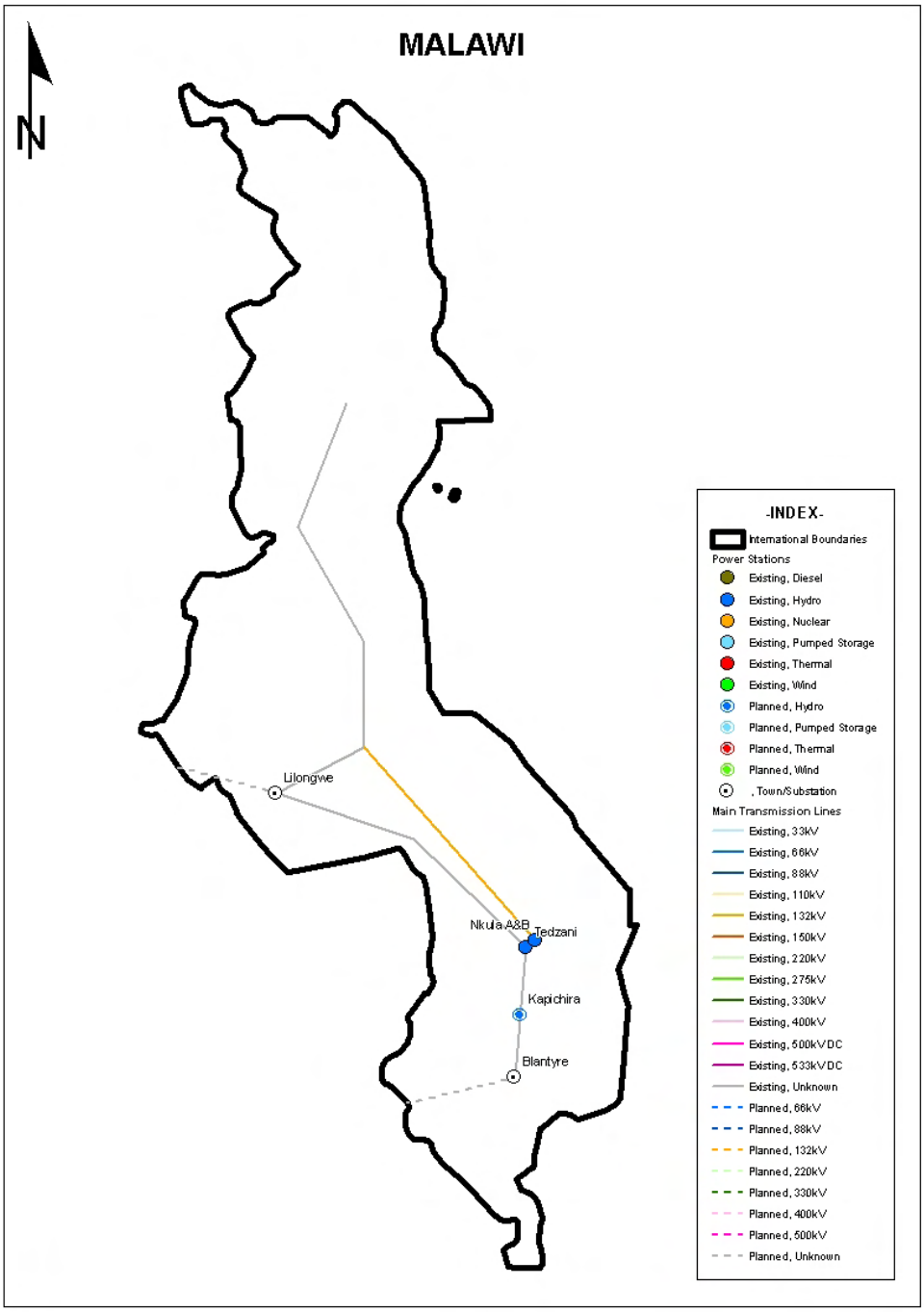
A task force was appointed in the 1990s to oversee the commercialisation programme as well as formulate an energy sector policy statement. This has since resulted in the Power Sector Policy Statement of July, 1999, and the draft revised Electricity Bill, 2000, which had been published by Parliament.

It appears that GOM is establishing two oversight entities in the electricity sector, or it is possible that the two are in fact the same entity of which the original name has changed:

- The Malawi Energy Regulatory Authority (MERA) with an oversight role in relation to electricity supply industry
- The National Electricity Council (NEC), an independent regulator, set up to undertake issues pertaining to licensing and regulating power producers.

D.5.3.2 Electricity Utilities

ESCOM is the state-owned enterprise responsible for generation, transmission and distribution of electricity in Malawi. The utility is owned almost wholly by the Government of Malawi (99%) while 1% is held by the Malawi Development Corporation (MDC) The utility falls under the jurisdiction of the Ministry of Finance and Economic Planning. The government has been trying to privatise the utility since 1997, although a number of problems, notably unrealistic tariffs, degradation of infrastructure, resistance from unions and other organisations and an apparent lack of real on behalf of the government has hindered the process.



The key elements of the sector policy statement were the separation of ESCOM into generation, transmission and distribution units and commencement of privatisation of distribution immediately with subsequent privatisation of generation. The process has become bogged down through a combination of bureaucracy, politics, lack of resources and the continued degradation of the assets of ESCOM, which have combined to make the sale less attractive than the government would like.

The process is supposed to result in the unbundling of the vertical structures into generation, transmission and distribution units. It is possible that there will also be three separate distribution units, covering the southern, central and northern parts of the country respectively. Furthermore, the other units within the company, such as the information technology unit will need to be accommodated in some form.

The government created the Public Enterprise Regulatory and Monitoring Unit under the Ministry of Finance in 1999 to assess the state of public enterprises. Malawi. It also established the Public Utility Reform Project (PURP) in order to oversee the final privatisation of the utility. In 2003, the government undertook to invite the first independent power producers to tender in Malawi.

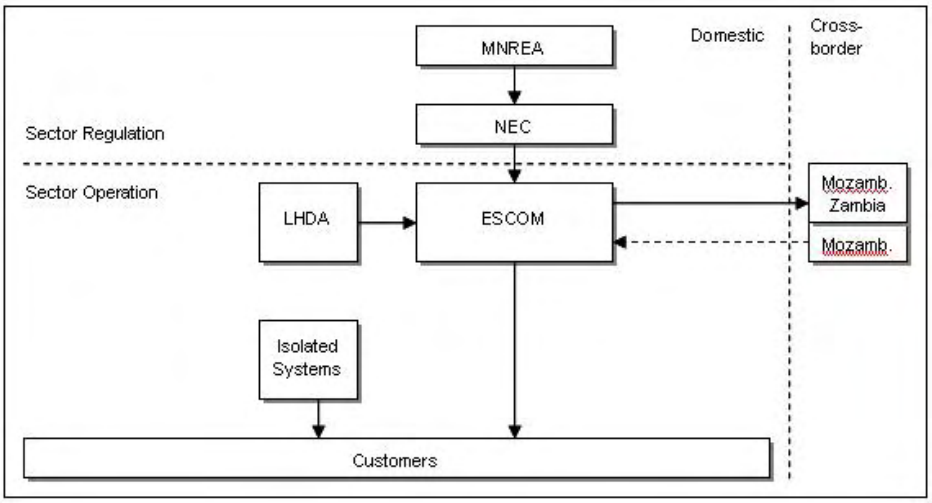
The Public Enterprises (Privatisation) Act of April 1996 and the Divestiture Sequence Plan (DSP) consisting of a list of 100 Public Enterprises approved by the Cabinet Committee on the Economy in August 1997 provides the basis for the establishment of the Privatisation Commission and the authority to privatise a particular enterprise respectively. Implementation of the reform agenda in the power sector has commenced with:

- the establishment of the Electricity Council (EC) in January 1999;
- the incorporation of ESCOM in July 1998 into a limited liability company wholly owned, for the time being, by the Government;
- the transfer of all assets, liabilities, property and staff of the old ESCOM to the new ESCOM Limited; and
- commencement of a commercialisation programme for ESCOM

D.5.3.3 Private Sector Participation

Apart from ESCOM, the only other players currently directly involved in the supply of power to customers are some industrial self-generators, e.g. in the sugar industry. New legislation has opened up the market for private enterprise and for local authorities to consider entering the power market, and especially the electricity distribution industry.

Figure 21: Malawi Electricity Supply Sector

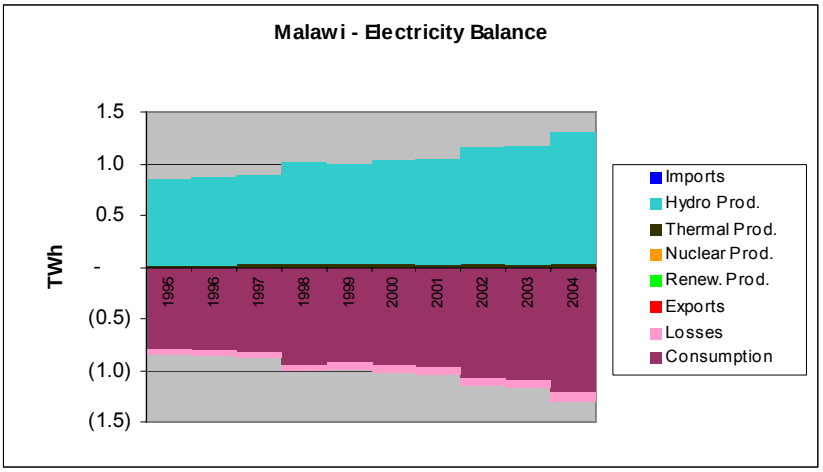


Source: SAPP

D.5.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 1.2TWh. The household electrification rate is approximately 5% and consumption per capita 99kWh/ann. Malawi is not interconnected with its neighbours, and produces all its own electricity from hydropower.

Figure 22 Malawi Electricity Consumption & Supply



Source: Energy Information Administration

D.5.5 Electricity Infrastructure

D.5.5.1 Generation (Existing & Expansion Plan)

Malawi has no known hydro-carbon reserves. Technically exploitable hydro capacity is some 700MW, of which none is economically exploitable (according to the World Energy Council). This makes the country dependent on imported power.

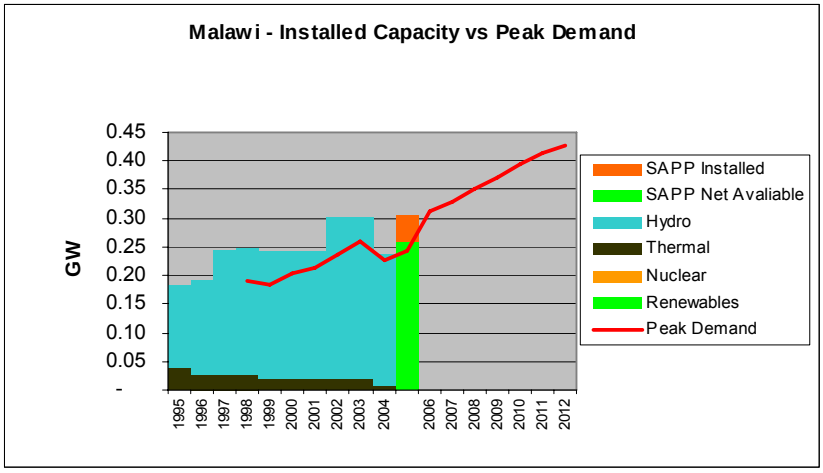
Malawi's installed power capacity currently stands at 305MW, with available capacity of 261MW. Of this, the majority is hydro (98%) with the rest being diesel generated. Three plants on the Middle Shire River account for three-quarters of this output. They are Tedzani (40MW), Nkula A (24MW) and Nkula B (80MW). A seven-year programme to enhance the capacity was begun in 1993 at Kapichira on the Shire River. This project added 128MW to the system. However, Malawi has suffered in recent years from floods and droughts that have both have an extremely damaging impact on the ability of ESCOM to function as commercially viable utility. This situation increases the importance of the interconnector with Mozambique.

The planned Kaphichira project includes a dam and hydroelectric power station on the Shire River in Malawi. The generating plant will consist of 4 x 32MW Francis turbine driven generating sets. Two sets are being installed initially in Phase I of the project with two sets planned for later in Phase II.

Outside of the grid, ESCOM also operates four small diesel sets in the remote northern parts of the country, and there is also roughly 30MW of privately installed capacity. Roughly half of this capacity is run by sugar mills in Malawi.

Peak demand is 247MW (2004). SAPP projects this to increase to 426MW by 2012, an overall increase of 72%, or an annual average increase of 7.0% in demand over this period.

Figure 23 Malawi Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

D.5.5.2 Transmission & Distribution

The present transmission network is simple and extends only to the more developed parts of the country. The system runs from south to north through the country, connecting the main centres of Blantyre, Lilongwe and Mzuzu.

Table 25 Malawi Transmission and Distribution Network (2001)

Item	Unit	Value
Transmission	kV	132, 66, 33
Distribution	kV	11
LV	V	400, 230
HV Circuit	km	3,656
MV Circuit	km	2,222
LV Circuit	km	2,461
Interconnections		Tanzania, Mozambique, Zambia

Source: International Energy Agency

D.5.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 26 Planned/Proposed Malawi Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Kaphichira Phase 2	Generation	Hydro	64MW	2009	Feasibility to be carried out
Kholombizo	Generation	Hydro	240MW	2018	-
Mpatamanga	Generation	Hydro	260MW	2020	-
Fufu	Gerneation	Hydro	100MW	2012	-
Mozambique – Malawi Interconnector	Transmissio n		220 kV	2008	Anticipated to increase capacity to 330 or 400 kV 80 km in Malawi

Source: SAPP, AfDB

D.5.6 Rural Electrification

A key objective of the government is to improve access to Electricity for people in peri-urban and rural area: as part of its efforts to reduce poverty transform rural economies and improve productivity. To this end, Government will pursue a number of options which will include grid and non-grid electrification. Under the grid option, it will finance the expansion of the distribution network to rural growth centres, trading centres, and public institutions (e.g. clinics, schools, boarder police, immigration and revenue posts.

The government considers that there are a number of areas, which will not be reached through grid extension due to their remoteness and low demand. These areas will be supplied by alternative energy sources, e.g. Solar PV and mini/micro hydros. A number of programmes to promote renewable sources of energy in rural areas, with a strong focus on lighting, have been instituted.

In January 2003 the Cabinet adopted the Malawi Energy White Paper, defining the desired changes and intended reforms in the energy industry in Malawi. Amongst these reforms was the drafting and finalisation of the Rural Electrification Bill. It was expected that this Bill would be ratified into law in 2004.

Malawi is well endowed with renewable energy sources including good sunshine throughout the year for photo-voltaic and photo-thermal applications, reasonable wind speeds for water pumping, domesticated animals for biogas applications, and hot springs for geothermal power generation.

About 5.000 PV About 5.000 PV-systems have been systems have been installed, but more than 50% of them are installed, but more than 50% of them are malfunctioning or have completely stopped working

D.5.7 Electricity Tariffs

Under the ESCOM tariff scheme, the most basic charge would amount to US$c 1.80/kWh, plus slightly less than US$ 1 per month fixed charge.

Table 27 ESCOM Tariffs (effective November 2003)

Customer	Unit	Value P	Value US$ cents (nominal)
Domestic			
Fixed charge	Fixed	90.94	84.12
≤ 30 kWh	/kWh	1.95	1.80
> 30 kWh and ≤ 750 kWh	/kWh	2.85	2.64
> 750kWh	/kWh	4.05	3.75
General (<40kVA)			
Fixed charge single phase	Fixed	298.19	275.82
Fixed charge three phase	Fixed	415.66	384.48
Consumption	/kWh	5.35	4.95
Max Demand Low Voltage			
Fixed charge	Fixed	1,100.50	1,017.94
Consumption	/kWh	2.98	2.76
Off-peak kVA charge	/kVA	350.53	324.23
Max Demand Medium Voltage			
Fixed charge	Fixed	1,061.11	981.51
Consumption	/kWh	2.39	2.21
Off-peak kVA charge	/kVA	655.24	606.09
Optional MD Medium Voltage			
Fixed charge	Fixed	1,061.11	981.51

Customer	Unit	Value P	Value US$ cents (nominal)
Consumption	/kWh	2.39	2.21
Off-peak kVA charge	/kVA	327.62	303.04
Export Medium Voltage			
Max demand	/kVA	18.36	16.98
Consumption	/kWh	0.014	0.01

Source: www.escommw.com

D.5.8 Utility Performance

The latest available ESCOM annual report is quite dated (2000), and care should therefore be taken when interpreting the numbers below as these are likely to have changed in the last six years.

Table 28 ESCOM Utility Performance (US$ 2000)

Item	Unit	Value
Production:		
Electricity produced & acquired		1,059
Electricity billed		877
Peak demand		197
Technical Efficiencies:		
Plant availability	%	93.7%
Thermal Heat Rate	%	NA
Trans/Dist. Losses	%	17.6%
Interruption Index	%	NA
Commercial Efficiencies :		
Distribution Non-Technical Loss	%	NA
Distribution Collection Rate	%	NA
Operational Efficiencies:		
Staff	No	2,262
Customers	No	NA
Generation capacity – installed	MW	220
Customer /Staff	No/No	NA
Staff/Capacity	No/MW	10
Financial Performance:		
Turnover	US$ mill	71.6
Profit	US$ mill	27.4
Asset Base	US$ mill	NA
ROA	%	NA
Equity vs Debt	%:%	NA
Debt Coverage Ratio	%	NA

D.5.9 Challenges

Table 29 Challenges in Malawi Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	Unbundling and PSP are already established as policy principles Restructuring of industry has been hindered by non-cost reflective tariffs, degradation of infrastructure and resistance from unions Unclear what the status is of establishment of regulatory organs (MERA/NEC)
Electricity Supply	Poor national planning process Energy security – Malawi is not interconnected with its neighbours and its generation capacity has been affected by adverse natural conditions High dependency on domestic hydro generation Sustainability – of 5000 PV systems installed, over half are malfunctioning or not working
Utility	ESCOM already commercialised (ring-fenced from government) Losses high Tariffs not cost-reflective or sustainable Financial performance considered weak, although results not available for review Installed capacity has low availability Process of rehabilitating and extending generation, transmission and distribution is underway
Market	Domestic access to electricity about 5%

D.6 Mozambique

D.6.1 Energy Sector Policy

The energy policy, approved in 1998, has the following main objectives:

- To ensure energy supply at the lowest possible cost, satisfying the requirements for economic development
- Support the availability of energy for the domestic sector, specifically charcoal, kerosene, gas and electricity
- Promote the reforestation to support the availability of woodmass
- Strengthen the institutional capacity of the principal agents that supply energy
- Promote economically feasible investment programmes with the aim of developing the energy resources (hydro, woodmass, charcoal and natural gas)
- Support energy exports
- Improve energy efficiency
- Promote the development of environmentally-friendly energy conversion and utilisation technologies (solar energy, biomass)
- Promote a more efficient, dynamic and competitive energy business sector.

The National Energy Strategy was approved by Decree 24/2000 in October 2000 and provides a blueprint for reform of the energy sector and competitive private sector participation. Part of this is the Action Plan for the Reduction of Absolute Poverty (APRAP) 2001 – 2005.

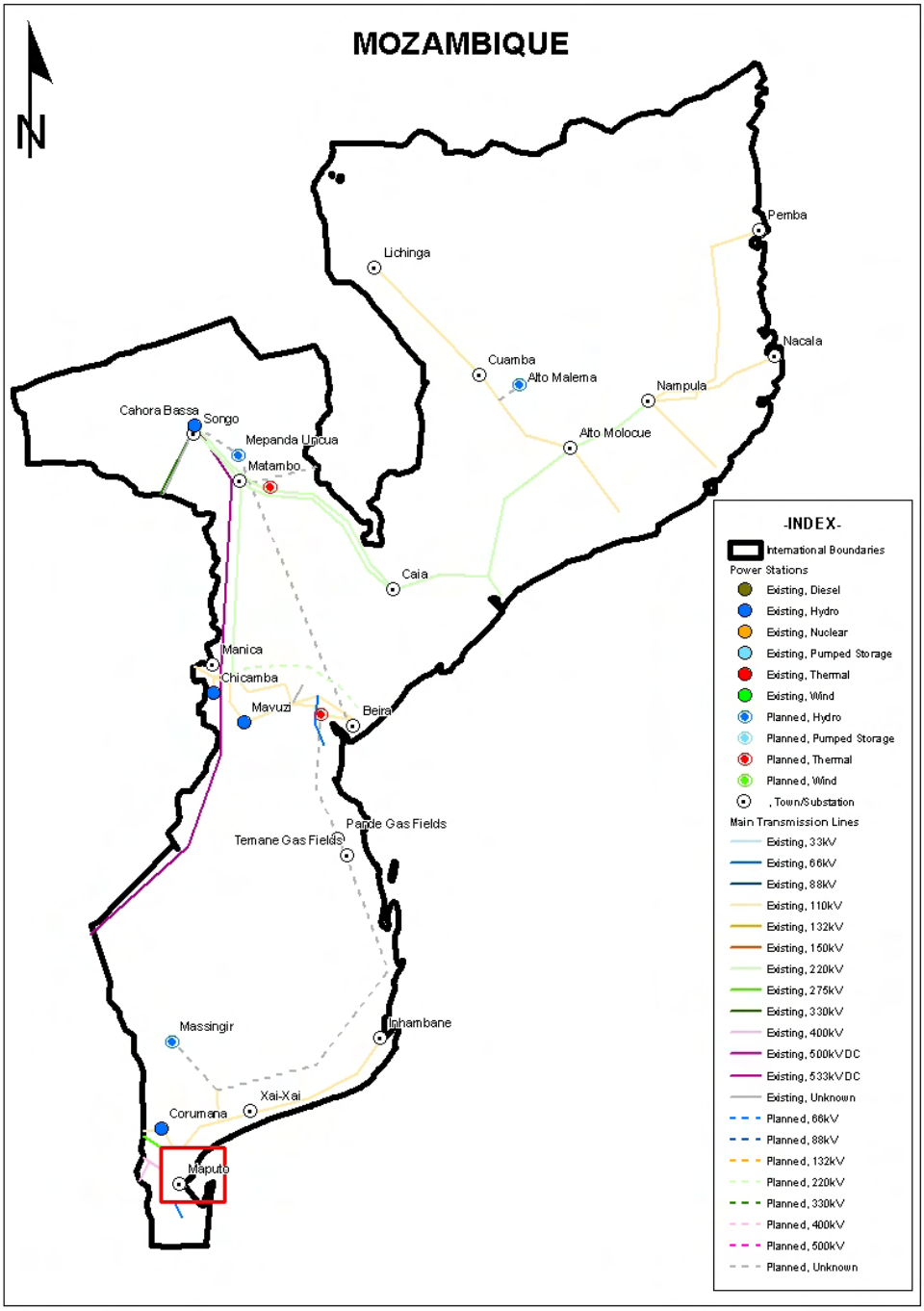
Under the APRAP, the government of Mozambique has proposed an energy programme that addresses the availability of electricity as a critical factor in addressing poverty. The main objectives of the programme are:

- To expand the population's access to energy sources, reducing the environmental impact of using non-renewable sources;
- Contribute to the supply of dependable energy in the main sections of the county, strengthening their economic growth and reducing regional imbalances;
- Promote the use of new and renewable energy sources in the electrification of remote areas;
- Electrification of districts with economic potential;
- Promote the participation of the private sector in the field of energy.

The objective of the Energy Reform Access Programme is to serve in peri-urban and rural areas through a grid expansion and the implementation of a National Energy strategy aimed at reforming the sector in order to create an enabling environment for greater Private Sector Participation (PSP). The power sector reform component consists of the following:

- separation of Electricite de Mocambique (EdM) into several business units;
- participation of the private sector in EdM's distribution and supply business, through strategic private investments; and
- the creation of a separate corporate public entity to provide transmission assets, and perform system operation.

The Energy Reform Access Programme was approved in late 2003, and funding is provided by the African Development Fund. Tenders were issued in 2003 for a transaction advisor to assist with all aspects of the process of letting concessions for rural electrification to qualified private sector companies. Private operators will be expected to make substantial investments in developing these rural concessions, but will be eligible to receive a subsidy towards connection costs on behalf of new


MOZAMBIQUE
N
Pemba
Lichinga
Nacala
Cuamba
Alto Malema
Nampula
Alto Molocue
Cahora Bassa
Songo
Mepanda Uncua
Matambo
Caia
Manica
Chicamba
Mavuzi
Beira
Pande Gas Fields
Temane Gas Fields
Massingir
Inhambane
Xai-Xai
Corumana
Maputo
-INDEX-
International Boundaries
Power Stations
Existing, Diesel
Existing, Hydro
Existing, Nuclear
Existing, Pumped Storage
Existing, Thermal
Existing, Wind
Planned, Hydro
Planned, Pumped Storage
Planned, Thermal
Planned, Wind
, Town/Substation
Main Transmission Lines
Existing, 33kV
Existing, 66kV
Existing, 88kV
Existing, 110kV
Existing, 132kV
Existing, 150kV
Existing, 220kV
Existing, 275kV
Existing, 330kV
Existing, 400kV
Existing, 500kV DC
Existing, 533kV DC
Existing, Unknown
Planned, 66kV
Planned, 88kV
Planned, 132kV
Planned, 220kV
Planned, 330kV
Planned, 400kV
Planned, 500kV
Planned, Unknown

customers. Subsidies will be financed by the Government of Mozambique, the World Bank and possibly other donors.

D.6.2 Energy Supply & Demand

Mozambique's total energy supply is 8.6 million tons of oil equivalent. Of this total, biomass accounts for 82%, whilst hydropower accounts for another 11%, with petroleum products making up the balance.

Household consumption accounts for 77% of total consumption, nearly all of that on raw combustibles, renewables and waste. Industry accounts for 16% of consumption, spread evenly between electricity and C,R&W. Transport accounts for 6% of consumption.

Table 30 Mozambique Energy Balance (2004, thousand TOEs)

Source	Coal	Petrol. Products	Natural Gas	Hydro	C, R & W	Electricity	Total
Production	23	-	2	1,003	7,208	-	8,236
Imports	-	658	-	-	-	527	1,185
Exports	-9	-	-	-	-	-818	-827
Stock/Bunkers	-	-22	-	-	-	-	-22
TPES	14	635	2	1,003	7,208	-291	8,571
Transform/Loss	-	-13	-2	-1,003	-1,211	895	-1,334
TFC	14	622	-	-	5,996	604	7,236
Industry	-	102	-	-	527	548	1,176
Transport	-	443	-	-	-	-	443
Resid./Other	14	68	-	-	5,470	56	5,607fs

Source: International Energy Agency

D.6.3 Electricity Legal and Regulatory Framework

In July 1997, the Mozambican parliament passed a law liberalising the electricity market, and thus opened it to private sector generators. The Government of Mozambique initiated the drive towards privatisation of the energy sector in 2000, with the objective of greatly increasing access to modern fuels.

In August 1997, a new Electricity Act was approved by parliament to define:

- The general policy for the organisation of the electrical energy sector and the administration of the supply of electrical energy
- The general legal framework for electrical energy generation, transmission, distribution and sale within the country, as well as its exportation to and importation from outside of the national territory, and granting concessions for such activities.

New municipal legislation was enacted in 1997, giving municipalities certain functions in investment planning and the operation of electricity services in local authorities. At the same time, the government commissioned a study of the possible reforms and regulation of the electricity sector. The objectives were to follow up the intentions of the Electricity Act through the granting of concessions, including proposals for tariff regulation. The main recommendations of this study, which has provided the basis for the National Energy Strategy, included:

- The adoption of a single buyer model, with competition as the model for reform
- The restructuring of EDM through vertical separation into hydro generation, transmission (including power procurement) and distribution business, complemented by horizontal separation of distribution through concessions (to EDM, municipalities and private participants) for well-defined geographical areas

- The strengthening of private sector participation by:
    - Introducing independent power producers (IPPs) in new generation projects, and possibly selling the existing hydro business;
    - Letting management contracts for distribution business followed by leases/concessions contracts; and
    - Outsourcing non-core transmission and distribution functions.
- Establishment of a mechanism and institutional arrangement for tariff regulation;
- Independent regulatory agency established by primary legislation; and
- Consideration of a multi-sectoral regulatory agency (at least for electricity and gas) as a longer term goal.

The thrust of the power policy is to tap into the vast hydropower resources the country has, and as a result the majority of large projects currently under consideration fall under the hydropower sector. However, there are several small thermal power projects under consideration for rural areas of Mozambique as well as the Energy Reform Access Programme which aims to address electrification of peri-urban and rural areas of Mozambique which will accelerate economic growth in the country.

D.6.3.1 Administrative and Regulatory Institutions

The Ministry of Mineral Resources and Energy (MIREME) is responsible for policy formulation within the mineral resources and energy sectors of the economy. In the energy sector, it supervises the activities of the two directorates, namely National Coal and Hydrocarbon Directorate (DNCH) and National Energy Directorate (DNE) through which government policies and programs are implemented. Government has further created a technical unit (UTIP) to promote the development of major hydropower projects (Cahora Bassa North and Mepanda Uncua hydropower projects).

D.6.3.2 Electricity Utilities

The main electricity authority is Electricidade de Mozambique (EdM), established by the state in 1977. EdM is a vertically-integrated utility, responsible for power generation, transmission and distribution. EdM is wholly owned by the government of Mozambique. It is responsible for all stages of the electricity supply chain from generation through transmission and distribution to final supply and billing of consumers.

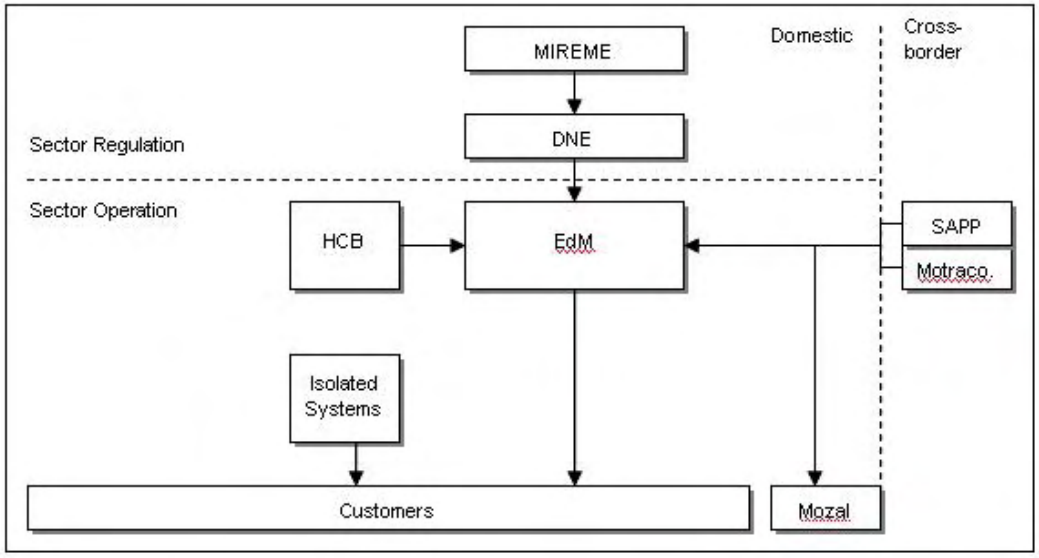
D.6.3.3 Private Sector Participation

The independent company, Hidroelectrica de Cahora Bassa (HCB), jointly owned by Portugal (82%) and Mozambique (18%) operates the biggest hydroelectric scheme in southern Africa at the Cahora Bassa Dam on the Zambezi River in Southern Africa. The dam is linked to South Africa by a 1,400km HVDC line.

In November 2006, it was reported that the Mozambican and Portuguese governments had signed an agreement to transfer majority shareholding in Cahora Bassa to Mozambique (increasing Mozambique's stake to 85% from 67%).

MoTraCo is a joint venture between the power utilities of Mozambique, South Africa and Swaziland formulated to transport power from South Africa to the Mozal plant in Maputo.

Figure 24: Mozambique Electricity Supply Sector

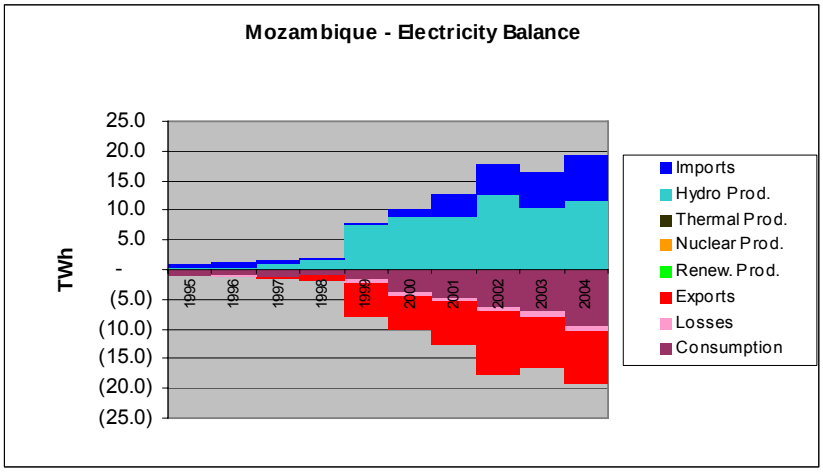


Source: SAPP

D.6.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 9.6TWh. The household electrification rate is approximately 7% and consumption per capita 510kWh/ann. The electricity supply and use profile changed dramatically after the resolution of hostilities and the reinstatement of hydro capacity in the second half of the 1990s. Today, Mozambique exports about three quarters of electricity production, but imports about 80% of consumption. The main reason for this apparent anomaly is the fact that the national power system is divided into two: the northern system exports to and the Southern system from South Africa, and the large share of consumption by the Mozal Aluminum Plant in Maputo in the south of the country.

Figure 25 Mozambique Electricity Consumption & Supply



Source: Energy Information Administration

D.6.5 Electricity Infrastructure

D.6.5.1 Generation (Existing & Expansion Plan)

Mozambique has substantial coal reserves (13% of the continental reserve excluding South Africa), as well as some exploitable gas reserves. It furthermore has significant hydro potential (3,700MW economically exploitable), of which more than 40% remains to be exploited. Mozambique's power is all hydropower, although the country also exports natural gas to South Africa (Temane gas field).

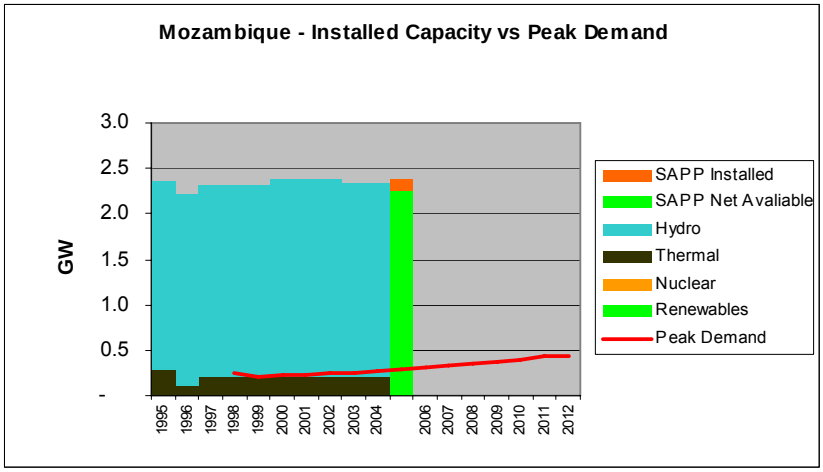
Mozambique has an installed power capacity of 2,382MW through EDM and Hidroelectrica Cahora Bassa (HCB), although none of HCB's capacity flows into the national grid. The net hydropower potential of the Zambezi River for electricity generation is estimated at 14,000MW, of which only 2,075MW is currently being exploited, mainly through Cahora Bassa.

In addition to Cahora Bassa there are 5 smaller hydropower plants, mainly in the south of Mozambique, with a combined installed capacity of just over 100MW. The Chibata hydrostation was built to respond to the growing needs along the Beira Corridor, since the local hydroelectric dams of Mavuzi and Chicamba could o longer satisfy the needs of the communities they serve.

Power output is set to increase with further generating plants planned. These include the Moatize thermal power station (1,000 MW), the Cahora Bassa northern expansion (550 MW) and the Mphanda Uncua hydropower station (2,500 MW). In November 2006, it was reported that negotiations for construction of Mphanda Uncua would be complete early in 2007.

In 2006, Mozambique's peak demand was 299MW. SAPP expects this demand to rise to 441MW by 2012. These figures do not include the complex arrangements between EDM, Motraco, Eskom, SEB and Mozal for power supply to the aluminium smelters near Maputo. This represents an increase of 37% over the period, or an annual average increase in demand of 5.9%.

Figure 26 Mozambique Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

D.6.5.2 Transmission & Distribution

In 1995, Mozambique had approximately 3,267km of high voltage transmission lines, of which the interconnection between the Cahora Bassa hydro station and South Africa accounts for more than 1,000km.

Table 31 Mozambique Transmission and Distribution Network (2001)

Item	Unit	Value
Transmission	kV	275, 220, 110, 60
Distribution	kV	33,22, 11, 6.6
LV	V	380, 220
HV Circuit	km	3,267
MV Circuit	km	3,500
Interconnections		South Africa, Malawi, Zimbabwe

Source: International Energy Agency

Mozambique has three transmission systems for electric energy. The northern system is fed from CahoraBassa (Hidroeléctricade CahoraBassa, HCB) on the Zambezi river in Tete. HCB supplies energy to Zimbabwe and South Africa via 400 kV AC and 533 kV DC lines respectively, and Mozambique (Tete, Zambeziaand Nampula) via a 220 AC line. The central system is fed from two hydroelectric stations in Manica province and supplies electricity to Manicaand Sofala, particularly to Beira city. The northern and central systems have recently been linked together by a 110 KV AC line. The southern system feeds Gaza and Maputo from South Africa

The transmission network has been increased since 1995, most notably by the Motraco Project, whereby the Mozal Aluminum Plant near Maputo is obtaining electricity from South Africa, via two 400kV overhead transmission lines and a corresponding substation.

Mozambique is connected to the Southern Africa Power Pool (SAPP) via the Republic of South Africa and Zimbabwean national grids. It is further

interconnected with Zimbabwe at two points in 110 and 4000 kV. EdM is interconnected with Eskom of RSA at three points in 275 kV 110 kV and in 400 kV. The 400 kV network, which is owned by MoTraCo, was constructed primarily to supply the MOZAL Aluminium Smelting Plant. The transmission line has been tapped in Swaziland and interconnected with the Mozambican grid in Maputo. In addition to the transmission links, some border towns in Mozambique are supplied from Malawi through 33 kV lines.

The proposed Mepanda Uncua project, that includes a hydropower plant, will further increase the transmission network if it goes ahead. The recommended transmission solution comprises two single circuit 400kV AC overhead lines from Mphanda Nkuwa dam, to a 400kV substation near Maputo (a distance of approximately 1560 km). The power plant could also be linked to the Songo switchyard at Cahora Bassa through two 400kV single circuits. This would also facilitate power exports to Zimbabwe.

The internal Mozambique transmission and distribution network is largely underdeveloped. The Energy Reform Access Programme, which was approved by the Ministry of Energy in 2003, will establish a grid-based peri-urban electrification network, including medium voltage lines for distribution substations, which will begin to address the current poor distribution network in Mozambique.

D.6.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 32 Planned/Proposed Mozambique Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Mepanda Uncua	Generation	Hydro	1,300MW	2012	Feasibility to be updated PPA to be agreed Procurement of EPC contractor
Moatize	Generation	Coal	1,000MW	2014	-
Massingir	Generation	Hydro	40MW	2016	Feasibility to be carried out PPA to be agreed
Mozambique – Malawi Interconnector	Transmission		220 kV	2008	Anticipated to increase capacity to 330 or 400 kV 120 km in Mozambique
Cahora Bassa – Mepanda Uncua	Transmission		TBA	TBA	Scheduling will be known once Mepanda Uncua has been decided
Mepanda Uncua - Beira	Transmission		TBA	TBA	Scheduling will be known once Mepanda Uncua has been decided
Massingir - Temane	Transmission		TBA	TBA	
Chicamba – Beira	Transmission		220 kV		

Source: SAPP, AfDB

D.6.6 Rural Electrification

FUNAE (rural energy fund) was created in 1997 with the objectives of promoting the development, production as well as utilisation of different forms of energy in the rural areas and urban areas where traditional supply would not be feasible. FUNAE is further empowered to promote the conservation and sustainable use of energy resources.

From 2000 to 2002, 29 projects were identified of which 79% were selected to receive financial support from FUNAE. In its strategic plan for 2004 to 2007, FUNAE planned to finance 24 projects in 2004, 78 in 2005, 146 in 2006 and 184 projects in 2007. Many of these would be operated by local governments.

The Energy Reform Access Programme was approved in late 2003, and funding will be provided by the African Development Fund. Tenders were issued in 2003 for a transaction advisor to assist with all aspects of the process of letting concessions for rural electrification to qualified private sector companies. Private operators will be expected to make substantial investments in developing these rural concessions, but will be eligible to receive a subsidy towards connection costs on behalf of new customers. Subsidies will be financed by the Government of Mozambique, the World Bank and possibly other donors.

The Ministry of Energy has recently placed an advert for consulting services with the objective of developing a plan for the utilisation of renewable energy and the supply of energy away from the national electricity grid.

D.6.7 Electricity Tariffs

The lowest tariff charged by EDM is US$c 3.77/kWh.

Table 33 EDM Tariffs (effective 1 February 2006)

Customer	Unit	Value Mt	Value US$ cents (nominal)
Low Voltage (Social, Domestic, Agriculture & General)			
Social (0<kWh≤100)	/kWh	1,010	3.77
Non-social Fixed Charge	Fixed	70.797	0.26
Domestic (0<kWh≤200)	/kWh	2,198	8.21
Domestic (200<kWh≤500)	/kWh	2,929	10.94
Domestic (500<kWh)	/kWh	3,077	11.49
Agriculture (0<kWh≤200)	/kWh	2,215	8.27
Agriculture (200<kWh≤500)	/kWh	3,164	11.81
Agriculture (500<kWh)	/kWh	3,462	12.93
General (0<kWh≤200)	/kWh	2,462	9.19
General (200<kWh≤500)	/kWh	3,516	13.13
General (500<kWh)	/kWh	3,847	14.37
LV Pre-paid			
Social	/kWh	1,010	3.77
Domestic	/kWh	2,802	10.46
Agriculture	/kWh	3,083	11.51
General	/kWh	3,532	13.19
	/kWh	1,378	5.15
Large Customers Low Voltage	/kW	105,973	395.72
	Fixed	207,308	774.12
Large Customers Med. Voltage	/kWh	1,144	4.27

Customer	Unit	Value Mt	Value US$ cents (nominal)
	/kW	118,615	442.93
	Fixed	973,079	3,633.64
	/kWh	1,020	3.81
Large Customers High Voltage	/kW	130,654	487.88
	Fixed	973,079	3,633.64

Source: www.edm.co.mz

D.6.8 Utility Performance

The latest EDM annual financial statements are for the year ending 31 December 2005.

Table 34 EDM Utility Performance (US$ 2005)

Item	Unit	Value
Production		
Electricity produced & acquired	GWh	2,098
Electricity billed	GWh	1,307
Peak demand	MW	285
Technical Efficiencies:		
Plant availability	%	NA
Thermal Heat Rate	%	NA
Trans/Dist. Losses	%	19.2%
Interruption Index	%	NA
Commercial Efficiencies :		
Distribution Non-Technical Loss	%	NA
Distribution Collection Rate	%	NA
Operational Efficiencies:		
Staff	No	3,194
Customers	No	338,597
Generation capacity – installed	MW	233
Customer /Staff	No/No	106
Staff/Capacity	No/MW	14
Financial Performance:		
Turnover	US$ mill	110.5
Profit	US$ mill	(6,5)
Asset Base	US$ mill	376,5
ROA	%	-1.7%
Equity vs Debt	%:%	0:1
Debt Coverage Ratio	%	7

D.6.9 Challenges

Table 35 Challenges in Mozambique Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	Unbundling, PSP and independent regulation policy in place Unclear what progress is with establishment of regulator Planning framework to account for multiple potential generation sources (EdM and private sector) – capacity challenge for project prioritization. UTIP has not yet delivered on the Mozambique-Malawi interconenctor nor Mepanda Uncua
Electricity Supply	Capacity to package large scale projects such as Mepanda Uncua for PSP Pressure for unenthusiastic potential offtakers to take on new transmission projects for prospective energy intensive industrial projects Unlocking large hydro potential in the country Expanding electricity access through additional national grid links, especially the North (Cahora Bassa) – South (Maputo) link
Utility	Tariffs are on the low side and are probably not fully cost reflective Although allowed, the unbundling of EdM has not yet taken place Losses are high EdM is still loss-making, and quite inefficient (with reference to staff numbers)
Market	Domestic access to electricity about 7%, with 50% of these households in the capital, Maputo