D.7 Namibia

D.7.1 Energy Sector Policy

The White Paper on Energy Policy was developed by the Energy Policy Committee of the Ministry of Mines and Energy and was released in May 1998. The White Paper states the following energy policy goals that form the framework for all future policy and strategy:

- Effective energy sector governance
- Security of supply
- Social upliftment
- Investment and growth
- Economic competitiveness and efficiency
- Sustainability.

In 1997, the Ministry of Energy identified the following challenges to the Namibian electricity supply industry (ESI):

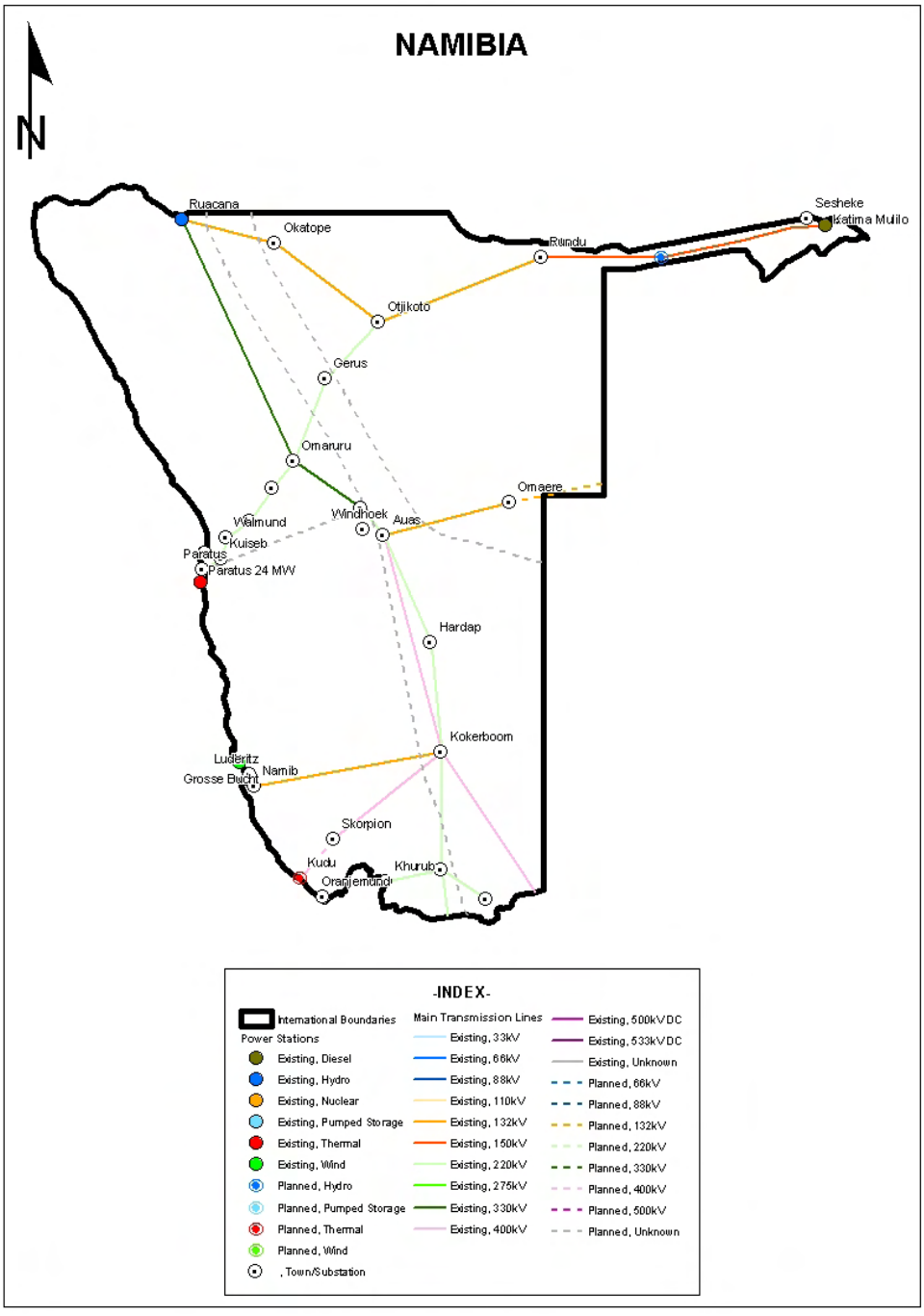
- Major investment requirements in the short to medium term - in generation, transmission and distribution infrastructure and operations;
- Increasing access to electricity among the Namibian population;
- Broadening of local and foreign private sector participation in the ESI;
- Impacts on Namibia of electricity sector reform in Southern Africa (particularly South Africa and the Southern African Power Pool);
- Loss of economies of scale due to a fragmented nature of the ESI; •
- Proliferation of a large number of electricity tariffs, often not cost-reflective, with resulting efficiency losses and unequal treatment of customers;
- Insufficient customer focus, leading to sub-optimal quality of supply and service;
- Human resource constraints with negative implications for efficiency and delivery;
- Diverse financial performance of electricity distributors, with adverse consequences for financial viability and sustainability; and
- An inability of many of the current distributors to plan, finance and sustain electrification programmes in their areas of supply.

To address the challenges the Ministry of Mines and Energy (MME) launched an in-depth investigation into the ESI in Namibia with the objective of ultimately making recommendations on possible future structures, which would enable the ESI to continue to be the engine for economic growth, development and prosperity in Namibia. The White Paper on Energy Policy, released by the MME in May 1998, gave further guidance to the restructuring exercise.

The policy endorses the following principles:

- To source power supplies for Namibian consumers in the most cost-effective manner, including the optimum utilisation of local generating assets;
- To ensure a reliable supply of power that promotes Namibian growth and development; and
- To increase diversity of supply and promote the use of local energy resources.

It is inevitable that major new generating projects in Namibia will have to be developed with private participation. The size of the Namibian electricity market and the small number of generating stations make it difficult to develop a competitive wholesale market within the country. Lastly, it is important for the viability of the transmission system that Namibia should not allow foreign utilities to 'cherry pick'


NAMIBIA
N
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Rundu
Sesheke
Katima Mulilo
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Windhoek
Auas
Walmund
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Existing, Wind
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Planned, Wind
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Main Transmission Lines
Existing, 33kV
Existing, 66kV
Existing, 88kV
Existing, 110kV
Existing, 132kV
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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

large Namibian customers without contributing to the overhead costs of Namibia's extensive transmission and distribution network.

The Namibian White Paper on Energy Policy states that government's aim is for Namibia to be able to produce 100 % of peak energy demands and 75 % of its total energy demands within its borders by the year 2010.

D.7.2 Energy Supply & Demand

Namibia's total energy supply in 2004 was 1.34 million tons of oil equivalent. Of this total, petroleum products account for 67% of the total, with biomass accounting for 14% and hydropower 10% of the total. Electricity imports account for the other 9%.

Domestic consumption makes up half of total consumption, of which raw combustibles, renewables and waste make up about a third. The transport sector consumes 43% of the Namibian energy supply.

Table 36 Namibia Energy Balance (2004, thousand TOEs)

Source	Coal	Petrol. Products	Hydro	C, R & W	Electricity	Total
Production	-	-	138	184	-	321
Imports	2	890	-	-	130	1,022
Exports	-	-	-	-	-6	-6
Stock/Bunkers	-	-	-	-	-	-
TPES	2	890	138	184	124	1,337
Transform/Loss	-2	-9	-138	-	116	-33
TFC	-	881	-	184	240	1,305
Industry	-	75	-	-	-	75
Transport	-	561	-	-	-	561
Resid./Other	-	239	-	184	240	663

Source: International Energy Agency

D.7.3 Electricity Legal and Regulatory Framework

The sector is governed by the Electricity Act of 2000, as overseen by the Ministry of Mines and Energy.

D.7.3.1 Administrative and Regulatory Institutions

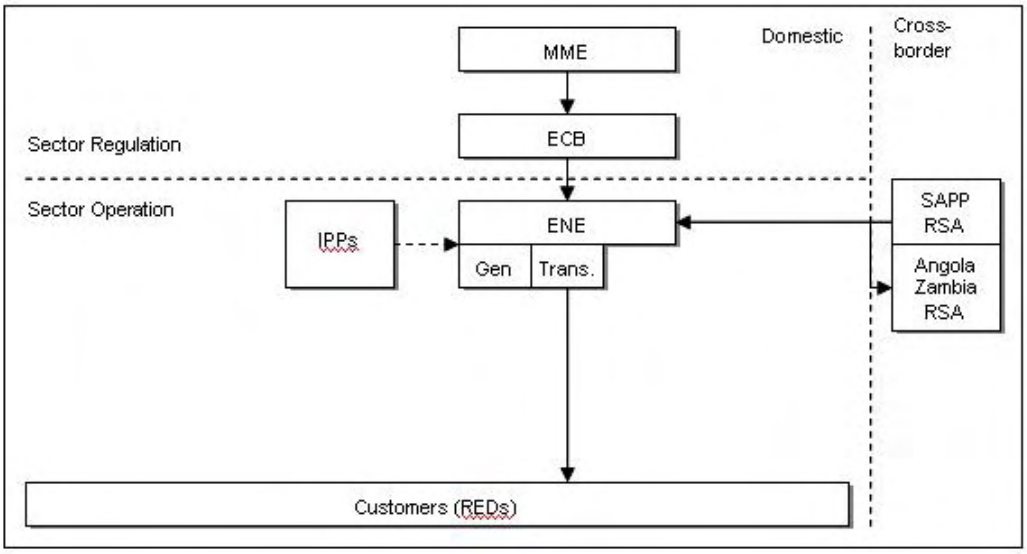
The Electricity Control Board is a statutory regulatory authority established in terms of the Electricity Act, 2000 (Act 2 of 2000). The Electricity Control Board has the core responsibility of regulating electricity generation, transmission, distribution, supply, import and export in Namibia. The Act covers the regulations relating to the issuing of licenses to operate in the sector and the obligations of licensees under the various licences.

D.7.3.2 Electricity Utilities

NamPower is responsible for the generation and transmission of electricity, as well as distribution outside of towns. Urban power distribution is channelled through the NamPower subsidiary, Premier Electric and the regional electricity distribution companies (REDs).

After the ESI reform, NamPower will not partake in distribution at all, as this function will be delegated to the REDs exclusively. The first REDs are already in place (Nored, Erongo and CENORED). There is still some uncertainty regarding the form of the central RED, including Windhoek. The Southern RED also remains to be established.

Figure 27: Namibia Electricity Supply Sector

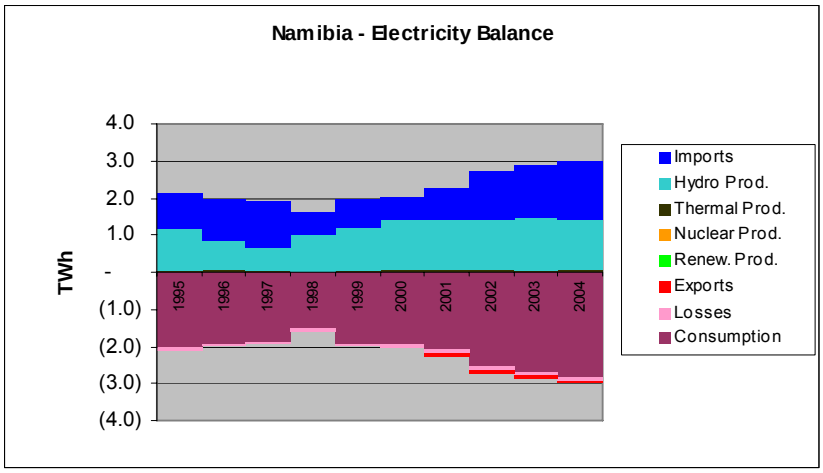


Source : SAPP

D.7.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 2.8TWh. The household electrification rate was approximately 34% in 2004 (but is likely to be higher today based on an aggressive rural electrification programme) and consumption per capita 1,414Wh/ann. Electricity imports account for nearly 60% of electricity consumption.

Figure 28 Namibia Electricity Consumption & Supply



Source: Energy Information Administration

D.7.5 Electricity Infrastructure

D.7.5.1 Generation (Existing & Expansion Plan)

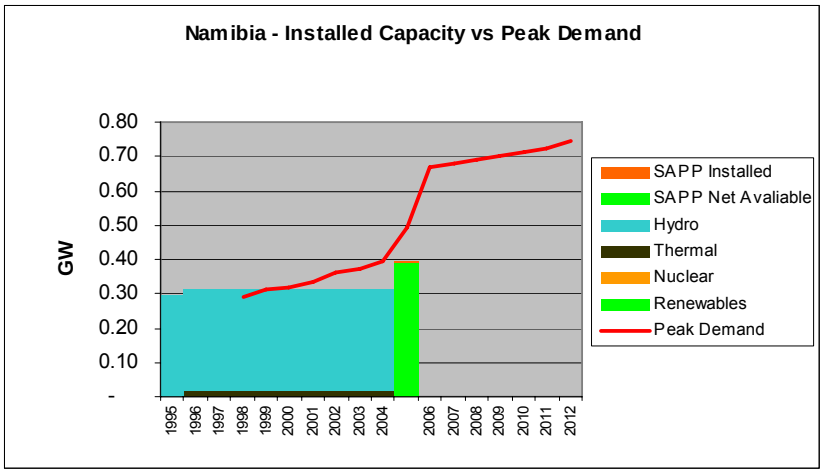
Namibia's energy resources include some natural gas reserves in the South of the country (2.2TCF) and about 1,000MW of hydro capacity (in the North).

Namibia has installed power capacity of 393MW of which 390MW is available. Hydroelectric sources account for around 95% of the total output.

NamPower has three power stations with a combined generating capacity of 380MW. The hydro facility at Ruacana is the most important, accounting for 240MW of this combined capacity. This generating capacity serves in the region of 50% of overall demand and the shortfall is made up through power imports from South Africa and other regional neighbours. A special arrangement between NamPower and the South African utility, Eskom enables Namibia to buy and utilise the surplus energy from South Africa at affordable rates.

According to the SAPP, Namibia's power demand is expected to increase from 670MW in 2006 to 746MW in 2012. This represents an increase of 11% over the period, and an annual growth of 2.5%.

Figure 29 Namibia Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

With the government's commitment to increasing access to electricity, NamPower has to explore new power generation sources. The alternatives being considered are the Kudu Gas Project, the Lower Cunene Hydropower Scheme (Epupa and Baynes Project) and the Popa Falls hydropower options (some in conjunction with Angola).

D.7.5.2 The Ruacana Scheme

The Ruacana scheme in the north of Namibia consists of:

- A large storage dam at Gove, approximately 80km south of Nova Lisboa in the Cunene River and about 430km upstream from Ruacana.
- A second dam at Calueque approximately 65 km upstream from Ruacana.
- A diversion weir about 1 km upstream from Ruacana in Angolan territory, by means of which water can be sufficiently dammed to divert it via an 8-metre diameter underground tunnel across the border to the power station in Namibia.
- The hydropower station consisting of three 80MW generating units driven by water from the surge headbay on top. Electricity is generated at 11,000 volts, transformed to 330,000 volts and fed up vertical tunnels to the switchgear on the surface from where it is distributed to the central areas of Namibia. The power station is underground and consists of three parallel caverns, draft tubes, interconnecting galleries and ducts.
- A 570km long, 330kV transmission line to transmit the power generated at Ruacana to a large distribution station near Omaruru where it is fed into the existing 220kV system for distribution across the country.

In 2003 Ruacana became the first hydropower facility in the world to adopt Profibus technology, with all measurement devices being upgraded using programmable logic controllers and system control and data acquisition software.

D.7.5.3 Transmission & Distribution

The Namibia transmission network extends to all the major centres. The country is interconnected with South Africa at present, but interconnectors are being developed with Zambia/Zimbabwe, and in future also with Angola (as part of the WESTCOR project). The network is made up of 132kV, 150kV, 220kV and 400kV AC lines.

Nam-power substantially reduced transmission losses between 2003 and 2004. This reduction is due to technical impact of recently completed 400KV transmission interconnector with South Africa.

D.7.5.4 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 37 Planned/Proposed Namibia Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Kudu	Generation	Gas	800MW	2009	PPA to be finalised Gas supply agreement to be finalized To be upgraded to 1600MW by 2014 Transmission integration required
Epupa	Generation	Hydro	360MW	2015	-
Popa	Generation	Hydro	23MW	2015	-
Divundu	Generation	Hydro	TBA	TBA	On Kavango River
Namibia – Zambia Interconnector	Transmission		TBA	TBA	
Namibia – Zimbabwe Interconnector	Transmission		TBA	TBA	
Namibia – Angola Interconnector	Transmission		400 kV	TBA	Part of Westcor

Source: SAPP, AfDB

D.7.6 Rural Electrification

The MME is responsible for the RE policy, whereas NamPower facilitates the planning of the RE Master Plan.

NamPower operates RE projects in its licensed supply areas, although most RE projects resort under Local Authorities, Regional Councils or the MRLGH. With the restructuring of the Electricity Distribution Industry (EDI), all RE projects (completed, in progress or planned) will in future be owned and operated by the Regional Electricity Distributors (REDs). The REDs will operate these projects integrated with the rest of their business, applying such cross-subsidies as allowed by the ECB. It is assumed that the allotment of RE funding between geographic areas will in future be RED-based (rather than Regional Council-based).

The Rural Electrification Programme is an ongoing NamPower project funded by the Ministry of Mines and Energy as well as through concessional loans. To date, funds for Rural Electrification have come from two sources –

- An allocation under a European Investment Bank (EIB) grant to NamPower for the construction of a South Africa-Namibia transmission interconnector. The amounts are an initial N$50 million for the next tranche of RE, and N$12 million per annum thereafter.
- A capital budget allocation through the MME of ± N$30 million per annum.

It is anticipated that the ECB will be introducing an RE levy on all transmission bulk supplies in future. The quantum and implementation date of this levy are not yet known. Funds from the ECB levy will be in addition to the EIB and MME funds.

The RE funds are used solely to subsidise the cost of establishment of RE infrastructure (grid extensions, substations, local reticulation and connections). The capital of RE projects is fully subsidised (i.e. there is no residual cost of capital to be recovered from users or through cross-subsidies).

D.7.7 Electricity Tariffs

End-user charges are levied by NamPower as well as the individual REDs and local authorities not yet incorporated into REDs. The individual local authorities all had quite disparate charges before the RED initiative was launched – in fact, one of the major objectives of RED process was tariff harmonization. The ECB is working towards simplified and harmonised distribution tariffs throughout the country, and has prescribed an Operating & Reporting Manual for this purpose. The individual REDs are presently substantially restructuring their tariff schemes which means any reporting on that process will be dated quickly.

Table 38 NamPower Tariffs (effective FY 2006/7)

Customer	Unit	Value N$	Value US$ (nominal)
Re-Distributors, Water Pumping, Commercial & Miscellaneous			
Unit charge	/kWh	0.1915	0.031
Maximum Demand	/kW	82.57	13.35
	/kVA	74.73	12.08
Rental	Fixed	Customer-specific	
Service charge	Fixed	270.00	43.65
Extension charge	Fixed	Customer-specific	
Electricity levy	/kWh	0.0045	0.0070
Mines			
Unit charge	/kWh	0.1836	0.0297
Maximum Demand	/kW	82.57	13.35
	/kVA	74.73	12.08
Rental	Fixed	Customer-specific	
Service charge	Fixed	270.00	43.65
Extension charge	Fixed	Customer-specific	
Electricity levy	/kWh	0.0045	0.0070
Export			
Unit charge	/kWh	0.2021	0.0327
Maximum Demand	/kW	82.57	13.35
	/kVA	74.73	12.08
Rental	Fixed	Customer-specific	
Service charge	Fixed	270.00	43.65
Extension charge	Fixed	Customer-specific	
Electricity levy	/kWh	0.0045	0.0070

Source: www.nampower.co.na

D.7.8 Utility Performance

The NamPower annual financial statements are available, as follows:

Table 39 NamPower Utility Performance (US$ 2006)

Item	Unit	Value
Production		
Electricity produced & acquired	GWh	NA
Electricity billed	GWh	NA
Peak demand	MW	NA
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	NA
Customers	No	NA
Generation capacity – installed	MW	NA
Customer /Staff	No/No	NA
Staff/Capacity	No/MW	NA
Financial Performance:		
Turnover	US$ mill	159.5
Profit	US$ mill	23.5
Asset Base	US$ mill	1,049.9
ROA	%	2.2%
Equity vs Debt	%:%	5:1
Debt Coverage Ratio	%	3

D.7.9 Challenges

Table 40 Challenges in Namibia Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	IPPs/PSP allowed, but not yet implemented Regulator is established and active
Electricity Supply	Mature national planning process in place, including for rural electrification Namibia remains dependent on imported power, mostly from South Africa – electricity security remains an issue Large indigenous power projects need to be supported (e.g. Kudu). Clarity is needed in planning and prioritisation of mooted generation projects Further interconnectors equally require support (Zambia/Zimbabwe and WESTCOR) Continued implementation of the REDs countrywide Clarity over roles between Nampower and the private sector with respect to development of alternative energy solutions
Utility	Nampower is properly commercialised, cost-recovering and profitable
Market	Domestic access to electricity about 34%, but is actively addressed in the electrification programme

D.8 South Africa

D.8.1 Energy Sector Policy

The White Paper on the Energy Policy of the Republic of South Africa (1998) sets the following policy objectives:

- Increasing access to affordable energy services
- Improving energy governance
- Stimulating economic development
- Managing energy-related environmental and health impacts
- Securing supply through diversity.

The Energy Policy is based on the following key objectives:

- Attaining universal access to energy by 2014
- Accessible, affordable and reliable energy, especially for the poor
- Diversifying primary energy sources and reducing dependency on coal
- Good governance, which must also facilitate and encourage private-sector investments in the energy sector
- Environmentally responsible energy provision.

D.8.2 Energy Supply

South Africa's total energy supply was 131 million tons of oil equivalent in 2004. Of this total, coal accounted for 68% of the total, crude oil 17% and petroleum products 3% of the total. Biomass accounted for 9% of energy needs, with gas providing 1% of the total. South Africa is the only country in the region with nuclear power, which accounted for 2% of energy demand in the country.

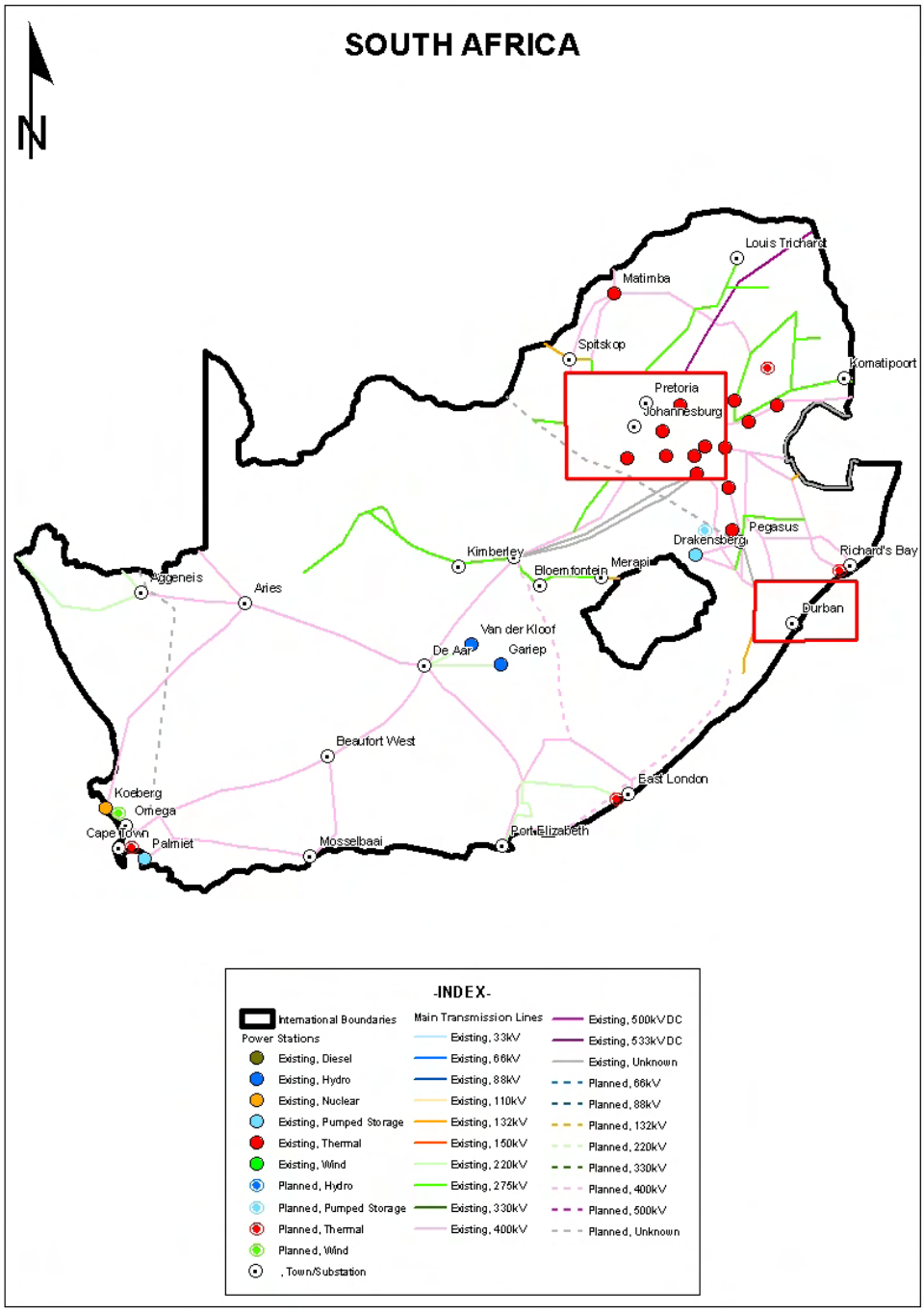
Industrial and residential consumption each make up about a third of consumption, with transport constituting about a quarter. About a third again of residential consumption is made up of combustibles, renewables and waste.

Table 41 South Africa Energy Balance (2004, thousand TOEs)

Source	Coal	Crude Oil	Petrol. Products	Gas	Nuc-lear	Hydro	Geo/ Solar	C, R & W	Electricity	Total
Production	137,074	187	-	1,658	3,483	190	92	13,314	-	155,998
Imports	1,244	22,830	1,724	-	-	-	-	-	844	26,643
Exports	-45,494	-1	-3,786	-	-	-	-	-246	-1,140	-50,668
Stock/Bunkers	1,573-	-	-2,410	-	-	-	-	-	-	-837
TPES	94,397	23,016	-4,472	1,658	3,483	190	92	13,068	-295	131,137
Transform/Loss	-76,153	-23,016	23,922	-569	-3,483	-190	-92	-3,500	17,280	-65,801
TFC	18,244	-	19,450	1,089	-	-	-	9,567	16,985	65,335
Industry	10,342	-	852	1,082	-	-	-	1,657	9,670	23,604
Transport	-	-	14,828	-	-	-	-	-	534	15,362
Resid./Other	4,348	-	2,564	7	-	-	-	7,910	6,781	21,610

Source: International Energy Agency

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


SOUTH AFRICA
N
Louis Trichardt
Matimba
Spitskop
Komatipoort
Pretoria
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Pegasus
Drakensberg
Richard's Bay
Kimberley
Merapi
Bloemfontein
Aggeneis
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Planned, 88kV
Planned, 132kV
Planned, 220kV
Planned, 330kV
Planned, 400kV
Planned, 500kV
Planned, Unknown

D.8.3 Electricity Legal and Regulatory Framework

The electricity sector is governed by the Electricity Act, No. 41 of 1987, as amended by the Electricity Amendment Acts of 1994 and 1995. The Department of Minerals and Energy oversees the sector.

D.8.3.1 Administrative and Regulatory Institutions

The Department of Minerals and Energy (DME) is responsible for ensuring exploration, development, processing, utilisation and management of South Africa's mineral and energy resources. The Electricity and Nuclear Branch is responsible for electricity and nuclear-energy affairs, while the Hydrocarbons and Energy Planning Branch is responsible for coal, gas, liquid fuels, energy efficiency, renewable energy and energy planning, including the energy database.

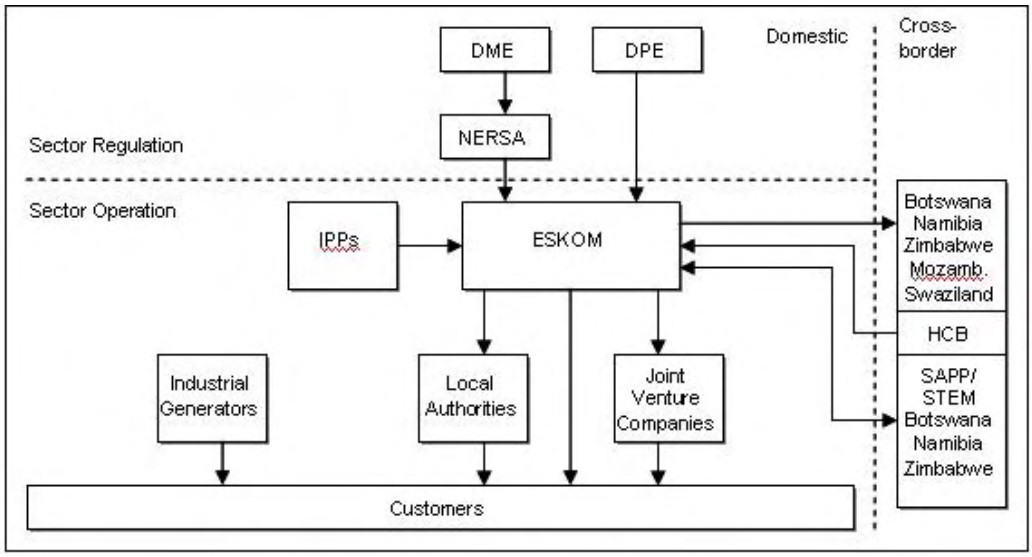
The South African cabinet approved The Energy Regulatory Bill in December 2003. This effectively allows for the setting up of a single National Energy Regulator (NERSA). The Bill, which amends the Electricity Act, Gas Act, and Petroleum Pipelines Bill, aims to streamline all energy sectors such as electricity, nuclear, liquid fuel and gas. The amendments mean that the National Electricity Regulator, a statutory body established in 1995 to replace the Electricity Controls Board, and the current authority for the electricity supply industry, will in future also be responsible for regulating sectors such as nuclear, gas and liquid fuels.

The DME completed a project on the Development of Guidelines (Market Rules) for the Introduction of Independent Power Producers (IPPs) and Private Service Providers (PSP's) in the Electricity Supply Industry (ESI) in July 2003. The purpose of the project was to assess the possibility of using an unbundled Eskom Power Pool (EPP) as the basis for moving towards a future multi-market model (MMM) for the ESI, including identification of potential barriers and constraints in existing institutional arrangements and necessary transitional arrangements. Included in the study were proposed mechanisms for international trading of electricity, advice on how various public purpose programmes, e.g. energy efficiency, demand-side management; electrification and research and development could be accommodated and proposed mechanisms for how IPPs, including both conventional and renewable ('green') generation options, and PSP's would be encouraged to participate in implementation and operationalisation of the recommended MMM.

At a logistical level, privatisation of the energy sector is the responsibility of the Department of Public Enterprises (DPE). The DPE has valued the country's electricity assets at around R100 billion (US$15billion).

In the medium-term, the government will also establish a separate state-owned transmission company that will be independent of generation and the retail business, with ring-fenced transmission system operation and market operation functions. Initially, this transmission company will be a subsidiary of Eskom and will eventually be established as a separate state-owned transmission company, before any investments are made in current or new generation capacity.

Figure 30: South Africa Electricity Supply Sector



Source: SAPP

D.8.3.2 Electricity Utilities

Eskom is a vertically integrated operation that generates, transmits and distributes electricity in Southern Africa. Eskom generates 95% of the electricity used in South Africa.

In terms of the Eskom Conversion Act, which was approved by Parliament during 2001, Eskom, previously a utility, was incorporated as a company with effect from July 2001. A new board of directors was appointed and divisional boards and approved sub-committees were established. Each of the main operating divisions of the company report into Eskom Holdings Limited.

Eskom currently accounts for more than 90% of the electricity generated in South Africa, but the government is committed to the privatisation of 30% of its generation capacity. This, however, does not necessarily suggest that a sale of 30% of Eskom's generation assets. However, Government has ruled out the possibility of sell-offs of parastatals. It is most likely that Eskom would remain in state hands, but the private sector would be involved in partnerships and concessions with them. The Department of Public Enterprises will simultaneously ensure policy certainty with the responsible departments, finalise the appropriate corporate structure, establish a coherent and sustainable financing strategy and move to implement as appropriate to the situation concessions.

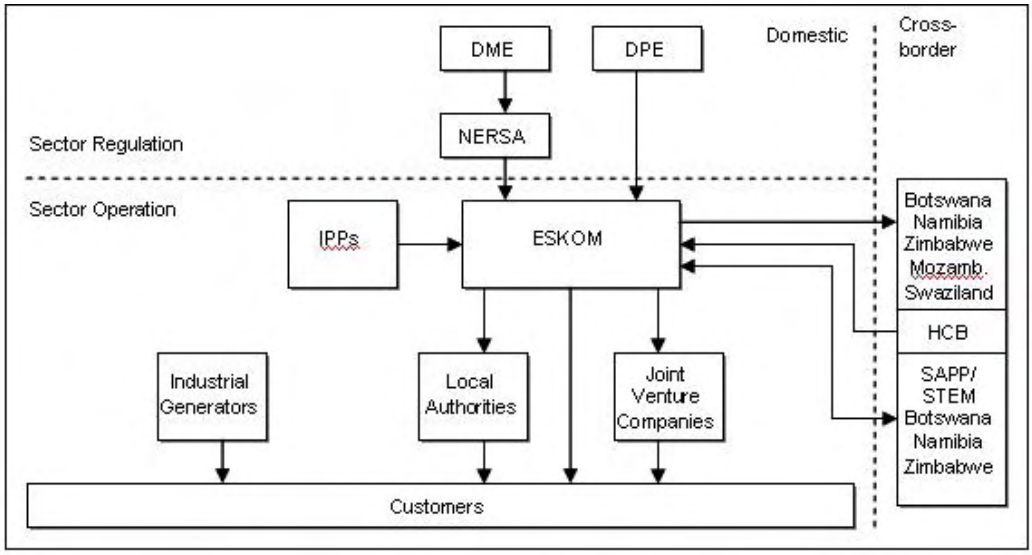
The restructuring of the electricity generation sector is intended to introduce significant competition to the industry. Privatisation also offers a range of ownership options for Black Empowerment Enterprises (BEE's), from the single investor to consortiums of investors, depending on investor's requirements and access to funding.

Other electricity producers include industrial self-generators (e.g. Sasol) and a few municipal distributors also owning and operating generating facilities.

The Electricity Industry Restructuring process outlines the plan for Eskom's distribution function to separate and merge with the municipal electricity undertakings to form six Regional Electricity Distributors (RED's). This process is overseen by EDI Holdings – a company established by the DME to manage the transition towards REDs.

Various RED 'models' have been considered. Originally, the plan was to have all local authorities and ESKOM Distribution amalgamate into five regionally-based REDs. That plan was later modified to have so-called metro REDs (based around the metropolitan municipalities) with ESKOM wrapping up smaller municipalities into a seventh 'national RED'. That plan has run into opposition, and it appears that something akin to the original model will again be followed. The Electricity Regulation Amendment Bill will now have to be modified again. A basic cause of opposition against the RED reforms is the impact that REDs would have on municipalities' ability to tax electricity as a source of revenue for other municipal services. Until the Constitution is modified (which enshrines this right), it is unlikely that REDs will progress.

Figure 31: South Africa Future Electricity Market Model

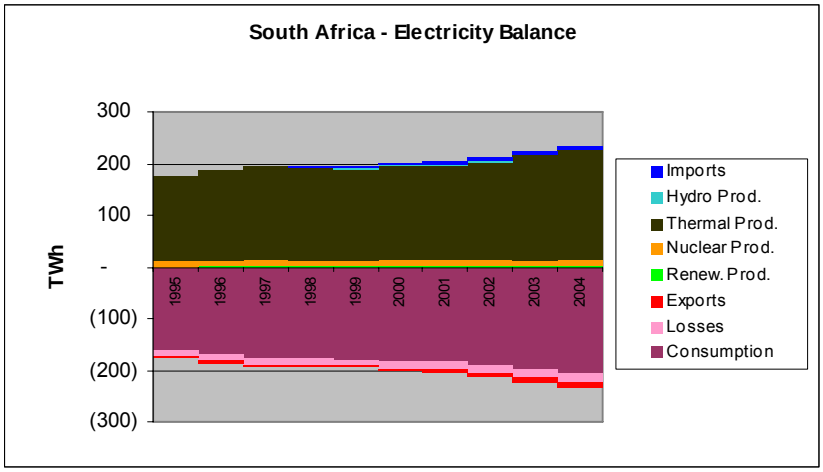


Source: SAPP

D.8.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 207TWh. The household electrification rate was approximately 66% in 2004 (but is likely to be higher now due to the ongoing electrification programme) and consumption per capita 4,653kWh/ann. South Africa is self-sufficient in electricity, but imports and exports (relatively) small amounts via SAPP STEM and bilateral arrangements.

Figure 32 South Africa Electricity Consumption & Supply



Source: Energy Information Administration

D.8.5 Electricity Infrastructure

D.8.5.1 Generation (Existing & Expansion Plan)

South Africa is estimated to have 5% of the global coal reserves (97% of Africa's reserve). It further has some 600MW of economically-exploitable hydro capacity, most of which is already developed.

South Africa's installed power capacity is around 42,000MW at present, with available capacity being 36,208MW. Of this Installed capacity, 94% is coal-fired power, 1% hydropower and 5% nuclear power. Some 95% of electricity is produced by Eskom, 3% by private generators and 1, 3% by municipal generators. The country imports electricity from Cahora Bassa hydro plant in Mozambique, the Zambian Electricity Supply Corporation and SNEL in the Democratic Republic of the Congo (DRC).

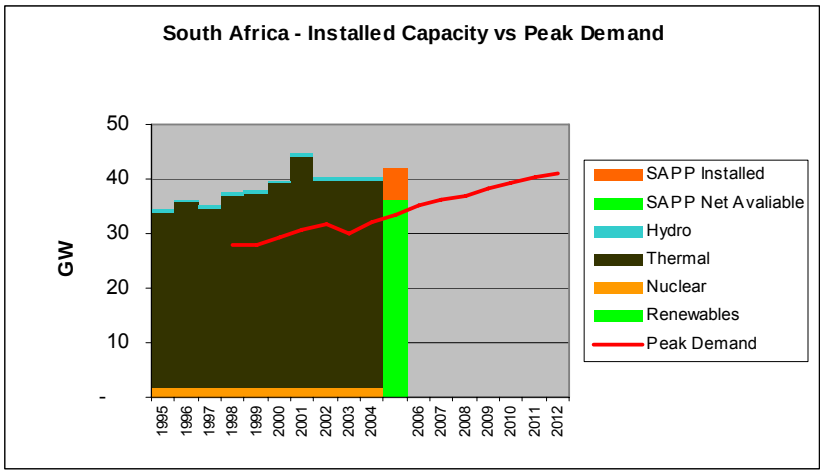
South Africa has a total of 53 generating stations, of which 20 are coal-fired, eleven gas turbines, ten hydroelectric stations, four bagasse stations, three pumped storage stations, and one nuclear station. A further three coal-fired stations were previously mothballed (Camden, Grootvlei and Komati) and are now being recommissioned. Of the total stations, 24 are operated by Eskom, 22 are municipal and seven are privately owned.

At present, the National Energy Regulator (NER) has issued 14 Generation licences for the generation of more than 500GWh per annum, in accordance with the Electricity Act.

The policy of encouraging new industrial projects with the promise of cheap electricity is one of the reasons for the steep increase in demand. During the early 1990s Eskom offered Alusaf (now BHP Billiton) an electricity price linked to the price of aluminium on the London Metals Exchange. A similar deal with the Canadian company Alcan to lure them into building an aluminium smelter at Coega has been concluded; Alcan and Eskom signed the PPA in November 2006. The smelter will need a power supply of about 1330MW, with first metal scheduled for 2010, which will put further pressure on the electricity supply capacity of South Africa.

According to the SAPP, South Africa's power demand is forecast to grow from 35,100MW in 2006 to 41,681MW in 2012. This represents an overall increase in demand of 19% over the period, or 3.4% on average.

Figure 33 South Africa Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

South Africa's fast-dwindling peak electricity generation capacity is expected to run out around 2007, and strategic decisions need to be made for additional power generation and interconnection.

A coal-fired base-load plant with an installed capacity of 3,600MW will take four to five years to build, preceded by up to three years of preparatory work. The immediate preference is therefore for gas-fired plant, requiring a shorter construction period with commissioning three years after the beginning of construction.

Eskom is committed to increase overall installed capacity by 10,000MW by the year 2014. The plan is to add 1,000MW of capacity every year for the next decade through a combination of brownfields and greenfields projects. To achieve this, the power utility has announced that it will spend up to R150 billion on rebuilding and recommissioning power stations over the next 5 years. Officials in the National Electricity Regulator (NER) have indicated that the re-commissioning of Eskom's three mothballed power stations and the construction of a new gas-fired station should be followed by the construction of another station in 2010 which, preferably, should be of the hydro pumped-storage variety.

D.8.5.2 Transmission & Distribution

Eskom is the only licensed transmitter of electricity in South Africa. In the distribution industry, Eskom directly distributes electricity to approximately one-third of South African electricity consumers, who account for approximately 60% of all electricity sales. The remaining two-thirds of the country's customers (and 40% of total sales) are supplied predominantly by local government electricity distributors (soon-to-be REDs).

From the power stations the electricity is transmitted via ± 30,000 kilometres of high voltage overhead power lines. Voltages on this transmission grid range between 132 kV to 765 kV.

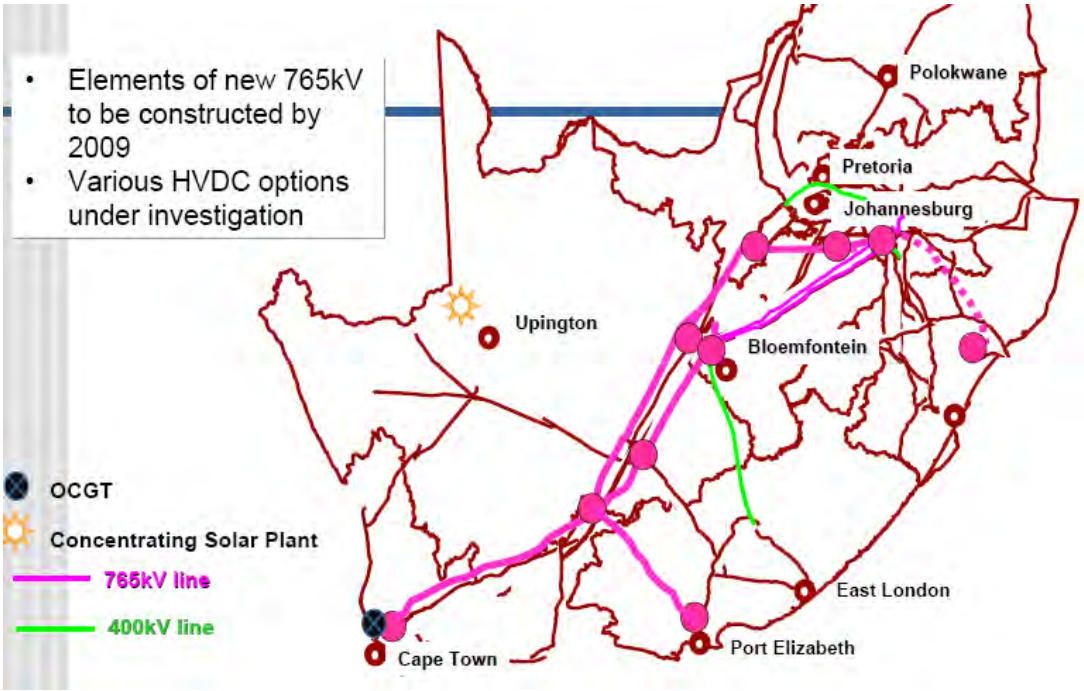
From the grid, power is distributed to consumers at a lower voltage via a distribution network of overhead lines, cables and transformers approximately 313,000km in length.

Table 42 South Africa Transmission and Distribution Network (2002)

Item	Unit	Value
Main transmission system	km	27,406
765 kV	km	1,153
533 kV DC (monopolar)	km	1,035
400kV	km	15,691
275kV	km	7,245
220kV	km	1,336
132kV	km	946
Distribution lines	km	43,330
165 – 132 kV	km	22,142
88 – 33 kV	km	21,188

Source: ESKOM Annual Report 2006

Figure 34: ESKOM Transmission Strengthening Plan



D.8.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 43 Planned/Proposed South Africa Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Mothballed Plants	Generation	Coal	3,500MW	2005-2010	-
OC Gas Turbine	Generation	Gas	500MW	2008	-
Greenfield	Generation	Coal	4,000MW	2012/13	-
Greenfield	Generation	Coal	2,500MW	2014	-
2xCCGT	Generation	Gas	1,500MW	2010	Fuel supply agreement to be concluded
2xPumped Storage	Generation	Hydro	2,330MW	2013	EIA to be completed
Namibia – South Africa (part of Westcor)	Transmission		400kV	TBA	
Namibia – Botswana (part of Westcor)	Transmission		400kV	TBA	

Source: SAPP, AfDB

D.8.6 Rural Electrification

The Electrification Distribution Industry (EDI) in South Africa has been comprised of a national utility, Eskom, and some 385 licensed municipalities (Local Authorities - LAs), represented by the South African Local Government Association (SALGA). Historically, service provision in SA was limited geographically to established towns and areas of economic activity. By 1993 approximately 3,7 million households had been electrified, mostly in cities and towns close to the established electricity grid, and with higher housing densities. At the end of 1993 access to grid electricity was approximately: 36% of the total population; 50% of the urban population; and 12% of the rural population. More than 25 000 rural schools had no access to electricity.

In 1994 the new democratic Government of South Africa (GoSA) launched the Reconstruction and Development Programme (RDP) that required an accelerated and sustainable National Electrification Programme (NEP). The NEP was selected as an accelerated Presidential Lead Project towards the RDP. Eskom and LA distributors accepted the RDP electrification targets in an unwritten (Social) Compact with Government.

The aim of Phase I (1994-1999) was to make 450 000 connections per year (Eskom 300 000 and municipalities 150 000 per year). By the end of 1999 the Compact had met its target by providing access to electricity for an additional 2 500 000 households, with additional connections to rural clinics and schools. Eskom had made 1 750 000 connections, distributed across the whole country, but mainly in rural areas, at a cost of R5 billion plus. LAs had made 750 000 connections, mainly in urban areas, at a total cost of R2 billion plus. The programme was funded by a combination of debt financing and by a mark-up contained as an implicit surcharge in the Eskom tariff. Eskom also agreed to transfer an amount of R300 million per annum (annually adjusted in line with tariff increases) to the National Electricity Regulator (NER) for allocation to the municipalities. The total cost of the NEP Phase I was about R8 billion, making it one of the largest, if not the largest electrification programme in the world at the time.

By 2001, an estimated 7.1 million of South Africa's 10.8 million households (66.1%) had electricity.

The on-grid electrification programme is complemented by off-grid and renewable initiatives. From an off-grid perspective, the most significant programmes have been the photo-voltaic concessions in deep rural areas.

In November 1998, Shell subsidiary, Shell Solar South Africa, and Eskom launched a multi-million dollar project to supply solar energy to 50,000 low cost housing units. The firms would provide the infrastructure, while the recipient communities will establish various ventures for supply and maintenance. The project is establishing 4-5 regional centers to manage collection and sales of appliances. To make the systems affordable for residents, the project is charging households a flat fee per month rather than billing customers for the cost and installation of the units. At the end of 2000, over 6,000 solar home systems had been installed, bringing electricity to an estimated 30,000 people.

In May 2002, the German government signed a financing agreement with the SAG for a non-grid electrification project. The project, which will take place in the North West and Eastern Cape provinces, will electrify approximately 30,000 households.

French-based Electricite de France (EDF) and Total signed an agreement to supply solar energy to 15,000 rural homes in Kwazulu-Natal. Each participating household will be supplied with a solar panel and a battery capable of powering lighting, television and radio.

D.8.7 Electricity Tariffs

There are about 2,000 different tariff structures in use across the distribution sector in South Africa. The EDI Holdings model has revealed that the average selling price is 0.30c/kWh, and the purchase price is about 0.15c/kWh. However, there are wide variations between distributors which could range for households from between 0.45c/kWh to R1.00/kWh.

ESKOM publishes a 43 page Tariffs & Charges Book every year. This is presented in simplified format below:

Table 44 ESKOM Tariffs (effective 1 April 2006, incl. VAT)

Customer	Unit	Value R	Value US$ (nominal)
Urban			
	R/day	3.76 – 562.15	0.61-90.88
Nightsave (≥25kVA) **	R/kVA	19.31-49.22	3.12-7.96
	c/kWh	11.82-15.33	1.91-2.48
	R/day	105.61-564.31	17.07-91.23
Megaflex (≥1MVA) ** ***	R/kVA	14.37	2.32
	c/kWh	9.16-61.26	3.10-9.90
	c/kVarh	3.00	0.48
	R/day	5.30-561.64	0.86-90.80
Miniflex (≥25kVA & ≤5MVA)**	R/kVA	6.74	1.09
	c/kWh	8.92-62.46	1.44-10.10
	c/kVarh	1.31	0.21
Businessrate 1 (≤25kVA)	R/day	7.58	1.23
	c/kWh	26.97	4.80
Businessrate 2 (>25kVA & ≤50kVA)	R/day	9.21	1.49
	c/kWh	26.97	4.36
Businessrate 3 (>50kVA & ≤100kVA)	R/day	14.34	2.32
	c/kWh	26.97	4.36

Customer	Unit	Value R	Value US$ (nominal)
Businessrate 4 (≤25kVA)	c/kWh	26.97	4.36
Residential			
Homepower bulk*	R/day	4.38	0.71
	c/kWh	26.71	4.32
Homepower 1 (25kVA)	R/day	3.67	0.59
	c/kWh	31.70	5.12
Homepower 2 (50kVA)	R/day	6.25	1.01
	c/kWh	31.70	5.12
Homepower 3 (>50kVA & ≤100kVA)	R/day	11.12	1.80
	c/kWh	31.70	5.12
Homepower 4 (16kVA)	R/day	2.59	0.42
	c/kWh	31.70	5.12
Homelight 1 (60A, 20A or 10A)	c/kWh	48.74-54.82	7.88-8.86
Homelight 2 (60A or 20A)	c/kWh	42.33-48.42	6.84-7.83
Hometake (20A or 60A)	c/kWh	42.33-45.37	6.84-7.33
Rural			
Nightsave rural (≥25kVA)**	R/day	9.47-561.56	1.53-90.78
	R/kVA	42.73-63.34	6.91-10.24
	c/kWh	9.50-13.79	1.54-2.23
Ruraflex (≥25kVA)**	R/day	9.60-564.12	1.55-91.20
	R/kVA	3.92	0.63
	c/kWh	11.57-98.40	1.87-15.91
	c/kVarh	1.98	0.32
Landrate 1 (16kVA/32kVA/25kVA)	R/day	12.41	2.01
	c/kWh	28.59	4.62
Landrate 2 (64kVA/50kVA)	R/day	15.83	2.56
	c/kWh	28.59	4.62
Landrate 3 (100kVA)	R/day	21.70	3.51
	c/kWh	28.59	4.62
Landrate 4 (16kVA)	R/day	11.12	1.80
	c/kWh	57.15	9.24
Landrate Dx (10A)	R/day	12.07	1.95

Notes: ** Supply voltage surcharge applies*
*** Supply voltage surcharge and transmission surcharges apply*
**** Seasonality applies*

Source: www.eskom.co.za

D.8.8 Utility Performance

Financial and technical situation of key utilities in the electricity sector

Table 45 ESKOM Utility Performance (US$ 2006)

Item	Unit	Value
Production:		
Electricity produced & acquired	GWh	232,295
Electricity billed	GWh	208,316
Peak demand	MW	33,461
Technical Efficiencies:		
Plant availability	%	87.4%
Thermal Heat Rate	%	NA
Trans/Dist. Losses	%	10.3%
Interruption Index	%	NA
Commercial Efficiencies :		
Distribution Non-Technical Loss	%	NA
Distribution Collection Rate	%	NA
Operational Efficiencies:		
Staff	No	29,697
Customers	No	3,758,931
Generation capacity – installed	MW	42,011
Customer /Staff	No/No	127
Staff/Capacity	No/MW	0.71
Financial Performance:		
Turnover	US$ mill	5,917.7
Profit	US$ mill	749.3
Asset Base	US$ mill	NA
ROA	%	9.2%
Equity vs Debt	%:%	3:1
Debt Coverage Ratio	%	2.5

D.8.9 Challenges

Table 46 Challenges in South African Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	Regulator building capacity to monitor compliance Black Economic Empowerment policy to be aligned with electricity sector capacity expansion requirements Continued implementation of the REDs countrywide as policy framework unfolds Renewable energy tariff policy still in development Market for IPPs has not been attractive until very recently, given Eskom's historically low production costs Mature regulator in place
Electricity Supply	Energy security – reserve margin <15% and regular power shortages High economic growth rate and technical challenges with generation park have led to unanticipated capacity constraints Distribution infrastructure is ageing and requires recapitalization Electricity connection and maintenance backlog eradication target of 2012 very tight, given limited municipal capacity to disburse funding for electricity infrastructure Severe skills shortages and HR capacity constraints in municipalities Theft of cables and materials reduces industry efficiency and reliability
Utility	Non-technical losses high in municipalities as a consequence of historical factors Reliance on coal-fired generation may reduce affordability of future generation as full cost accounting is considered Challenges to managing existing nuclear generation capacity and considering future "large scale" (Koeberg-style) and "small scale" (PBMR style) capacity additions. Need for technical and project management skills REDs process has been tied up for some years – to the detriment of small municipal distributors Although tariffs differ widely over the distributors, these are mostly at cost-recovering levels (many distributors in fact generate a surplus from electricity which cross-subsidises non-electricity services)
Market	Domestic access to electricity about 66%, but growing on the back of the electrification programme Non-acceptance of non-grid electrification technologies remains an issue

D.9 Swaziland

D.9.1 Energy Sector Policy

There is no formal energy 'policy' in Swaziland, rather, energy and electricity policy issues were addressed in successive five-year national development plans. From 1988, the government has published a National Development Strategy in which it sets planning priorities. The latest version (Vision 2022 – Key Macro and Sectoral Strategies) was published in August 1999.

The NDS/Vision 2022 identifies key macro-economic strategy areas, including industrialization and environmental management. For infrastructure, it promotes integrated and decentralised provision. Under infrastructure, 'Fuel and Energy' is a category in its own right. Here, the NDS/Vision 2022 lists the following issues:

- Research and Development
    - Expedite research and development for better understanding of energy systems and technology development
    - Identify future options for the development of the Swaziland Electricity Supply Industry in general
    - Investigate clean coal technologies for using local coal instead of imported coal
    - Consolidate data on energy and fuel resources
    - Assess the development and dissemination of appropriate renewable energy technologies
    - Identify suitable petroleum substitutes.
- Efficiency
    - Ensure improved energy efficiency
    - Establish cost-reflective pricing policies for all types of consumers which make energy affordable yet encourage conservation and efficient use of resources
    - Investigate the possibility of competition within the electricity supply industry
    - Assure full participation in the development of the Southern African Power Pool so as to ensure access to the new regional market opportunities
    - Establish storage facilities for fuel resources
    - Ensure full participation of all sectors concerned in renewable energy projects and issues
    - Increase education campaigns to address fuel-related accidents.
- Accessibility
    - Ensure improved access to a range of energy services for the whole population in urban, peri-urban and rural areas
    - Make electricity available and affordable in rural areas so as to improve social economic development and welfare
    - Ensure sustainable fuelwood management.

D.9.2 Energy Supply & Demand

The IEA does not report the Swaziland energy balance. The simplified balance, reconstructed from EIA data, is as follows:

Table 47 Swaziland Energy Balance (2004, thousand TOEs)

Source	Coal	Petrol. Products	Hydro	Total
TPES	234	179	50	463

Source: Energy Information Administration

D.9.3 Electricity Legal and Regulatory Framework

Three Bills have recently been approved by the Swazi Parliament. They are:

- Swaziland Regulatory Authority Bill 2005
- Swaziland Electricity Company Bill of 2005
- Swaziland Electricity Bill of 2005

These bills are planned to enable the establishment of IPPs and competition in the country's ESI.

D.9.3.1 Administrative and Regulatory Institutions

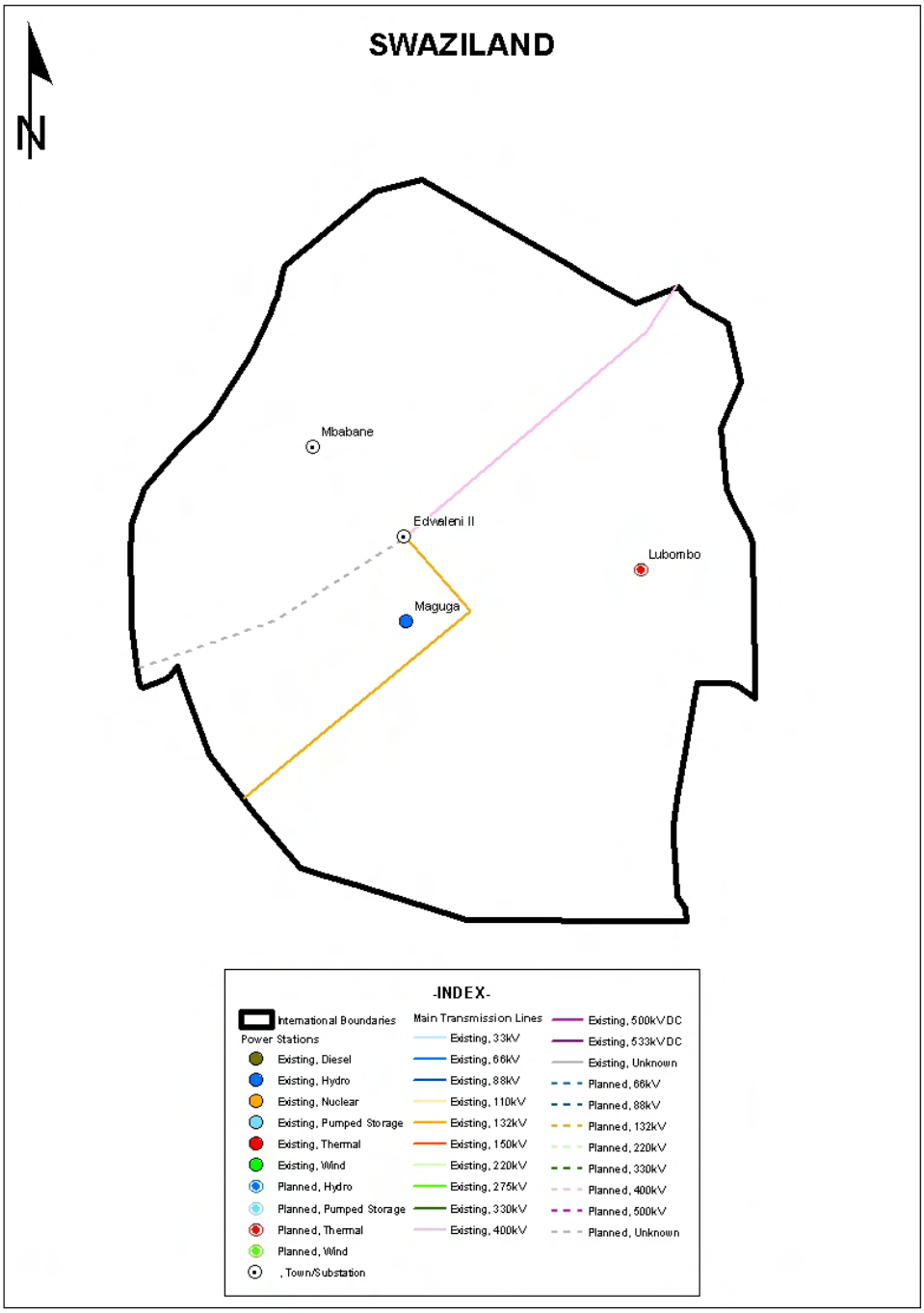
The Ministry of Natural Resources and Energy is the national energy authority. The objectives of the Energy Section of the Ministry are to:

- Administer and improve legislation that regulates the energy sector
- Analyse energy policy and develop long-term integrated energy policies (technical issues, energy statistics, energy economic analysis, scenario development, modeling of energy demand, supply and socio-economic and environmental interaction
- Supervise technical studies, investigations, research and projects
- Provide technical supervision, monitoring and regulation of the activities of the oil companies and the electricity supply industry
- Increase access to affordable energy in the rural areas
- Provide energy security through energy trade and diversity of supply sources

D.9.3.2 Electricity Utilities

The Swaziland Electricity Board (SEB) is the parastatal responsible for the generation, transmission and distribution of electricity and is the direct responsibility of the Ministry of Works, Power and Communications. The main function of the SEB is the provision of reliable and safe power supply of acceptable quality to meet the needs of customers and other stakeholders efficiently, profitably and in an environmentally sound manner.

The SEB's current business development objectives are to facilitate the development of a vibrant business development environment through which effective utilisation of SEB resources will create value for all stakeholders. This would ensure enhanced competitiveness of the industry and further stimulate sustained growth. Furthermore SEB are to:

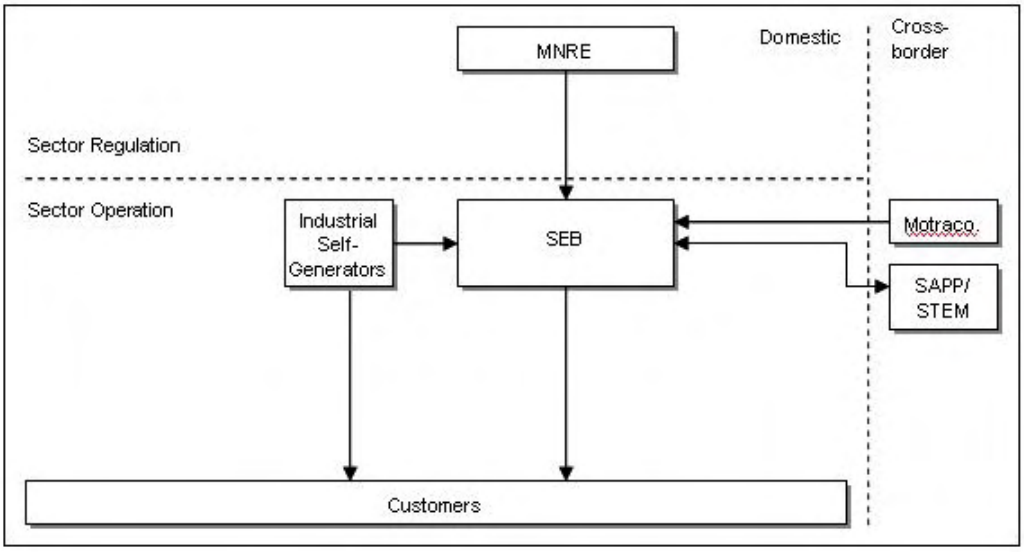

SWAZILAND
N
Mbabane
Edwaleni II
Lubombo
Maguga
-INDEX-
International Boundaries
Power Stations
Existing, Diesel
Existing, Hydro
Existing, Nuclear
Existing, Pumped Storage
Existing, Thermal
Existing, Wind
Planned, Hydro
Planned, Pumped Storage
Planned, Thermal
Planned, Wind
, Town/Substation
Main Transmission 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

- Assess alternative forms of generation plants including the attraction of Independent Power Producers (IPP) to invest in the development of such plants.
- Develop generation, transmission and distribution infrastructure in a cost effective manner and ensure timely delivery and within budget constraints.
- Develop appropriate tariffs to ensure the effective and efficient use of assets thus attracting new customers into the electricity supply market and further retain existing ones.
- Effectively deliver rural electricity supplies infrastructure as part of ongoing rural empowerment efforts by the Government of Swaziland.
- Provide and develop strategies and business plans for each of the operational division within SEB for improved organizational performance as required by the Performance Contract with the Government of Swaziland.
- Monitor the performance of the organization against the set targets in the performance contract and report to government and also provide input to none performing divisions within SEB.

D.9.3.3 Private Sector Participation

The SEB owns a majority of the country's power stations. There are also five private power stations, including three sugar mills, one pulp mill which burn biomass, and a mine which burns coal.

Figure 35: Swaziland Electricity Supply Sector

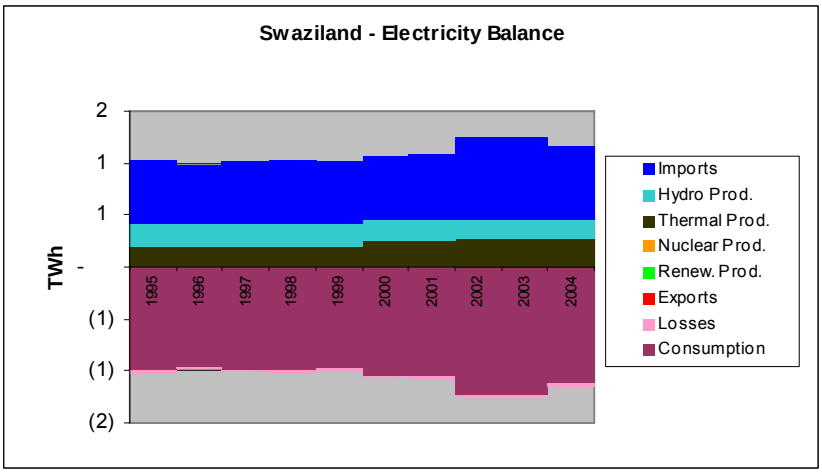


Source: SAPP

D.9.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 1.1TWh. The household electrification rate is approximately 20% and consumption per capita 989kWh/ann. About 60% of electricity supplied is imported from South Africa.

Figure 36 Swaziland Electricity Consumption & Supply



Source: Energy Information Administration

D.9.5 Electricity Infrastructure

D.9.5.1 Generation (Existing & Expansion Plan)

Swaziland has significant coal deposits (13% of the continent's resource, excluding South Africa). It furthermore has at least 100MW of technically exploitable hydro capacity, although this may not be cost-effective.

SAPP reports Swaziland's installed capacity as 51MW, with available capacity being 50MW. The EIA however reports a much larger figure (128MW installed), of which 80% is sourced from hydropower with the balance from thermal sources.

All SEB power stations are hydro-powered, and there are an additional five private power stations, including three located at sugar mills, one at a pulp mill, which burns biomass, and one located at a mine which burns coal. The third source of electricity is the interconnector link with Eskom in South Africa. In 2004, Swaziland imported about 60% of its electricity from South Africa.

Swaziland's hydro-power plants are located at Ezulwini and Maguduza. The 20MW Luphohlo-Ezulwini hydroelectric station represents the largest part of domestic installed capacity. The second hydro plant, Maguduza, was recommissioned in 2001 after a major turbine refurbishment.

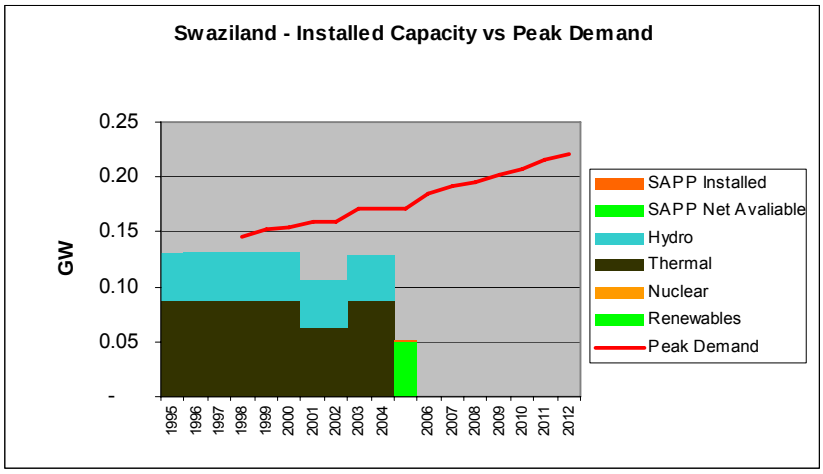
The Maguga Dam Project, which is scheduled to be completed in 2007, is a joint project between South Africa and Swaziland, incorporates the provision of a 20MW hydropower station in addition to irrigation for downstream users.

Swaziland has been involved in a joint venture project with South Africa. project with South Africa. The Swaziland Komati Project Enterprise is a Project Enterprise is a power project located in the Komati River Basin and it entails construction of two dams Basin within Swaziland and South Africa for the purposes of hydroelectric power and establishing agricultural projects.

Other major projects underway include the feasibility study on a Bagasse Power Station which will increase the production of local electricity in Swaziland, ultimately reducing the country's imports from South Africa. The construction of a thermal power station at Mpaka with an installed capacity of 1,000 MW is in the process of being planned. Once completed, the power station will enable Swaziland to be self-sufficient and sufficient excess power would be exported to the rest of the SADC region

Peak demand for power in Swaziland in 2006 was 188MW, with South Africa supplying the bulk of the shortfall in local supply. SAPP estimates that demand will rise to 221MW by 2012 (an increase of 18% over the period, or an annual average growth rate of 4.3%).

Figure 37 Swaziland Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

Apart from Maguga, there are plans to possibly build a 1,000MW coal-fired plant in Swaziland that would be used to supply into the regional network.

D.9.5.2 Transmission & Distribution

Prior to the installation of a new 400kV connector, Swaziland had a network of 1,118km of HV circuit lines and a further 3,071 km of MV transmission lines (132kV and 66kV): Swaziland is currently switching from receiving electricity from its three 132kV Eskom distribution networks, to receive power from a duplicate 400kV supply through Eskom and Motraco 400kV systems. The system will significantly improve the quality and reliability of the electricity supply.

Table 48 Swaziland Transmission and Distribution Network (2002)

Item	Unit	Value
Transmission	kV	132, 66
Distribution	kV	33, 11
LV	V	400, 230
HV Circuit	Km	1,118
MV Circuit	km	3,071
Interconnections		South Africa

Source: International Energy Agency

In its future planning, the Swaziland Electricity Board is also investigating the possibility of drawing power from the Cahora Bassa Hydroelectric plant in central Mozambique. Such a project would probably take several years and a massive capital outlay would have to be realised.

D.9.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 49 Planned/Proposed Swaziland Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Maguga	Generation	Hydro	20MW	2007	-
Lubombo	Generation	Thermal	1,000MW	2010+	Feasibility studies to be finalised
Switch to Eskom & MOTRACO systems (Edwaleni – South Africa)	Transmission		400 kV	2007	Anticipated to improve quality and reliability of supply

Source: SAPP, AfDB

D.9.6 Rural Electrification

Under Swaziland's rural electrification programme (part-financed by the Taiwanese Government), the Ministry of Natural Resources and Energy (MNRE) through the Select Committee for Rural Electrification, has developed a selection criteria and identified priority areas that will benefit from extending the national electricity grid to rural areas of Swaziland.

The first phase of the Rural Electricity Programme got underway in 2003. Once completed the project is expected to connect 70 schools, five clinics, one pre-school, one heath centre, three border control posts and will benefit around 50,000 people in the rural areas. Overall, the project consists of 22 sub-projects and includes approximately 700km of new transmission lines.

D.9.7 Electricity Tariffs

The lowest entry cost tariff in Swaziland is UScents 6.9/kWh, with a minimum charge of US$ 5.18 per month.

Table 50 SEB Tariffs (effective 2006, excl taxes)

Customer	Unit	Value E	Value US$/cents (nominal)
Domestic	/Month	8.36	1.31
	/kWh	44.08	6.90
	Minimum	33.08	5.18
General Purpose	/Month	8.36	1.31
	/kWh	58.63	9.18
	Minimum	113.95	17.85
Small Commercial	/Month	8.36	1.31
	/kWh	58.63	9.18
	Minimum	113.95	17.85
Off-peak Water Heating	/Month	8.36	1.31
	/kWh	31.29	4.90
	Minimum	57.42	8.99
Large Commercial & Industrial	/Month	8.36	1.31
	/kWh	22.64	3.55
	/kVA	72.06	11.29

Customer	Unit	Value E	Value US$/cents (nominal)
	Minimum	Per tariff schedule	
Irrigation	/Month	8.36	1.31
	/kWh	22.64	3.55
	/kVA	72.06	11.29
	Minimum	Per tariff schedule	

D.9.8 Utility Performance

The performance of SEB in the last financial year may be summarized as follows:

Table 51 SEB Utility Performance (US$ 2006)

Item	Unit	Value
Production:		
Electricity produced & acquired		1,020
Electricity billed		856
Peak demand		172
Technical Efficiencies:		
Plant availability rate	%	NA
Thermal Heat Rate	%	NA
Trans/Dist. Losses	%	16.1%
Interruption Index	%	NA
Commercial Efficiencies:		
Distribution Non-Technical Loss	%	NA
Distribution Collection Rate	%	NA
Operational Efficiencies:		
Staff	No	659
Customers	No	58,716
Generation capacity – installed	MW	51
Customer /Staff	No/No	89
Staff/Capacity	No/MW	13
Financial Performance:		
Turnover	US$ mill	63.4
Profit	US$ mill	7.6
Asset Base	US$ mill	95.7
ROA	%	8.0%
Equity vs Debt	%:%	3:1
Debt Coverage Ratio	%	35

D.9.9 Challenges

Table 52 Challenges in Swaziland's Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	PSP/IPPs allowed in principle, but not yet implemented in practice No plans to unbundle SEB
Electricity Supply	Country remains dependent on imported energy Own generation is largely hydro (excluding private diesel generation) Key self-sufficiency projects must be emphasized (e.g. Mpaka) HR and skills shortages as are found in most small country utilities
Utility	SEB commercialised through 2005 Bills Losses remain high Tariff is low, but may be cost-reflective. SEB is profitable, although some efficiency challenges remain
Market	Domestic access to electricity about 20%

D.10 Zambia

D.10.1 Energy Sector Policy

In 1994 the government promulgated the National Energy Policy (NEP). The policy measures contained within the NEP revolved around:

- the restructuring of the electricity industry
- improving accessibility to electricity
- the electrification of productive areas
- developing hydro power generating potential.

The National Energy Policy states that The Energy Policy is aimed at promoting optimum supply and utilisation of energy, especially indigenous forms, to facilitate socio-economic development of the country and maintenance of a safe and healthy environment.

D.10.2 Energy Supply & Demand

Zambia's total energy supply was 6.9 million tons of oil equivalent in 2004. Of this, 80% was in the form of biomass and other similar products, whilst hydropower accounted for 10% and crude oil 8%. Coal and petroleum products each accounted for 1% of the total.

Households make up more than two thirds of energy consumption, most of which is raw combustibles, renewables and waste. Industry consumes 24% of energy and transport 6%.

Table 53 Zambia Energy Balance (2004, thousand TOEs)

Source	Coal	Crude Oil	Petrol. Products	Hydro	C, R & W	Electricity	Total
Production	137	-	-	728	5,495	-	6,360
Imports	-	555	119	-	-	-	674
Exports	-6	-	-8	-	-	-20	-35
Stock/Bunkers	-41	-	-15	-	-	-	-55
TPES	90	555	96	728	5,495	-20	6,943
Transform/Loss	-7	-555	494	-728	1,312	683	-1,425
TFC	83	-	589	-	4,183	663	5,518
Industry	76	-	158	-	628	457	1,319
Transport	-	-	342	-	-	1	342
Resid./Other	7	-	58	-	3,554	206	3,826

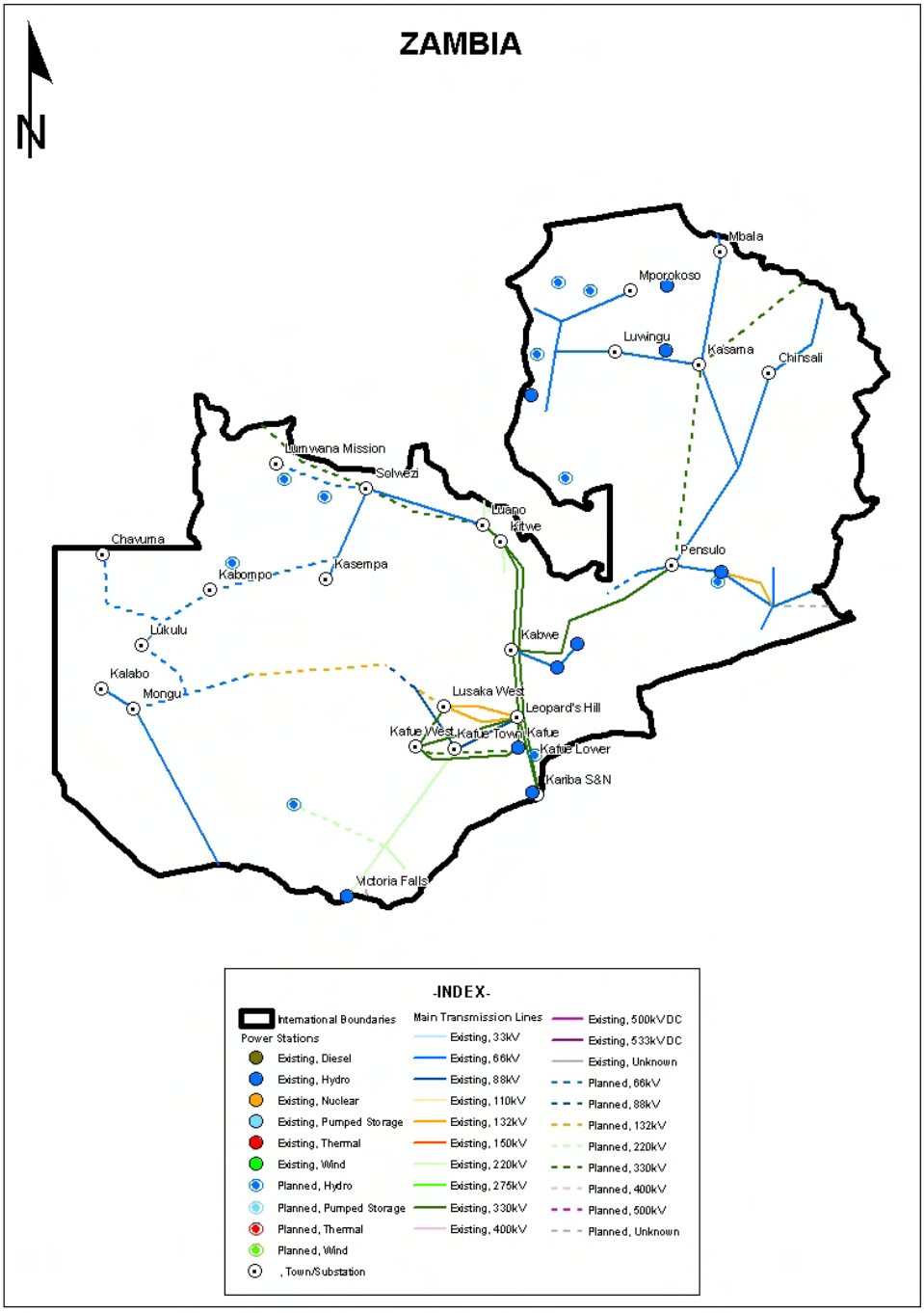
Source: *International Energy Agency*
Notes: *TPES = Total Primary Energy Supply; TFC = Total Final Consumption*

D.10.3 Electricity Legal and Regulatory Framework

D.10.3.1 Administrative and Regulatory Institutions

The Electricity Act of 1995 (as amended in 2003) governs the sector. The Ministry of Energy and Water Development is responsible for the overall co-ordination of the sector. The Energy Regulation Act of 1995 created the Energy Regulatory Board (ERB) is the independent organisation that is responsible for issuing of licences in the sector as well as setting of the tariff structures in Zambia.

The effect of these acts was to abolish the statutary monopoly of ZESCO, allow establishment of other electricity utilities, and also to establish an independent regulator of the energy sector, the ERB.


ZAMBIA
N
Mbala
Mporokoso
Luwingu
Kasama
Chinsali
Mumwana Mission
Solwezi
Luano
Kitwe
Chavuma
Kabompo
Kasempa
Pensulo
Lukulu
Kalabo
Mongu
Kabwe
Lusaka West
Leopard's Hill
Katue West
Katue Town
Katue
Katue Lower
Kariba S&N
Victoria Falls
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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

In 1998 the FPI was launched, and this saw the splitting of the market into the four major utilities. These are:

- ZESCO – vertical integrated national utility
- CEC – private supplier to the mines
- KNBC – State-owned generation company
- M&L – formerly owned by the state-owned mining conglomerate ZCCM. M&L has since been sold to private investors.

D.10.3.2 Electricity Utilities

ZESCO Ltd is Zambia's largest power utility. It originated in 1906 when a small thermal station was built in Livingstone to serve a section of the town. In spite of the Victoria Falls potential, it was not until 1938 that hydro-electric power was first generated at a small station in the third gorge below the falls.

ZESCO is a vertically integrated electricity utility formed in 1970. 60% of ZESCO's peak demand is attributable to the mining operations on the Zambian Copperbelt. Through interconnections to SNEL in the Democratic Republic of Congo and ZESA in Zimbabwe, ZESCO plays a key role in the Southern African Power Pool (SAPP) by exporting and wheeling power to the Southern African region.

ZESCO is a parastatal company under the Companies Act. Its governance has evolved over time to one that defines an arms-length relationship with Government.

Until recently, Kariba North Bank Power Company (KNBC) was under the Management control of ZESCO on behalf of the government. Operationally, however, it is still under the control of ZESCO and its output is considered part of the national production.

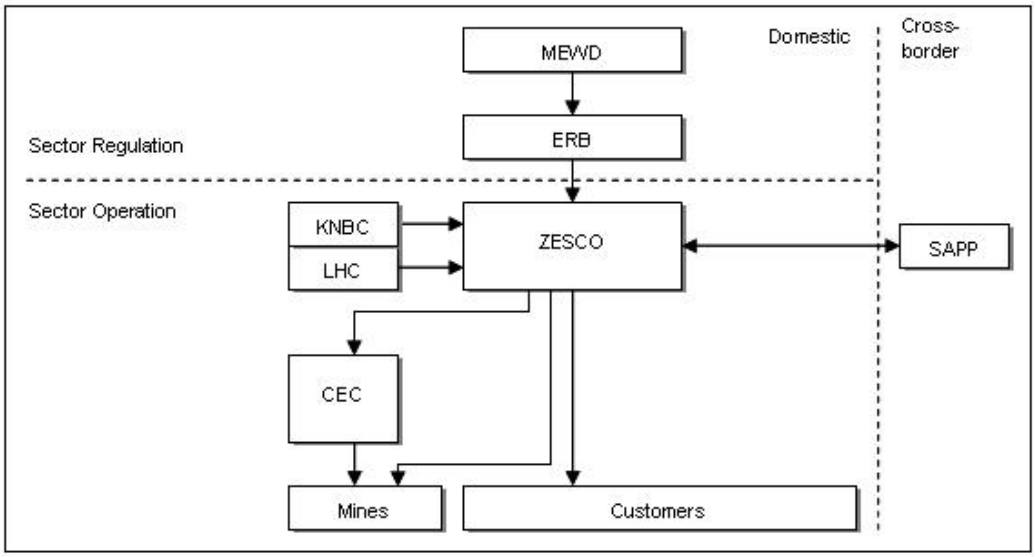
D.10.3.3 Private Sector Participation

The Copperbelt Energy Corporation PLC (CEC) is a privately owned company that transmits and distributes electrical energy to Zambia's critical mining industry based on the Copperbelt Province. CEC's transmission and distribution network consists of 808 kilometres of overhead lines and 36 high voltage substations. The current carrying capacity of the network is in excess 700MW. CEC also serves the region by operating an interconnector with the Democratic Republic of Congo (DRC), through which power is wheeled to Zambia, Zimbabwe and South Africa. CEC buys most of its power on long term contracts from the state utility, ZESCO. CEC's power system handles close to seventy percent of Zambia's total electricity demand. CEC further operates 80MW of emergency gas turbine plants in selected substations of our network.

Lunsemfwa Hydro Power Company (LHPC) owns a hydro power generation facility.

Government issued a Framework and Package of Incentives for Private Sector Participation in Hydropower Generation and Transmission Development in 1998.

Figure 38: Zambia Electricity Supply Sector

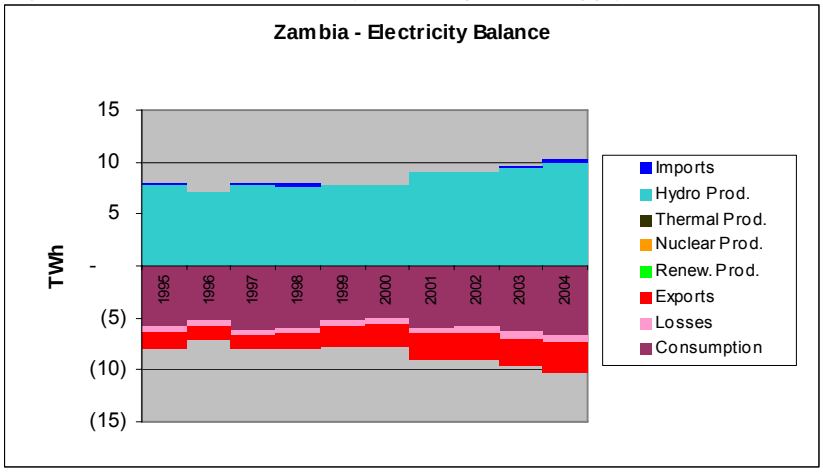


Source: *SAPP*

D.10.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 6.7TWh. The household electrification rate is approximately 12% and consumption per capita 620kWh/ann. Zambia produces all its own electricity, nearly all from hydropower, and exports some 30% of electricity production.

Figure 39 *Zambia Electricity Consumption & Supply*



Source: *Energy Information Administration*

D.10.5 Electricity Infrastructure

D.10.5.1 Generation (Existing & Expansion Plan)

Zambian energy resources are largely hydropower (1,300MW economically-exploitable and a further 2,100MW technically exploitable), although there are some coal reserves (1% of the continent's resources, excluding South Africa).

Current installed power capacity in Zambia stands at 1,632MW, of which 1,630MW is available capacity. Of this 99% is produced by hydropower sources and the balance from thermal power.

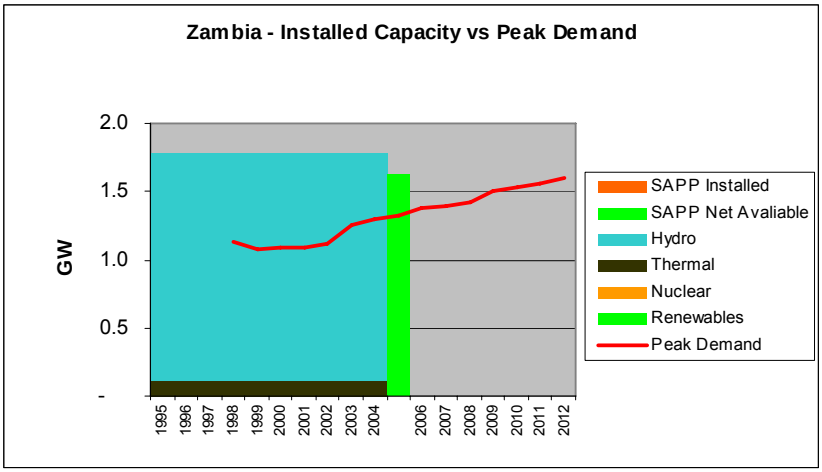
There are three main operating power stations, which are operational and contribute to the electrical power needs of the country. The Kafue Gorge power station and the Kariba North Bank power stations produce 900MW and 600MW respectively, while the Victoria Falls power station gives out 108MW.

The rest, about 32 MW, is from isolated hydropower stations and diesel power stations dotted around the country. Many of the diesel stations have surpassed their normal service life and are very expensive to run, resulting in the government pressing for alternative sources of power to be developed in the country.

There are four small hydro stations with a combined capacity of 23.75MW. These are Lusiwasi (12MW), Musonda Falls (5MW), Chishimba Falls (6MW) and Lunzua (750kW). Generally, the small hydro power stations do not have sufficient water storage capacity to operate through the dry season. CEC owns and operates (80MW) of stand-by diesel based gas turbine generators. Lunsemfwa Hydro Power contributes (38MW) with two medium hydro and KCM operates (20MW) from one waste steam site.

Peak demand in 2006 was 1,370MW. SAPP projects this to increase to 1,606MW by 2012. This represents an overall increase of 17% for this period, or 3.7% on an annual average basis.

Figure 40 Zambia Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

There are numerous plans to increase Zambia's capacity, largely through additional hydropower sources.

D.10.5.2 Transmission & Distribution

The transmission system has a total of 4,638 km of transmission lines spread as follows: 2,008 km of 330kV lines, 348 km of 220kv, 85 km of 132kV, 704 km of 88kV, and 2,823 km of 66kV lines (of which 2,180 km are under ZESCO's Distribution and Supply Directorate). The total transformer installed capacity is about 3,000MVA. It serves as a national grid to transport power from the generating stations and other systems to the Distribution Bulk supply points throughout the country and also to the Copperbelt Energy Corporation and Export points.

Zambia plays a strategic position in the Southern African Power network. Presently, Zambia is a net exporter of electricity and conducts its trade with Democratic Republic of Congo, Namibia and South Africa

A major transmission intervention will be the building of the Zambia-Tanzania interconnector, linking SAPP and EAPP and providing a channel for the export of power from Inga. This project is discussed under the 'Interconnector Projects' section of this report.

D.10.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 54 Planned/Proposed Zambia Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Refurbishment	Generation	Hydro	210MW	2006	-
Itezhi-Tezhi	Generation	Hydro	120MW	2007	Business model to be decided Detailed design required Funding to be arranged ZESCO-NamPower PPA to be finalised
Kafue Lower	Generation	Hydro	600MW	2009	Business model to be decided Detailed design required Funding to be arranged PPA to be finalized
Kariba North	Generation	Hydro	360MW	2009	-
Expand Kariba North	Generation	Hydro	200MW	2020	Detailed design required Funding to be arranged
Kalungwishi	Generation	Hydro	220MW	2014/15	-
Zambia – Tanzania Interconnector	Transmission		330 kV		
Various internal transmission lines	Transmission				Depending on new generation

Source: SAPP

D.10.6 Rural Electrification

The Rural Electrification Authority was created through the Rural Electrification Act of 2003, to promote and facilitate access to electricity by the rural population of Zambia. The Authority is structured into a Planning & Projects unit, Administration & Finance unit and Public Relation unit.

The REA applies the Guidelines on the Selection of RE Projects for Funding by Government (issued by the RE Fund Committee in 1995).

JICA is currently supporting the development of a 20 year rural electrification master plan under the auspices of the Ministry of Energy and Water Development (MEWD) and the Rural Electrification Authority (REA). The master plan will include:

- o long-term (20 year) rural electrification plan (including extension of distribution lines, mini-grids and household connections)
- o Financial plan based on the long-term rural electrification plan
- o Recommendations towards electrification policy
- o Action plan for rural electrification
- o Capacity development of Zambian authorities through the joint implementation of the study.

The project involves:

- o Collection of baseline data
- o Selection of candidate sites for electrification through workshops in harmonization with decentralization trend in Zambia
- o Present best options for rural electrification (GIS mapping, demand forecast, cost analysis, etc.)
- o Policy analysis and recommendations (implementation modality, business model, action plans, socio-environmental consideration etc)
- o Finalising the master plan.

D.10.7 Electricity Tariffs

The lowest tariff payable in the ZESCO scheme is for an unmetered service connection, where the payment will amount to US$1.06/month if the circuit breaker is 2A or smaller.

Table 55 ZESCO Tariffs (effective 1 April 2005, excl taxes)

Customer	Unit	Value K	Value US$ (nominal)
Un-metered Residential			
Consumption ≤2A	/Month	4,911.00	$1.06
Consumption >2A and ≤15A	/Month	17,770.00	$3.83
Metered Residential (15kVA)	Fixed	5,845.00	$1.26
Consumption ≤300kWh	/kWh	70.00	1.51c
Consumption >300kWh and ≤700kWh	/kWh	100.00	2.15c
Consumption >700kWh	/kWh	163.00	3.51c
Commercial (15kVA)	Fixed	29,227.00	$6.30
Consumption	/kWh	163.00	3.51c
Social Services	Fixed	23,382.00	$5.04
Consumption	/kWh	135.00	2.91c
Maximum Demand			
MD1 - Capacity >25kVA and ≤300kVA	/kVA	6,943.00	$1.50
Consumption	/kWh	100.00	2.15c
Fixed	Fixed	68,002.00	$14.65
MD2 - Capacity >300kVA and ≤2000kVA	/kVA	12,990.00	$2.80
Consumption	/kWh	85.00	1.83c
Fixed	Fixed	136,003.00	$29.30
MD3 - Capacity >2000kVA and ≤7500kVA	/kVA	19,587.00	$4.22
Consumption	/kWh	63.00	1.36c
Fixed	Fixed	272,006.00	$58.60
MD4 - Capacity >7500kVA	/kVA	19,696.00	$4.24
Consumption	/kWh	52.00	1.12c

Customer	Unit	Value K	Value US$ (nominal)
Fixed	Fixed	544,012.00	$117.19

Source: www.zesco.co.zm

D.10.8 Utility Performance

Financial and technical situation of key utilities in the electricity sector

Table 56 ZESCO Utility Performance

Item	Unit	Value
Production:		
Electricity produced & acquired	GWh	8,855
Electricity billed	GWh	7,737
Peak demand	MW	1,330
Technical Efficiencies:		
Plant availability	%	NA
Thermal Heat Rate	%	NA
Trans/Dist. Losses	%	12.6%
Interruption Index	%	NA
Commercial Efficiencies :		
Distribution Non-Technical Loss	%	NA
Distribution Collection Rate	%	89%
Operational Efficiencies:		
Staff	No	3,814
Customers	No	297,235
Generation capacity – installed	MW	1,630
Customer /Staff	No/No	78
Staff/Capacity	No/MW	2.3
Financial Performance:		
Turnover	US$ mill	220.5
Profit	US$ mill	12.1
Asset Base	US$ mill	836.2
ROA	%	1.5%
Equity vs Debt	%:%	3:1
Debt Coverage Ratio	%	12

D.10.9 Challenges

Table 57 Challenges in Zambia's Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	Competition allowed in electricity sector, ZESCO unbundled and independent regulator established. There is a history of multiple role players in the electricity sector A major challenge is bringing in private sector investors into the planned generation projects
Electricity Supply	Electricity demand projected to outstrip supply soon Industry Zambia must capitalise on historical generation and transmission (interconnector) expansion studies to realise their potential Zambia is hydro-dependent. Still, two thirds of hydropower remains untapped. Some major hydro projects have been on the books for a long time but have not progressed From a regional perspective, the strengthening of the transmission wheeling network through Zambia remains a priority, as well as the interconnection with Tanzania
Utility	ZESCO tariffs appear low but a profit is made Losses are lower than most other countries in this study
Market	Domestic access to electricity about 12%

D.11 Zimbabwe

D.11.1 Energy Sector Policy

The objectives of the Energy Policy are:

- to ensure accelerated economic development
- to facilitate rural development
- to promote small-medium scale enterprises
- to ensure environmentally friendly energy development, and
- to ensure efficient utilisation of energy resources

Some of the salient points contained in the draft White Paper, entitled "Electricity Reform in Zimbabwe" are already being implemented. These include:

- Unbundling: the restructuring and unbundling of ZESA into separate generation, transmission, distribution and supply units. This process will allow new and independent players to enter into the industry.
- Rural Electrification: establishment of the Rural Electrification Fund and an independent Board. Its aim will be to accelerate the pace of electrification in Zimbabwe.

D.11.2 Energy Supply & Demand

Zimbabwe's total energy supply in 2004 stood at 9.3 million tons of oil equivalent. Of this, 64% was produced from biomass and related products, whilst 22% of demand was met through coal. Petroleum products accounted for 7% of the total and hydropower a further 5%.

Consumption is dominated by households (84%), largely made up of combustibles, renewables and waste. Industry contributes 11% to energy demand.

Table 58 Zimbabwe Energy Balance (2004, thousand TOEs)

Source	Coal	Petrol. Products	Hydro	C, R & W	Electricity	Total
Production	2,191	-	475	5,934	-	8,600
Imports	25	648	-	-	175	849
Exports	-137	-	-	-	-	-137
Stock/Bunkers	-11	-	-	-	-	-11
TPES	2,068	648	475	5,934	175	9.301
Transform/Loss	-1,551	-13	-475	-	694	-1,345
TFC	517	635	-	5,934	870	7,956
Industry	300	61	-	110	391	861
Transport	5	404	-	-	-	410
Resid./Other	212	152	-	5,824	480	6,668

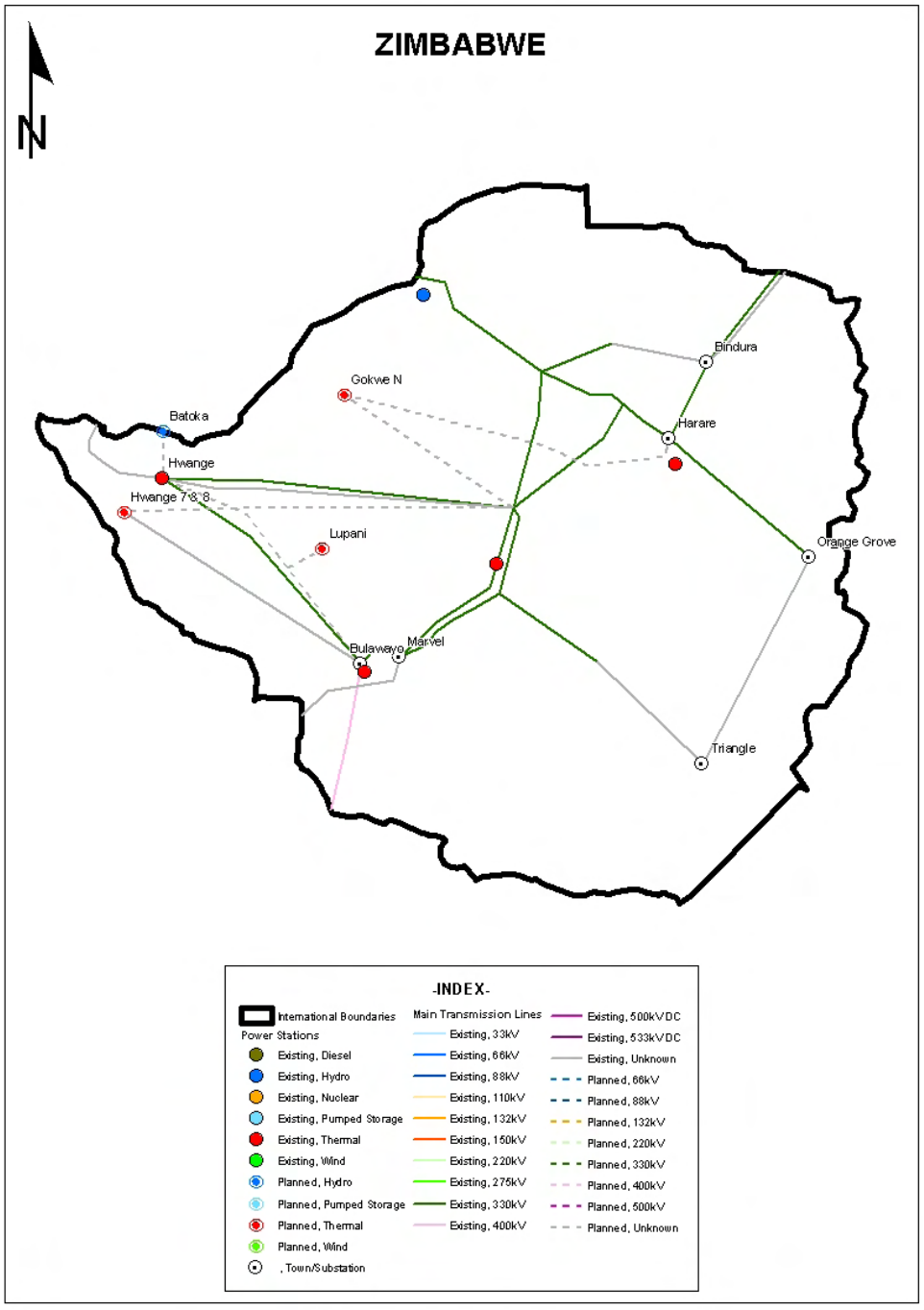
Source: International Energy Agency
Notes: TPES = Total Primary Energy Supply; TFC = Total Final Consumption

D.11.3 Electricity Legal and Regulatory Framework

D.11.3.1 Administrative and Regulatory Institutions

The Ministry of Energy and Power Development oversees the sector, by means of the Electricity Act of 2002 (as amended).

The Act establishes the Eelectricity Regulatory Commission (ZERC). The Act confers upon ZERC the Authority to fully and independently regulate the new industry and no entity can generate, transmit or distribute or import electricity even


ZIMBABWE
N
Bindura
Gokwe N
Batoka
Harare
Hwange
Hwange 7 & 8
Lupani
Orange Grove
Bulawayo
Marvel
Triangle
-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

for its own consumption, without ZERC's permission. The permission is granted in the form of a licence that stipulates strict rules of operation that have to be complied with by the licencee. The Commission is the only legal authority that can approve a tariff increase.

In 1991, the Government of Zimbabwe adopted a public enterprise reform strategy as part of a World Bank driven Economic Structural Adjustment Programme (ESAP). For the electricity sector, the Government adopted a two-pronged programme of reform – a performance improvement programme (PIP) for the national utility, the Zimbabwe Electricity Supply Authority (ZESA), and a legal and regulatory reform programme for the electricity sector in general. Ten years later, significant success has been achieved in improving the utility's performance in technical operations and customer service.

However, there has been very little progress on the legal and regulatory front. This has adversely affected the utility's financial performance, as well as frustrating the Government's efforts in attracting private sector investment. The centrality of the tariff question reflects the importance of the customer or end-user to the power

One of the aims of the White Paper on Electricity Reform in Zimbabwe is the establishment of Wholesale Electricity Market (WEM). The electricity from the power producers will flow via the transmission and distribution infrastructure owned by the transmission and distribution companies respectively. It is hoped that some large customers will be supplied directly from the transmission grid and can therefore be participants in the WEM as buyers and sellers. Customers will normally use a supply company to secure their power needs.

D.11.3.2 Electricity Utilities

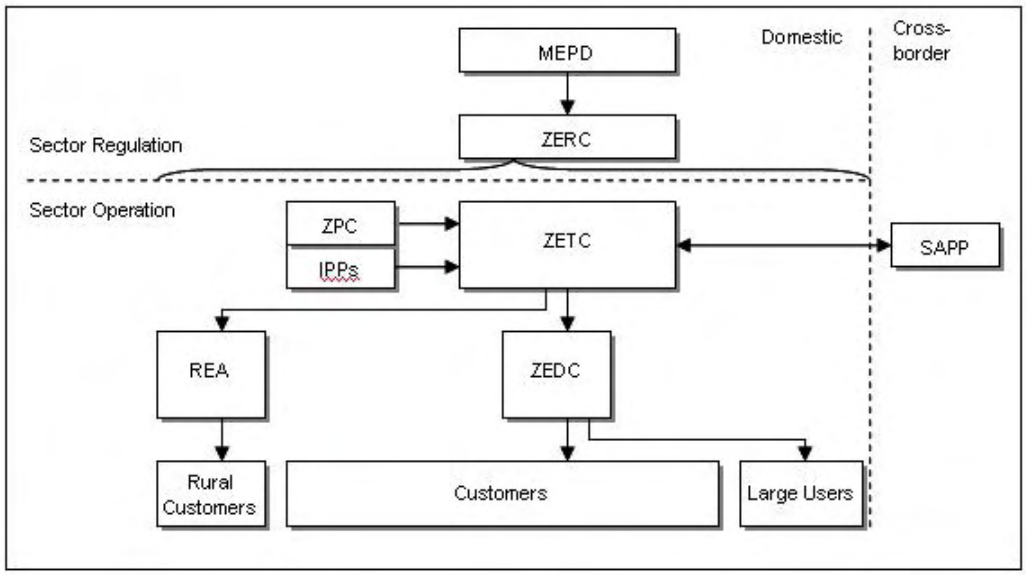
The Act unbundled ZESA and completely changed its structure from a vertically integrated entity where as one company it had been responsible for the generation, transmission and distribution of electricity and instead created three successor companies namely:

- Zimbabwe Power Company (ZPC)
- Zimbabwe Electricity Transmission Company (ZETC)
- Zimbabwe Distribution Company (ZEDC).

These are the regulated entities.

ZESA Holdings was created through an amendment to the Act, the Electricity Amendment Act No. 3 of 2003 and its function and role is to hold shares on behalf of the government in the successor companies. The Act also allows for the setting up of companies to take over the non-regulated business of ZESA. These are ZESA Enterprises (comprising of Transport, Projects, Technology Centre and Production Services) and Powertel. The Commission does not regulate ZESA Holdings, ZESA Enterprises and Powertel because they are not involved in generation, transmission and distribution of electricity except in so far as they affect the efficient operations of the regulated companies.

Figure 41: Zimbabwe Electricity Supply Sector

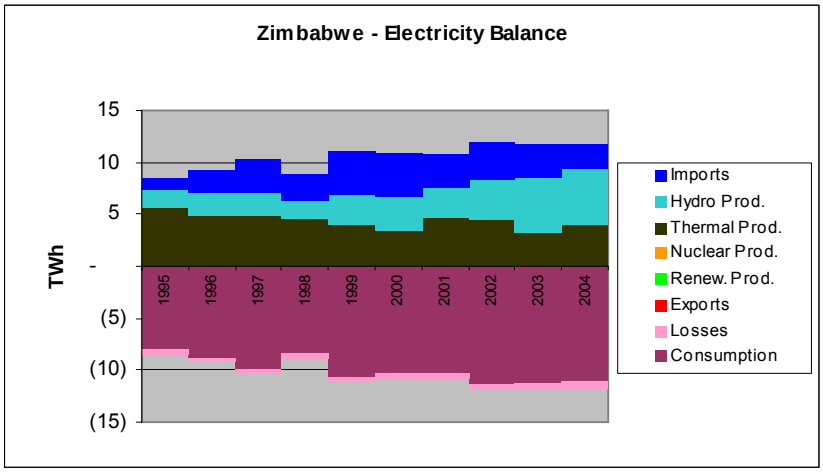


Source: SAPP

D.11.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 11TWh. The household electrification rate is approximately 40% and consumption per capita 917kWh/ann. Electricity consumed is sourced one third from thermal production, nearly half hydro and just less than 20%from imports.

Figure 42 Zimbabwe Electricity Consumption & Supply



Source: Energy Information Administration

D.11.5 Electricity Infrastructure

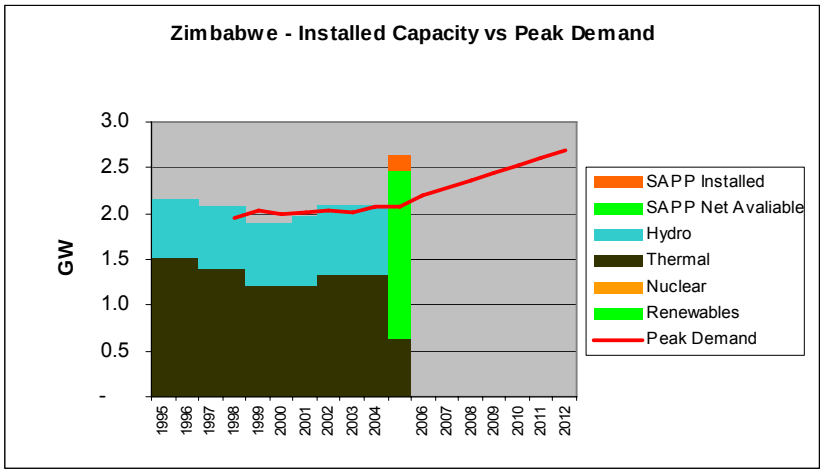
D.11.5.1 Generation (Existing & Expansion Plan)

Zimbabwe has significant coal reserves – a third of the non-South Africa resources in Africa. It furthermore has 2,100MW of technically exploitable hydro capacity.

Zimbabwe's installed capacity is 1,990MW of power, of which 1,825MW is available capacity. Of this, 64% is thermal and 36% hydropower. Zimbabwe has four thermal stations in Harare, Bulawayo, Hwange and Munyati, with Lake Kariba (hydro) normally providing about 20% of the country's needs. The country currently imports electricity from South Africa, DRC and Mozambique.

Peak demand in 2006 stood at 2,208MW, and is projected to increase to 2,688MW in 2012. This represents an increase in demand of 22% over the period, or an annual average increase of 4.5%.

Figure 43 Zimbabwe Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

There are plans to increase the electricity production capacity, although the current economic situation militates against large investment.

D.11.5.2 Transmission & Distribution

The 220kV interconnection with Botswana is used more as an emergency support line for that country, since Botswana is also dependent on power imports to satisfy demand. Between 150MW and 500MW can be supplied from South Africa, depending on the loading on the Cahora Bassa line. Zambia, which is interconnected at 330kV at Kariba, also serves as the interconnection for the Democratic Republic of Congo (DRC), which has a 220kV, 250MW interconnection into the Zambian grid.

While the interconnection with Zambia can carry up to 700MW, supply is currently limited to an average of 100MW to 200MW due to generation constraints in Zambia.

D.11.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 59 Planned/Proposed Zimbabwe Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Kariba South	Generation	Hydro	300MW	2007	Review of conjunctive operations on Zambezi Revision of detailed engineering design Feasibility of ass. transmission
Hwange 7 & 8	Generation	Coal	660MW	2008	Fuel supply MOU required Funding required
Lupani	Generation	Gas	300MW	2009	-
Batoka	Generation	Hydro	800MW	2014	-
Gokwe North	Generation	Coal	1,300	2020	Update feasibility studies Funding required
Various internal transmission lines	Transmission				Depending on new generation, such as Gokwe

Source: SAPP, AfDB

D.11.6 Rural Electrification

The government approved a new rural electrification policy in 1995 to guide selection and prioritise projects. Zimbabwe also plans to provide electricity to more than 562 rural districts using solar electricity systems. Two systems would be built to generate 100kW and 500kW respectively. These would provide lighting in homes, as well as providing power to medium and small rural industries.

In early 2002 the Rural Electrification Fund Bill was passed, providing for the establishment of the Rural Electrification Board (REB), and the Rural Electrification Agency (REA). They have been tasked with the expansion and acceleration of the expansion of access to electricity in the rural areas. The programme is known as the Expanded Rural Electrification Programme (EREP). The process is being funded through a 3% electricity levy and other government contributions. The programme has run into problems however, as the 3% levy is insufficient to keep the rollout going.

The Rural Electrification Agency (REA) was created by the Rural Electrification Fund Act (Chapter 13:20) No. 3/2002 that became effective in May 2005. REA administers a special fund under this Act which finances rural electrification projects. ZESA had, before the Act was promulgated, been administering REA. The REA Board now administers the Agency and is accountable to the Minister of Energy and Power Development.

D.11.7 Electricity Tariffs

The ZEDC tariff schedule could not be obtained.

D.11.8 Utility Performance

ZESA's total annual energy sales are just under 11,000 GWh (10,779 GWh in 1999 and 10,685 GWh in 2000). This level of sales reflects total system losses of about 12.8% of energy sent out. The number of customers supplied is nearly 500,000.

Recent ZESA annual financial statements could not be obtained.

D.11.9 Challenges

Table 60 Challenges in Zimbabwe's Electricity Sub-sector

Category	Challenge
Policy/ Legal & Regulatory Framework	ZESA unbundled, independent regulator established International PSP constrained by current political dispensation
Electricity Supply	Zimbabwe already faces demand shortfall Country remains dependent on imported power Some major generation projects in the planning pipeline (coal and hydro) Some key links on the national grid remain to be constructed
Utility	Financial situation of unbundled ZESA entities not known, but is expected to be fragile in the current economic climate
Market	Domestic access to electricity about 40%, and growing in an active electrification programme

D.12 Kenya

D.12.1 Energy Sector Policy

A National Energy Policy of 2004 provides a comprehensive policy framework for the energy sector. It was prepared by the Ministry of Energy with inputs by the ERB.

The goal of the Government is to ensure adequate, quality, cost-effective and affordable supply of energy to meet development needs, while protecting and conserving the environment. Specific objectives include:

- Provide sustainable quality energy services for development;
- Utilise energy as tool to accelerate economic empowerment for urban and rural development;
- Improve access to affordable energy services;
- Provide an enabling environment for the provision of energy services;
- Enhance security of supply;
- Promote development of indigenous energy resources; and
- Promote energy efficiency and conservation as well as prudent environmental, health and safety practices.

D.12.2 Energy Supply & Demand

Total energy demand in Kenya was 16.9 million tons of oil equivalent in 2004. Of this total, biomass and related products accounts for some 75%, whilst oil accounts for a further 12%. Petroleum products accounted for 7%, geothermal 5% and hydropower 1%.

Households consume about 80% of energy supplied, most of this in the form of combustibles, renewables and waste. Transport makes up about 14% and industries 6%.

Table 61 Kenya Energy Balance (2004, thousand TOEs)

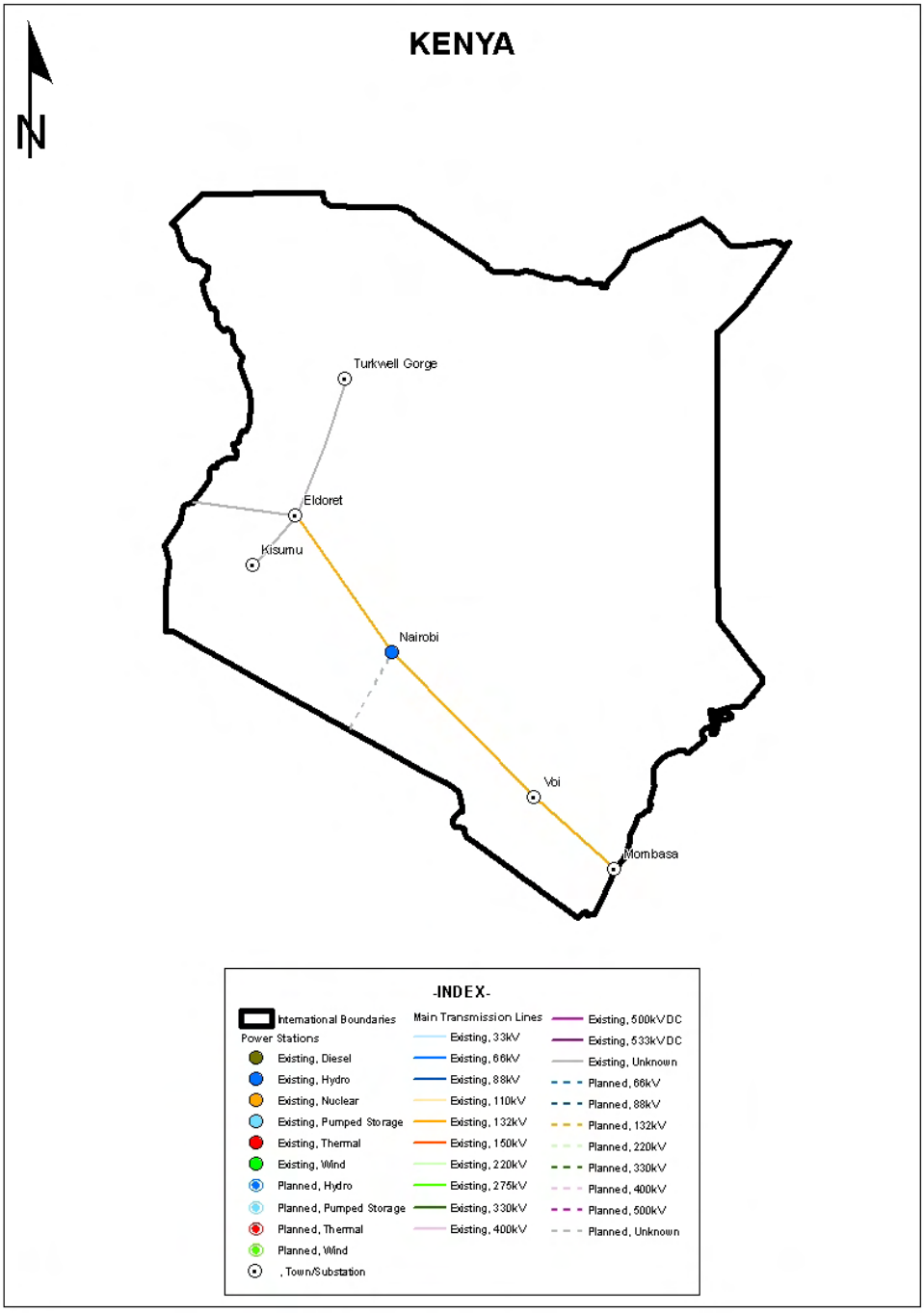
Source	Coal	Crude Oil	Petrol. Products	Hydro	Geo/ Solar	C, R & W	Electricity	Total
Production	-	-	-	247	890	12,539	-	13,675
Imports	66	2,054	1,586	-	-	-	7	3,714
Exports	-	-	-432	-	-	-	-	-432
Stock/Bunkers	-	-	-37	-	-	-	-	-37
TPES	66	2,054	1,117	247	890	12,539	7	16,920
Transform/Loss	-	-2,054	1,166	-	-	-4,489	395	-6,120
TFC	66	-	2,283	-	-	8,050	402	10,801
Industry	66	334	-	-	-	-	256	657
Transport	-	1,532	-	-	-	8,050	-	1,532
Resid./Other	-	389	-	-	-	-	145	8,583

Source: International Energy Agency

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

D.12.3 Electricity Legal and Regulatory Framework

The sector is legislated by means of the Electric Power Act, 1997. The Ministry of Energy formulates policy on the energy sector, in addition to administering the Rural Electrification Scheme.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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

Restructuring of Kenya's power sector which started in 1997, separated the functions of generation from those of transmission and distribution. Following those changes in the power sector, a new structure was adopted:

- KPLC owns all transmission and distribution assets, buys electricity in bulk from generating companies for transmission, distribution and retail to customers. KPLC owns and operates the national transmission and distribution grid, and is responsible for the scheduling and dispatch of electricity to more than 600,000 customers throughout Kenya. KPLC also develops, operates and maintains the distribution network, and ensures satisfactory delivery of service to its customers.
- The Kenya Electricity Generating Company (KenGen) manages and develops all public power electricity generating facilities. It sells electricity in bulk to KPLC. KenGen produces about 80% of the electricity consumed in the country. The company utilises various sources to generate electricity ranging from hydro, geothermal, thermal and wind. Hydro is the leading source, with an installed capacity of 677.3MW (72%).
- Independent Power Producers (IPPs) build, own and operate power stations and sell the power in bulk to KPLC.
- The Electricity Regulatory Board (ERB) reviews electricity tariffs and enforces safety and environmental regulations in the power sector as well as safeguarding the interests of electricity consumers.

The sectoral reforms made some other important steps as well. A revaluation of tariffs was undertaken to reach the long-run marginal cost. A 2% levy to abound the Rural Electrification Fund was raised to 5%. Oil products distribution was liberalised. Finally, KPLC's financial situation was strengthened through a revision of the bulk purchase tariff to KenGen and through the transformation of debt to KenGen into preference shares.

A new Energy Bill, precisely tackling the limits of the 1990s reforms, was adopted by the Cabinet in late 2006. The Bill will transform the Electricity Regulatory Board into an Energy Regulatory Commission, in order to cover all sub-sectors and to reinforce the regulator's independence and prerogatives (removal from the State Corporation Act, capacity to license without the Minister's final decision, prerogative to adopt secondary legislation). Finally, the Bill will create an independent Rural Electrification Authority to manage the Rural Electrification Programme and the Rural Electrification Fund.

Other commitments made by the government under the plan to 2010 include the following:

- Conduct a tariff study on electricity by June 2006, based on which, by December 2006, all distribution tariffs should be reviewed, a Power Purchase Agreement established between KenGen and KPLC, and a separate tariff for transmission established.
- Update the 1997 Master Plan.
- Open KenGen's capital to private investors (30% Initial Public Offering).
- Develop new power generation capacity or new regional supply sources.
- Elaborate and maintain an up-to-date Least Cost Development Plan.
- Accelerate Geothermal Resource Assessment through the creation of a special company.
- Reduce the Government direct equity in KPLC to below 39% in order to remove it from the purview of the State Corporation Act (currently 40.41% + 10.81% for NSSF).
- Contract a performance-based two-year Management Service consultant for KPLC, to be in place by September 2005.

- Implement a new connection policy at KPLC to improve the customers base, key to the utility's financial sustainability and to increased national access rates.
- Undertake a study to standardize LPG cylinders, valves and regulators.
- Develop a Public Private Partnership for KPLC.

D.12.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 5.5TWh. The household electrification rate is approximately 8% and consumption per capita 170kWh/ann. Nearly all of the national consumption is produced in-country (59% hydro, 22% thermal with 17% coming from renewable sources). Imports are less than 3%.

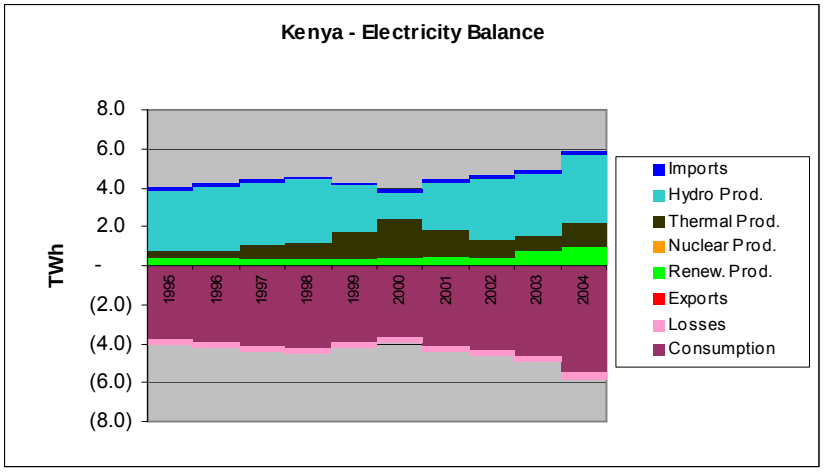


Figure 44 Kenya Electricity Consumption & Supply
Source: Energy Information Administration

D.12.5 Electricity Infrastructure

D.12.5.1 Generation (Existing & Expansion Plan)

The interconnected system in Kenya has a total installed capacity of 1,232 MW made up of 707 MW of hydro (including 30 MW of non-firm import from Uganda), 398 MW of thermal, 127MW of geothermal, and 0.35 MW of wind. The total operational capacity is 1,121MW. KenGen, the government owned utility, owns 83% of the generation while independent power producers own the remaining 17% of the effective capacity.

The effective hydro capacity is 654 MW. There are 8 main hydro stations. There are seven cascaded hydro stations along the Tana River with a total installed capacity of 565 MW and these stations range in size from 7.4 MW to 225 MW. The other major station is the Turkwel hydro station completed in mid 1991 and with an installed capacity of 106 MW.

There are several small hydroelectric projects with a total installed capacity of 6.2 MW. Provided that these stations are well maintained and retrofitted, they should continue to provide power to the grid during the planning horizon.

There are five thermal stations connected to the interconnected system, two belonging to KenGen and three to IPPs. The effective capacity of these stations

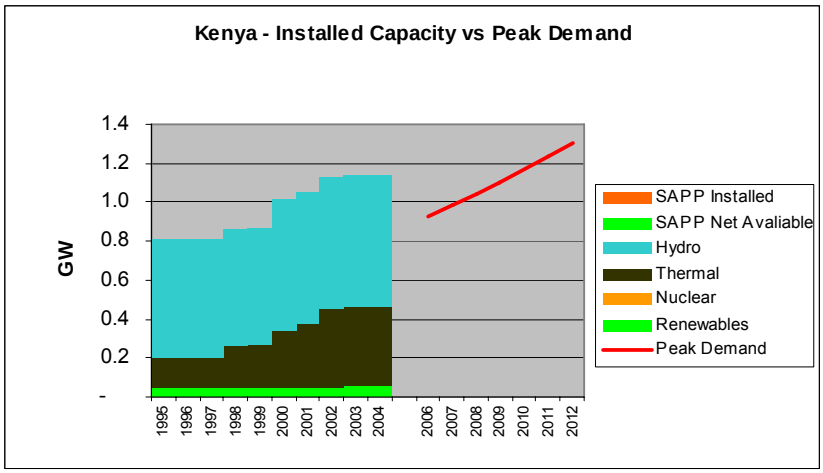
amounts to about 340 MW. The Kipevu Station has steam and diesel units while there are combustion turbine units at the New Kipevu Station (2x30 MW). At the Nairobi South Station there is a 13.5 MW combustion turbine with an effective capacity of 10 MW which is due for retirement and will be in standby mode from 2005. The Iberafrica Diesel Station has a capacity of 56.5 MW and the barge mounted GT belonging to Westmont has a capacity of 43 MW. A recent generation addition to the system is the 74 MW medium speed diesel station developed by Tsavo Power Company in Mombasa.

The Iberafrica contract is being negotiated for the next 15 years, the Westmont GT is expected to retire in 2004, the Kipevu steam units are expected to retire in 2009 as is the Nairobi combustion turbine. Iberafrica is considered to retire in 2020 and the Tsavo diesels in 2022.

The Olkaria I geothermal station has a capacity of 45 MW and is owned by KenGen while Olkaria III is only 12 MW and is owned by an IPP. Construction of the Olkaria II 70 MW geothermal station experienced delays and the station is now in service.

Current peak demand is 897MW and this is expected to rise to 1,275MW by 2010 and 1,767MW by 2015. There are three scenarios for power demand growth according to the East Africa Power Master Plan. According to the Plan, a low growth scenario will see power demand rise from 712MW in 2001 to 1,020 by 2010 and eventually to 1,927MW by 2025. Under the medium growth scenario, this rises to 1,173MW in 2010 and 2,602MW in 2025. Under the high growth scenario, this rises to 1,275MW in 2010 and 3,379MW by 2025.

Figure 45 Kenya Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

There are no specific generation projects being pursued by the EAPP at present.

D.12.5.2 Transmission

The combined network of transmission and distribution lines stretches for more than 23,000 kilometres across the country. The national grid is operated as an integral network, linked by a 220kV and 132kV transmission network. A limited length of 66 kV transmission lines is also in use.

The system load is concentrated in Nairobi and Mombasa. From Kipevu thermal plant in Mombasa a double circuit 132kV line connects to Rabai substation on the outskirts of Mombasa. From there, a single circuit 132kV transmission line runs northwest to Nairobi (440km). From Nairobi a double circuit 132kV line extends to the Ugandan border and then continues to Nalubaale hydro power station in Uganda (a total distance of 518 km) passing by Olkaria I and II and Lessos. From Rabai, a single circuit 132kV transmission line feeds Kilifi.

The Tana River hydropower developments of Masinga, Kamburu, Gitaru, and Kiambere feed into Kamburu by short lengths of 132kV transmission line. From Kamburu a single circuit 132kV line runs to Kindaruma and then continues on to Nairobi.

From the Rabai 220kV substation, near Mombasa, a 416km long 220kV single circuit line runs to Kamburu via Kiambere. Two single circuit 220kV lines connect Kamburu to Nairobi (108 km) terminating at Dandora substation. At Kamburu there is a 132/230kV, 540MVA substation which assists in evacuating most of the power generated by the Tana River hydro stations. In addition, there is another 220kV line interconnecting Kiambere to Dandora via the Embakasi substation in Nairobi.

There is a new 220kV double circuit line between Nairobi and Olkaria and between Kiambere and Nairobi. The Turkwell hydro station is connected to the grid at the Lessos 132/220kV substation via a 230 km 220kV transmission line.

Due to the absence of adequate reactive support in the Kenya system, low voltages are observed in and around the Nairobi area. The system requires shunt compensation in order to maintain an acceptable voltage profile.

D.12.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 62 Planned/Proposed Kenya Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Zambia - Tanzania - Kenya Interconnector	Transmission		330 kV	n/a	

Source: SAPP, EAPP

Source: SAPP

D.13 Tanzania

D.13.1 Energy Sector Policy

In 1999, the government of Tanzania approved a new electricity industry policy and restructuring framework, which would reduce the over-dependence on hydro resources and increase utilisation of other indigenous resources such as natural gas and coal. Other objectives of the programme include:

- Increasing sector efficiency to meet electricity demand and provide for sufficient reserve margins;
- Accelerated electrification to ensure access to the broadest cross-section of the population and centres of economic activity;
- Ensure long term economic viability and sustainability of the electricity industry to meet the challenges of economic development;
- Reduce public sector expenditure and debt by transferring the commercial risks inherent in investments in the electricity sub-sector to private capital.

D.13.2 Energy Supply & Demand

Tanzania's total energy demand was 18.75 million tons of oil equivalent in 2004. Of this, biomass and related sources accounted for 92% of demand, whilst petroleum products accounted for a further 6% and gas and hydro 1% each.

Table 63 Tanzania Energy Balance (2004, thousand TOEs)

Source	Coal	Petrol. Products	Gas	Hydro	C, R & W	Electricity	Total
Production	40	-	107	203	17,181	-	17,530
Imports	-	1,231	-	-	-	10	1,241
Exports	-	-	-	-	-	-	-
Stock/Bunkers	-	-22	-	-	-	-	-22
TPES	40	1,209	107	203	17,181	10	18,749
Transform/Loss	-25	-18	-	-203	-2,818	156	-2,907
TFC	15	1,191	107	-	14,363	166	15,842
Industry	15	111	107	-	1,295	52	1,581
Transport	-	893	-	-	-	-	893
Resid./Other	-	172	-	-	13,067	114	13,353

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

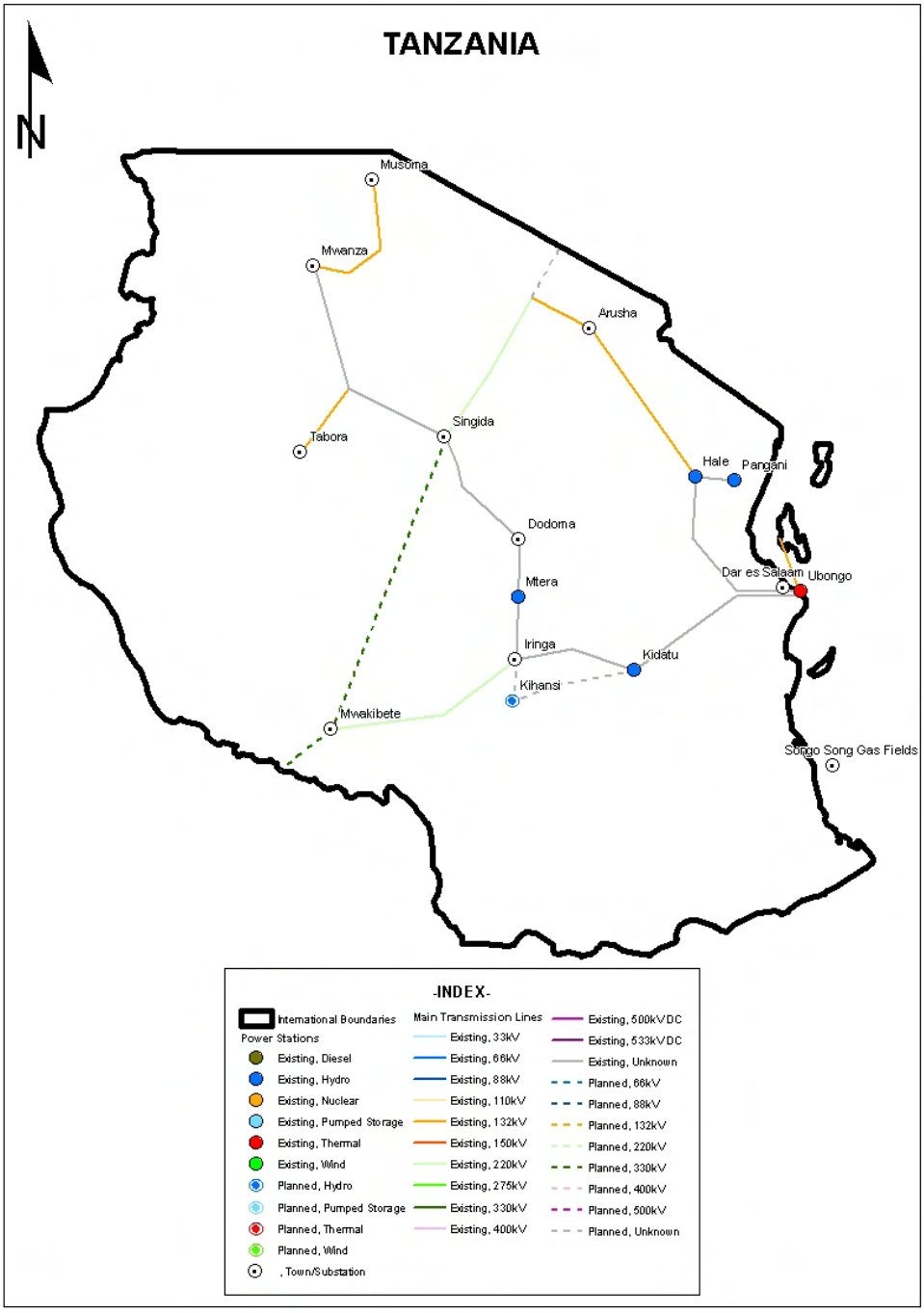
D.13.3 Electricity Legal and Regulatory Framework

D.13.3.1 Administrative and Regulatory Institutions

The Energy department of the Ministry of Energy and Minerals became operational in 1985. The department has four sections:

- petroleum and gas
- electricity
- new and renewable energy
- energy development.

The department is responsible for overseeing the development of the energy sector on behalf of the government in line with the National Energy Policy.


TANZANIA
N
Musoma
Mwanza
Arusha
Singida
Tabora
Hale
Pangani
Dodoma
Mtera
Dar es Salaam
Ubongo
Iringa
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Existing, Hydro
Existing, Nuclear
Existing, Pumped Storage
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Planned, Hydro
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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

The Tanzania Electric Supply Company Limited (Tanesco) is a parastatal organisation under the Ministry of Energy and Minerals and the Ministry of Finance. The Company generates, transmits, distributes and sells electricity to mainland Tanzania, and sells bulk power to the Zanzibar State Fuel and Power Corporation (ZSFPC) which in turn sells it to the public in islands of Unguja and Pemba. TANESCO owns most of the electricity generating, transmitting and distributing facilities in Tanzania.

Currently, Tanesco is a vertically-integrated utility, which the government aims to restructure into a number of separate companies comprising several generation companies, a national transmission company and two or more distribution companies.

In line with the electricity industry policy, a government decision was made to privatise Tanesco. The long-term strategy involves unbundling the currently vertically integrated structure and introduces competition where applicable. Current stakeholders and consumer interests are to be safeguarded through regulation.

The Presidential Parastatal Sector Reform Commission (PSRC) is the organisation that is tasked with overseeing the reform and ultimately privatisation of Tanesco and other utilities. A privatisation unit has been formed within Tanesco to oversee privatisation and corporate restructuring issues.

Netgroup of South Africa were the management contractors of Tanesco for the last four years, but this contract recently terminated.

D.13.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 2.4TWh. The household electrification rate is approximately 11% and consumption per capita 67kWh/ann. Tanzania is not presently interconnected with its neighbours. By 2004, nearly all of its electricity production (92%) was from hydro, but the thermal share is likely to increase in future (Songo Songo).

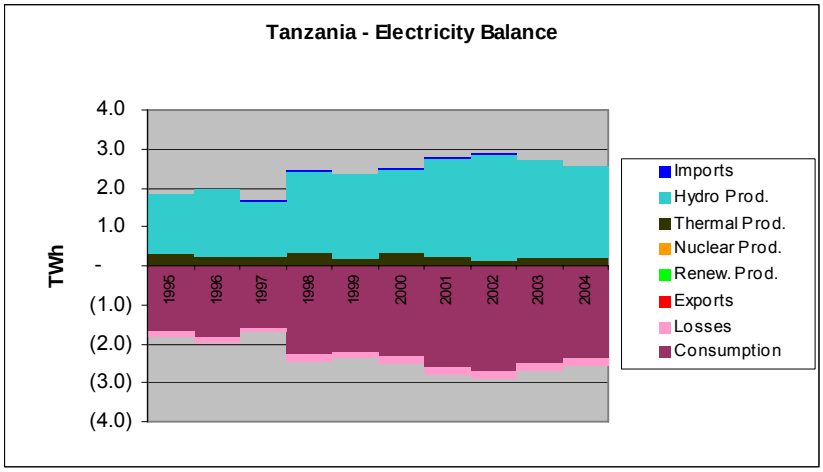


Figure 46 Tanzania Electricity Consumption & Supply
Source: Energy Information Administration

D.13.5 Electricity Infrastructure

D.13.5.1 Generation (Existing & Expansion Plan)

Tanzania relies mainly on hydroelectric power generation. Of the approximately 900MW installed generating capacity, 561MW is hydroelectric, 309MW grid-connected thermal plants and the remaining 30MW isolated generation plants serving remote areas of the country. Tanesco imports power from Uganda through a 132kV line to feed the Kagera region, while townships in Mbeya (Tunduma and Vwawa) and Sumbawanga receive electricity from Zambia through 33kV and 66kV lines respectively.

Hydropower is the key provider of commercial electricity in Tanzania. There are two key rivers in Tanzania that account for the energy, these being the Rufiji system (Great Ruaha and Kihansi) and the Pangani. They contain the key reservoirs of Mtera (3,200 Million m3), Kidatu (125 Million m3) and Nyumba ya Mungu (875 Million m3). The total installed hydropower capacity is 561MW.

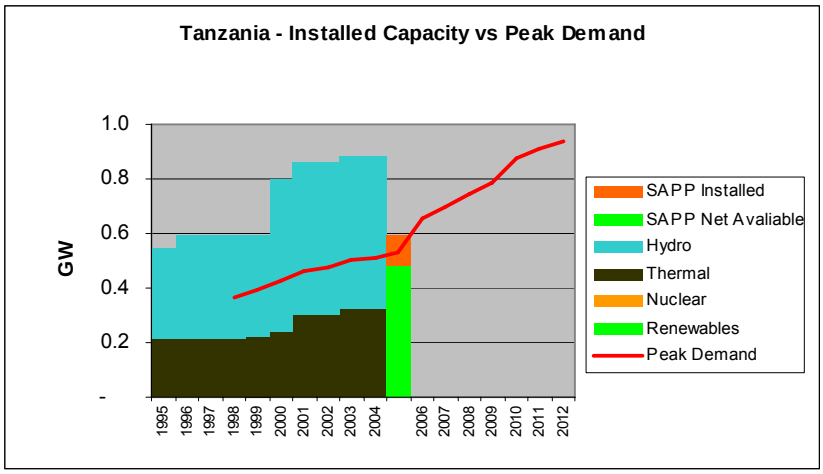
The key hydropower stations in the system are Kidatu (204MW), Lower Kihansi (180MW), Mtera (80MW), New Pangani Falls (68MW), Hale (21 W) and Nyumba ya Mungu (8MW). 55 isolated and mini hydroelectric generators having a capacity of 23MW, supply 135km of area not connected to the grid.

Tanzania has good potential to develop at least 4.5 GW of hydropower, and feasibility studies have already been conducted on the potential to develop sites at Rumakali (222 MW), Ruhudji (358 MW) and Mandera (20MW). Furthermore the potential to develop mini-hydro stations at Tosamaganga, Kikuletwa and Uwemba has been investigated.

The total generation capacity matches demand. However changing patterns of hydrological conditions have adversely affected generation, making it remain below demand and therefore resulting in frequent load shedding. In order to increase generation, the Government, in 1992, changed its policy stand to allow for private participation in generation.

Peak demand was 563MW in 2006 and this is expected to grow to 937MW by 2012. According to the East Africa Power Master Plan, there are three scenarios for power demand development in Tanzania. Under the low demand scenario, demand will grow from 465MW in 2001 to 668MW by 2010. It is anticipated that under this growth scenario, demand will peak at 1,118MW in 2025. Under the medium growth scenario, demand will rise to 792MW in 2010 and peak at 1,515MW in 2025. Under the high growth scenario, demand will reach 966MW in 2010 and peak at 2,027MW in 2025.

Figure 47 Tanzania Capacity vs Demand (GW)



Source: Energy Information Administration, SAPP

Following the policy change two independent power producers (IPPs) have been licensed, namely, the Independent Power Tanzania Limited (IPTL) and Songas Limited. The IPTL's construction of a generating station is complete. The Songas Limited IPP is based on a wider project, which is intended to extract offshore natural gas from afar and transport it through a pipeline to the generating site.

IPTL has entered into a Power Purchase Agreement (PPA) with TANESCO while Songas Limited is yet to sign a PPA with TANESCO. IPTL sells electricity to the State-owned power company, Tanesco, under a 20-year power purchase agreement (PPA). This costs Tanesco at least Tsh2.3 billion (US$ 2 million) each month as a capacity charge for the power it can produce – whether it is used or not.

D.13.5.2 Transmission & Distribution

The transmission system in Tanzania operates at voltages of 220kV (2,625km), 132kV (1,440km) and 66kV (486km) including a 132kV submarine cable interconnecting mainland Tanzania with Dar es Salaam. The distribution system operates at 33kV (7458km) and 11kV (3,732km) with a 449/230V (12,992 km) low voltage network supplying a mix of residential, commercial and industrial consumers. Maximum demand is around 476MW and there are approximately 500,000 legally connected customers.

TANESCO operates 22 regions mostly according to political administrative boundaries with the exception of Dar es Salaam, which is divided into four Tanesco regions, and the Coast region, which is administered under Dar es Salaam. Tanesco regions carry out the core business for the company, that is generation, transmission, and distribution. The ownership of the Ubungo gas turbine is expected to be transferred to Songas upon the commission of the Songo Songo gas to electricity project.

Tanesco imports power from Zambia and Uganda. Tanesco imports power from Zambia through a 33KV line to feed parts of Mbeya region. A project is underway to construct a 66KV line from Zambia to supply power to Rukwa region. Tanesco imports power from Uganda through a 132KV line to feed Kagera region. Such power trading is facilitated by Power purchase Agreements.

It has also entered into Power Purchase Agreements (PPA) with smaller producers such as Kiwira Coal mine and Tanwat Limited. Total electricity purchases from non-utility generation were 53.3 million units.

D.13.5.3 Summary of Proposed Expansions

The following generation and transmission projects are planned.

Table 64 Planned/Proposed Tanzania Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Ubongo	Generation	Gas	40MW	2004	
Ubongo	Generation	Gas	40MW	2005	
Kinyerezi	Generation	Gas	60MW	2007	
Kinyerezi	Generation	Gas	80MW	2009	
Ruhudji	Generation	Hydro	358MW	2016	
Mchuchuma	Generation	Coal	200MW	2022	
Mchuchuma	Generation	Coal	200MW	2024	
Rumakali	Generation	Hydro	222MW	2027	
Zambia-Tanzania Interconnector	Transmission		330kV		
Tanzania-Kenya Interconnector	Transmission		330kV		

Source: SAPP, AfDB

D.14 Uganda

D.14.1 Energy Sector Policy

A new Energy Sector Policy was introduced in 2002. In formulating this policy, Uganda considered the main characteristics of the energy sector and its linkages with the rest of the economy and the international environment. These characteristics include the following aspects:

- Uganda has abundant energy resources, especially hydrological and other renewable resources, yet there is widespread energy poverty all over the country. There is an urgent need to develop the resources and improve energy supply.
- Planning for modern energy supply, especially electricity has been limited mainly to urban and semi-urban areas. A paradigm shift in energy planning is required to achieve equitable modern energy distribution.
- An inadequate and inefficient power supply system, arising from stunted generation capacity growth, a poor transmission and distribution infrastructure and poor utility commercial practices, has been prevalent. The sub-sector badly needs large investments and prudent utility practices.
- Sustainable development is difficult to achieve as it is incompatible with economic poverty that is prevalent in the country. Therefore, Government has the challenge of expanding access to affordable, reliable and adequate energy supplies to address the poverty issues.
- Energy development and environmental damage are intricately related. The policy recognizes the need to mitigate both the physical and social environmental impacts created by energy development, especially hydropower.
- The energy sector is directly linked to the other sectors of the economy, providing their life-blood. The sector is a major contributor to Government revenues and decisions taken in the sector have a direct bearing on the performance of the other sectors. The policy framework provides for harmonisation with the policies of the other sectors of the economy as well as the decision making process on either side.
- In the current environment of globalisation the policy must be compatible with international trends, whether regional or global. In particular, the policy provides for a conducive environment to attract private finance and encourage energy trade and other aspects of partnerships. This is particularly required as the energy sector is currently constrained by inadequate financing.

D.14.2 Energy Supply & Demand

The IEA does not report an energy for Uganda, and a simplified version is therefore reconstructed from EIA data:

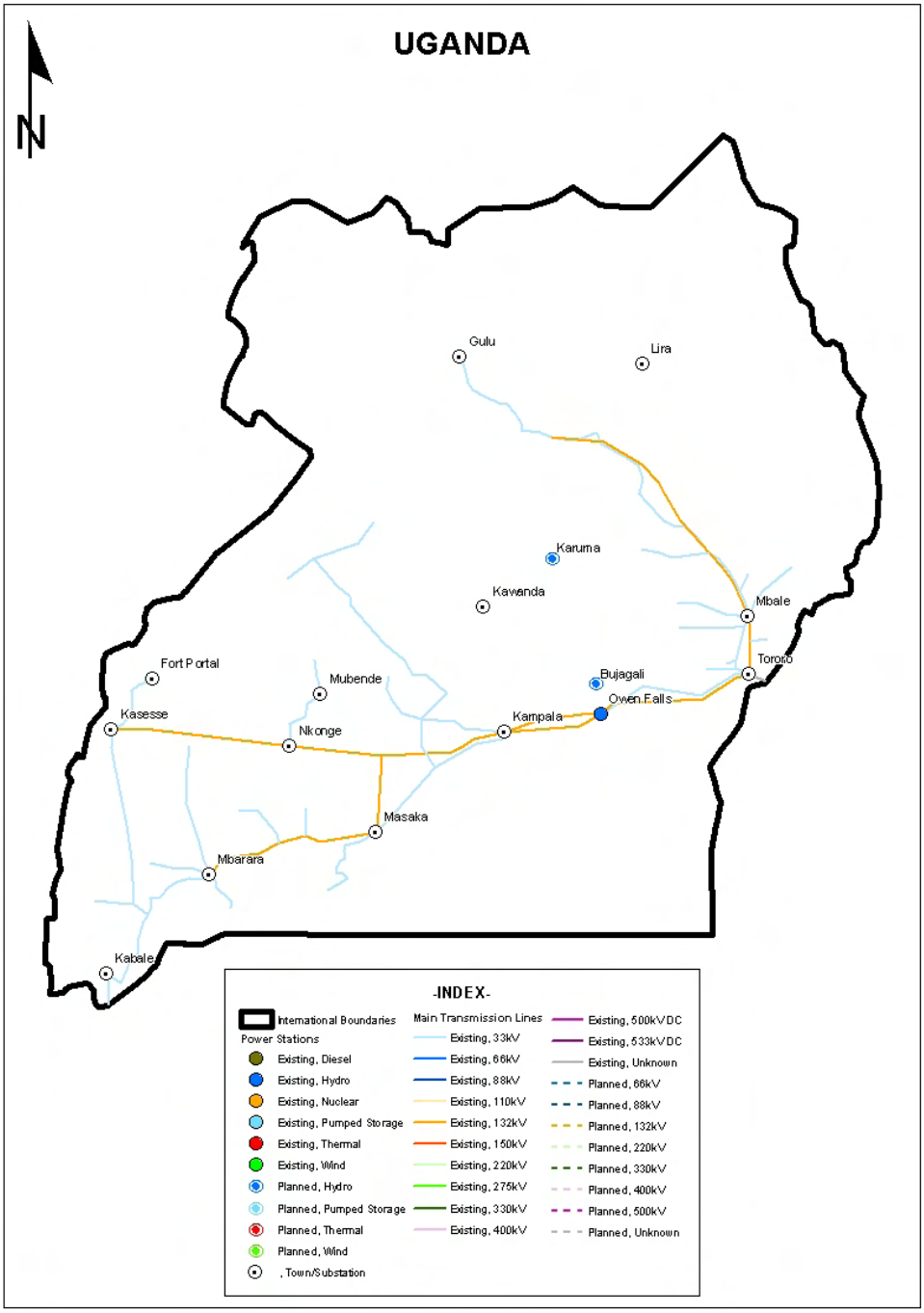
Table 65 Uganda Energy Balance (2004, thousand TOEs)

Source	Petrol. Products	Hydro	Total
TPES	554	452	1,006

Source: Energy Information Administration

D.14.3 Electricity Legal and Regulatory Framework

The Ministry of Energy and Mineral Development oversees the electricity sector, under the Electricity Act, 1999.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Lira
Karuma
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Bujagali
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Planned, 220kV
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Planned, 500kV
Planned, Unknown

Administrative and Regulatory Institutions

The power sub-sector covers electricity generation, transmission and distribution including rural electrification. In 1999, following approval by Cabinet of the Power Sector Reform and Privatisation Strategy and enactment of a new electricity law (Electricity Act), the Electricity Regulatory Authority (ERA) was established to regulate the industry. Thus, while the MEMD is responsible for policy the ERA regulates the industry independently of the Ministry.

The Uganda Electricity Board (UEB), the national utility company lost its monopoly in the sector by this enactment. As part of the liberalisation process, UEB has been unbundled to create different business entities for generation, transmission and distribution known as Uganda Electricity Generation Company Limited (UEGCL), Uganda Electricity Transmission Company Limited (UETCL) and Uganda Electricity Distribution Company Limited (UEDCL) respectively.

The generation and distribution businesses were leased out to ESKOM (South Africa) and Globeleq/ESKOM respectively. The distribution assets are now managed by a specially-created company, UMEME. These contracts are long-term concessions. Under a concession arrangement the existing assets will remain in public ownership, whilst the right to operate the assets and invest in their expansion will be let to an experienced private sector power company.

New generation capacities will be developed as Independent Power Producer (IPP) projects. IPPs already awarded are:

- Bujagali concession – Aga Khan Foundation
- Aggreko 500 MW
- Mutandiwe 500 MW
- Kakira Sugar Works co-generation 14 MW

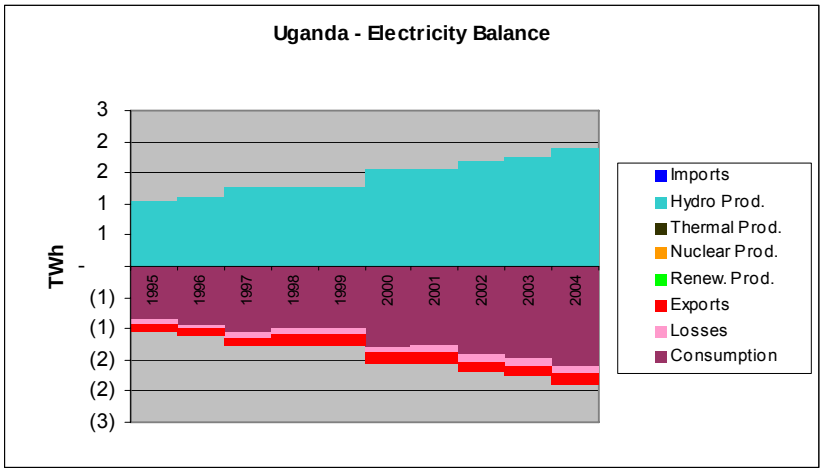
Transmission will remain a public function in the medium term.

A Rural Electrification Fund (REF), Board (REB) and Agency (REA) have been created to manage the RE programme.

D.14.4 Electricity Sources and Application

The following figure presents the national electricity balance for the decade up to 2004. Total annual consumption is 1.6TWh. The household electrification rate is approximately 4% and consumption per capita 62kWh/ann. By 2004, nearly all electricity production was from hydropower. That position would have changed already with the short-term thermal generating pl ants installed around Kampala. Uganda exports about 9% of production.

Figure 48 Uganda Electricity Consumption & Supply



Source: Energy Information Administration

D.14.5 Electricity Infrastructure

D.14.5.1 Generation (Existing & Expansion Plan)

The electricity demand in Uganda is supplied by two main hydroelectric plants namely Nalubaale generating station and the Kiira generating station. There are other small hydro generating stations. The total installed capacity at the major hydro plants amounts to 300 MW.

The electricity demand in Uganda is supplied by two main hydroelectric plants namely Nalubaale generating station and the Kiira generating station. There are other small hydro generating plants; Maziba and Kikagati (not in operation) located in the Southwest with a 1 MW and 1.25 MW capability respectively, Kilembe Mines and Kasese Cobalt plants, privately owned, located in the west and with a capability of 5 and 10 MW respectively. There are three other micro hydro plants.

The Nalubaale and Kiira generating stations are located approximately 3 km downstream from the mouth of the Victoria Nile. The Nalubaale power station was originally commissioned in 1954 with two 15-MW units. Civil works were provided for an ultimate installation of 10 units. Between 1954 and 1968, a further eight 15-MW units were progressively commissioned bringing the station to 150 MW. Between 1989 and 1998, the units were rehabilitated and upgraded from 15 to 18 MW and, at present, the station has a rated capacity of 180 MW.

Until construction of the Nalubaale power station, flows in the Victoria Nile (and the level of Lake Victoria) were controlled by Ripon Falls, a natural hydraulic control about 3 km downstream from the mouth of the river. During construction, the Ripon Falls rock bed was partly demolished lowering the bed by about 4.5 m to improve flow to the powerhouse. This is significant in that the hydraulic control of the flow in the river and the upper levels of the lake are now at the dam.

The station has the capability of operating as a storage facility using Lake Victoria for storage. However, it presently operates as a run-of-river plant, with some daily peaking operation. Flows past the station are controlled in accordance with the Agreed Curve, which Riparian governments have agreed will match the natural regime of the Lake and the outflow patterns.

Due to the age of the Nalubaale plant, the maintenance period, that would normally be 2 weeks for new plants, is increased to 4 weeks per year for planning purposes. The forced outage rate is assumed at 2.5%. These factors result in an overall availability of 9 units out of 10 for generation at the Nalubaale plant. A 0.5%

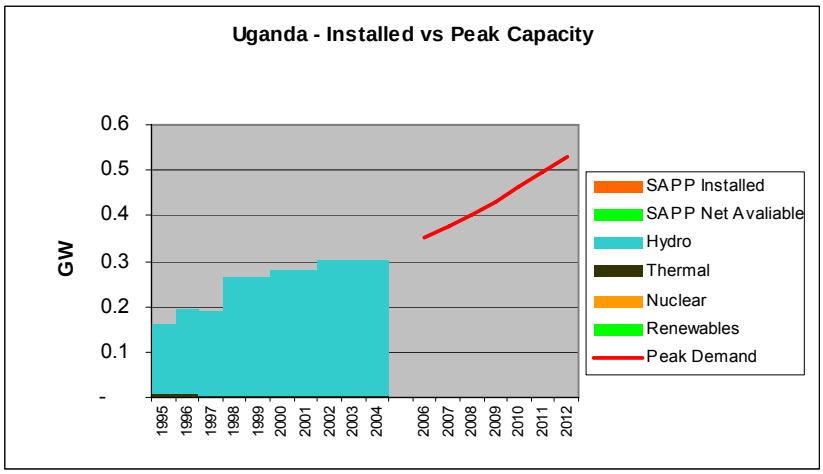
derating of the unit outputs has also been allowed for station service. Retirement of these units is considered to be outside the planning period (2004 to 2023).

The Kiira generating station is new and is adjacent to the existing Nalubaale power station. The Kiira station uses the same reach of river to develop the hydraulic head for the station and is located some 600 m downstream from the Nalubaale powerhouse. The Kiira generating station, located on the east bank, was designed so that there would be no interference with the operation of the existing powerhouse.

Diesel units are scattered throughout the country and supply areas that are not connected to the main grid. These generators range in size from 100 kVA to 350 kVA and the total of the principal generators amounts to 2,400 kVA. There are plans to eventually connect some of the load centers being supplied by these units to the main grid at which time these units could be moved to supply other loads and as such will not be considered in the study. Some other diesel stations will be replaced by mini hydro plants that will not necessarily be connected to the main grid.

Three sugar factories presently generate electricity from cogeneration plants using bagasse as the principal fuel. The total installed capacity of these three plants is 7.2 MW.

Figure 49 Uganda Capacity vs Demand (GW)



Source: Energy Information Administration, EAPP

According to the East Africa Power Master Plan, there are three scenarios for power development in Uganda. Under the low growth scenario demand for power will increase from 270MW in 2001 to 310MW in 2010 and will reach peak demand of 658MW in 2025. Under the medium growth scenario, power demand will reach 418MW in 2010 and 1,334MW by 2025. The high growth scenario sees demand in Uganda growing to 496MW in 2010 and 1,910MW by 2025.

D.14.5.2 Transmission & Distribution

The main transmission voltage in Uganda is 132kV with the sub-transmission system operating at 66kV. Generation at Nalubaale and Kiira is transmitted to the east via a 117km double circuit 132kV transmission line to the Tororo substation at the border with Kenya. The double circuit line continues to Lessos substation in Kenya. From the Tororo substation a 132kV transmission line extends 260 km to the northwest to supply the town of Lira.

To the west of Nalubaale and Kiira, a double circuit line and a single circuit line serve the load centre of Kampala and the west of the country. The three

substations supplying Kampala are Lugogo, Kampala North and Mutundwe. The double circuit 132kV transmission line from Nalubaale loops into Lugogo substation (75km) before continuing to Kampala North substation (5.5km). A single circuit line also connects Nalubaale to Kampala North direct (68.8km). Mutundwe substation to the west of Kampala is fed by one single circuit line from Kampala North (11km) and one single circuit line from Lugogo (11km).

From Mutundwe substation a single circuit 132kV line (84.5km) feeds Kabulasoke substation to the west. From Kabulasoke one 132kV line goes to Nkonge and Nkenda in the west (216km) and another single circuit 132kV line supplies Masaka to the south west (59.2km). At Masaka West one 132kV line feeds Mbarara (130.5km) whilst a second line crosses the Tanzanian border and continues south to Bukoba in Tanzania.

Voltage problems exist at Nkenda as the town is far from the main generation and the demand is high. Capacitor banks have been installed but voltage fluctuations continue to be a problem.

D.14.5.3 Summary of Proposed Expansions

The EAPP is pursuing the following generation projects.

Table 66 Planned/Proposed Uganda Generation and Transmission Projects

Name	Category	Type	Capacity	Expected Date	Comments
Bujagali	Generation	Hydro	250MW		
Karuma	Generation	Hydro	150MW		
Kalagara	Generation	Hydro	400MW		
Ayago-North	Generation	Hydro	400MW		

Source: AfDB

No transmission projects have been identified.