Southern Africa sub-regional study: South Africa and Zimbabwe

Electricity access sub-theme

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EXECUTIVE SUMMARY

Various technological, institutional, and financial and policy factors have limited the capacity of African nations to provide modern energy services to majority of their citizens, and this has hampered progress made in achieving their development goals. This deficiency is more marked in the electricity subsector, in which access to power is around 65%, with most countries having less than 20% access. Despite, this general aspect, the situation is worse for the poor in these countries, where access is generally below 5% – and even lower for rural areas. This paper focuses on the accessibility of electricity to the poor in South Africa and Zimbabwe as a means to improve understanding of the various factors that affect increasing modern energy access to the poor in these countries. This was done by examining the impact on the poor of various policy reform programmes in the subsector. Three factors, namely electrification levels, electrification rates, and consumption per capita, were used to determine access, while electricity tariffs and expenditure were used to determine access. The paper discusses the two countries separately and then provides a comparative analysis.

South Africa

South Africa is the most industrialized country in Africa, and endowed with a wide spectrum of natural resources. It is now going through major changes in many spheres of its economy, including energy, following the democratic elections in 1994. An important aspect that is directing all aspects of government is the need to address the enormous disparities in income levels and living conditions between the different racial groups, a result of apartheid. The rural areas are even more impoverished than urban ones.

After the 1994 democratic elections, the government launched the first phase of the National Electrification Programme (1994-99), aimed at increasing electrification from 36% to about 66% nationally by 2001, 46% rural and 80% urban. By the end of 2001, 66.1% of households were electrified, with more than 3.4 million connections made since 1994. Since then several policies have been made in the electricity sector that are of direct relevance to this work, of which the most important are the restructuring of the electricity supply industry and direct subsidies for the poor and dis-advantaged.

Power sector reforms

The government intends restructuring electricity assets through the Eskom Conversion Act, which is the first step in the restructuring of the electricity supply industry (ESI). It has announced that by 2006, 30% of the ESI assets will be sold to the private sector, without compromising social and development goals.

Subsidies to the poor

The government established a National Electrification Fund to subsidize a portion of the capital costs of new electricity connections as a result of the electrification programme. This Fund derives its income not only from the electricity industry, but also from fiscal allocations, grants and other sources. A standard connection subsidy is given to new households under the national electrification programme, with differentiation in subsidy level based on geographic region, supply technology or other factors. Electricity basic services support tariff (EBSST) is another initiative that the government established in 2002 to provide free electricity, 20-50 kWh per household per month, to the poorest sector of the population. The support tariff is estimated to provide an approximate power requirement for lighting, media access and limited cooking, and is expected to be worth about R200 per year to a poor household. The cost to government is estimated at about R630 million annually initially, and will increase as the rate of electrification. An off-grid electrification programme that mainly involves wide dissemination of solar home systems (SHS) to the disadvantaged areas was embarked on 2000, and now up to 12 000 such systems are disseminated with over 70% direct subsidy from government.

Impacts of the electrification program on the poor

Levels of community welfare improved as a result of electrification programmes, though these improvements differ among households, some of which were limited to using electricity for lighting and media. Other community-wide benefits include the reduction of fires from reduced paraffin and candle use, and potentially reduced local and indoor air pollution where electricity is more extensively used for cooking and heating.

Zimbabwe

Zimbabwe is a landlocked country in Southern Africa, and a member of SADC. Independence in April 1980 ended the white-minority rule, with the country inheriting all the ills of a racially divided society. Zimbabwe's economy relies heavily on agricultural crops, with significant poverty, that is closely related to the country's history of governance by the minority white government. After independence the government embarked on policies aimed at redressing economic imbalances of the past, including reforms in the power sector.

Power sector

Power sector objectives include increasing electricity access to previously disadvantaged people, through grid electricity expansion and off grid electrification. The Zimbabwe Electricity Supply Authority (ZESA) is the nucleus of the generation, transmission and distribution of electricity in Zimbabwe. The electricity sector does not meet local demand, and supply is supplemented by imports from neighbouring countries.

Electricity tariffs and expenditure

The government in Zimbabwe has final control of the level of payable tariffs, which have been changing on an annual basis. In August 1999 an automatic tariff adjustment formula was introduced, whereby the tariff setting is based on several variables with different weights. Subsidies that apply to the poor in the tariff structure include the following:

- Lifeline tariff for lighting and small power applications, about 50 kWh per month.
- Lifeline tariff for lighting, small power and basic heating, e.g. hot plate stove, ironing, about 300kWh per month.

Power sector reforms

Four main factors have been the major reasons behind power sector reforms in Zimbabwe:

- Restructuring as a component of the general economic reforms.
- Restructuring parastatals to empower historically marginalized groups.
- Restructuring to enhance power sector efficiency.
- Restructuring to mobilize finance for capital investments in the power sector.

Impacts of reforms on electrification

In 1992 the government of Zimbabwe initiated a performance improvement programme whose objectives, among others, were to achieve growth of ZESA for total electrification of the country. SHSs were installed in the rural services areas of health and education. Between 1993 and 1997 more than 8 500 institutions and homes out of a total of over 2.5 million had been electrified under the Global Environment Facility project, one of the projects operating in the country.

Recommendations

Energy and poverty alleviation

Emphasis on electricity programmes for the poor should not be focused on lighting only, as the pressing needs of the poor include others services such as cooking, income-generating activities, etc. Hence, in designing electricity programmes for the poor, strategies should be able to capture the following;

- The reduction of arduous human labour for domestic activities and agriculture.
- Modernization of biomass as a modern energy source.
- Cooking in a safe, healthy and pleasant environment.
- The provision of energy for income generation in households, farms and village industries.

Power sector liberalization

Policies that encourage local small independent power producers should be promoted in countries where there are clear advantages in doing so – such as captive plants (sugar, wood and pulp, etc). There is need to strengthen regional economic organizations that will play a role in increasing energy services to the poor and disadvantaged. New initiatives like the New Partnership for Africa's

Development (NEPAD) should be used as a vehicle for this suggestion. The role of government subsidies in the energy access sector is and will continue to be important in Africa.

Way forward

This work concludes by suggesting ways forward to address the gaps identified. These include the following:

- Innovative technological approaches to reduce connection fees, technical and non-technical losses, distribution costs, etc are needed to reduce the overall cost of increasing access to electricity, especially for the poor.
- The use of renewable energy, especially SHSs, as a poverty alleviation tool needs proper investigation. The importance of education, adequate training and information to the poor are crucial in realising any expected benefits.
- Maximisation of the social benefits of grid and off-grid expansion requires improvement inn the overall information and understanding of the intended users.
- The role of different economic and financial instruments in increasing energy access to the poor needs careful study and sensitive consideration in order to link the poor to modern society
- The associated characteristics of the poor need proper understanding and this would require participatory approaches.
- Development of local management and control schemes of energy investments is needed. Public-private management schemes can be explored.

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LIST OF ACRONYMS USED

BEE	black economic empowerment
CIDA	Canadian International Development Agency
DANCED	Danish Cooperation for Environment and Development
DANIDA	Danish International Development Agency
DME	Department of Minerals and Energy
DRC	Democratic Republic of Congo
EBSST	electricity basic services support tariff
EDI	electricity distribution industry
EREP	Expanded Rural Electrification Programme
ESI	electricity supply industry
ESMAP	Energy Sector Management Assistance Programme
FAO	Food and Agriculture Organization
GDP	gross domestic product
GEF	Global Environment Facility
GNESD	Global Network on Energy for Sustainable Development
GNI	gross national income
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IMF	International Monetary Fund
IPP	independent power producer
JICA	Japan International Cooperation Agency
LPG	liquefied petroleum gas
LRMC	long run marginal cost
NEF	National Electrification Fund
NEP	National Electrification Programme
NEPAD	New Partnership for Africa's Development
NER	National Electricity Regulator
NGO	non-governmental organization
NMD	notified maximum demand
ODA	overseas development assistance
OECD	Organization for Economic Cooperation and Development
PBMR	pebble bed modular reactor
PIP	performance improvement programme
POD	point of delivery
PPC	Parliamentary Portfolio Committee
RDP	Reconstruction and Development Programme (South Africa)
RED	regional electricity distributor
REF	Rural Electrification Fund (Zimbabwe)
SADC	Southern African Development Community
SAPP	Southern African Power Pool

SHS	solar home system
TOU	time of use
TPES	total primary energy supply
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
ZESA	Zimbabwe Electricity Supply Authority

1. INTRODUCTION

Increasing access to affordable, adequate, and reliable modern energy services remains a major challenge to many developing nations of the world, especially the poor in South-East Asia and Africa. Modern energy is not only the pivot of national economic development, but also provides services to meet basic human needs such as water and sanitation and cooking, and is the engine for productive activities of the poor as well as satisfying their social services such education and health. The link between access to modern energy services and poverty eradication is therefore very strong. Poverty indicators such as high infant mortality, low life expectancy, and high illiteracy and fertility rates will not improve unless adequate modern energy services are available to the poor. Also, since the bulk of the poor are usually in rural areas, which are generally deprived of basic services, the young and more energetic migrate to urban areas in search of improved livelihoods thinking that they can access these services (including modern energy), resulting in an increase of urban poor. The provision of modern energy services is crucial to poverty eradication or reduction. Unfortunately, the poor depend on traditional biomass (firewood and charcoal) to cook their food, but the use of these fuels is problematic, because their associated technologies are grossly inefficient and the resultant emissions can cause serious health problems. It is estimated that over 60% of the population of sub-Saharan Africa depends on this fuel source. Reliance on traditional biomass only worsens the life of poor and cannot contribute to eradicate or reduce poverty.

In general, providing modern energy services to the poor in Africa poses a unique dilemma for policy-makers and other stakeholders. Despite the continent has abundant fossil and renewable energy sources, exploiting them remains a daunting task because of major technological, institutional, and financial obstacles (Davidson & Youba, 1991). Financial obstacles remain the most important. Poor energy investments, an underdeveloped downstream energy sector, and poor management of proceeds from the huge fossil fuel imports are some of the barrier affecting the use of modern energy by most Africans, particularly the poor. Further, overseas development assistance (ODA) which has been traditionally used on pro-poor programmes is dwindling, while their effectiveness is being questioned. However, donors are now calling for new approaches on their poverty alleviation programmes, including those concerned with energy (CIDA 2002).

This paper will focus on electricity access to the poor within the Global Network on Energy for Sustainable Development (GNESD), but the scope will be confined to Southern Africa, with South Africa and Zimbabwe as case studies. The paper first provides a brief background on the production and use of electricity in Southern Africa, before providing the rationale and approach for the study. The countries were analysed to identify the impacts of specific policies and programmes in the power sector on the poor, with special reference to electricity reforms.

1.1 Electricity sources and utilization in Southern Africa

1.1.1 Potential electricity sources

The potential for electricity supply in Southern Africa can be considered as that within the Southern African Community (SADC), which includes nearly all countries in the sub-region, and the body also has several ongoing energy initiatives and a regional energy administration. In general, Southern Africa is a net energy exporter. In 2000, the region produced 2.3% of the world's primary modern energy, while it consumes 1.4% (the rest being exported). South Africa is dominant in the sub region's energy sector, accounting for 84.9% of modern consumption and 77.4% of its production. Modern energy reserves in the sub region are diverse: 60.7 billion tonnes of coal, 156 million tonnes of oil, and 1138.0 billion cubic metres of natural gas (Maya 2000), but the location of these is skewed. Most of the coal reserves are in South Africa with some in Botswana and Zimbabwe. Angola is the only significant oil producer, while natural gas occurs in a few more countries, Angola, Mozambique, Namibia, Tanzania and South Africa. Access to modern energy in the sub-region is limited, with the majority depending on firewood and charcoal at household level. Mozambique, Zambia and Malawi are the countries that are most highly dependent on these fuels for satisfying their household demand.

The total installed capacity of SADC is 54.183 GW, and it produces about 229 000 GWh annually, as of 2000 (EIA 2002). Thermal sources dominate power production, with 81% of installed capacity; others sources are about 14% for hydro and 4% for nuclear. The highest hydroelectricity potential is in the Democratic Republic of Congo (DRC) – estimated at 100 000 MW, followed by Zambia at

21 400 MW (see Table 1). Only less than 5% has been exploited, with a total installed capacity of 8 014 MW. Zambia, Mozambique and DRC account for almost 70% of the 28 760 GWh produced in 2000 (Maya 2001).

Table 1: Hydro and thermal electricity in Southern Africa
Source: Maya (2001); Wamukonya (2001); Eskom (1996)

Country	*Max. hydro generating capacity (MW) (1996)*	*Hydro exploitable potential (Mwe (1994))*	*Max. thermal generating capacity (MW) (1996)*	*Total gross electricity production (GWh) (1996)*
Angola	208.0	16 000	158.27	1 046.57
Tanzania	375.0	6 000	107.00	2 003.20
Mozambique	491.19	12 500	97.39	609.56
Malawi	216.20	900	24.56	859.90
Zimbabwe	666.0	13 300	1056.00	7 323.3
Zambia	1670	21 400	86.0	7 836.0
Botswana	0	0	118.0	724.0
Lesotho	3.25	450	1.51	12.13
Swaziland	40.50	600	9.5	197.50
Mauritius	54.2	-	264.60	1 150.81
Namibia	240.0	120	147.0	873.3
South Africa	2 247.0	3500	35690.50	184 500.29
DRC	2 522.96	100 000	37.8	5 739.65

1.1.2 Access to electricity

In general, access to electricity in Africa is extremely low, estimated at 17%, though with variation among the sub-regions, as opposed to over 70% for most developing regions (Davidson & Sokona 2003). North Africa has an average of 85.8%, followed by Southern Africa at 20.75%. The least electrified region is Central Africa with only 9.0% access (World Bank 2001). However, a large number of countries are below 9%. Table 2 illustrates household electricity access levels in the SADC region.

Table 2: Household access to electricity for SADC countries, 2000
Adapted from O'Sullivan and Hamaide (2002)

Country	*Est. population (m)*	*% access*
Angola	12.7	5.0
Botswana	6.2	22.0
D.R Congo	50.95	6.7
Lesotho	2.1	5.9
Madagascar	15.4	11.1
Malawi	11.0	5.0
Mauritius	1.2	50.0
Mozambique	17.6	5.8
Namibia	1.7	20.2
South Africa	42.3	66.0
Swaziland	1.0	20.0
Tanzania	33.7	10.5
Zambia	10.0	18.0
Zimbabwe	11.9	20.0
Average		**20.75**

The percentage of access does not always tell the true picture regarding the situation of the poor because, in some areas with access, affordability could be a constraint. As a result, there are a number of cases where power utilities have surplus generation while a relatively low number of households have access to electricity. It has been estimated that SADC has a surplus of over 11 000 MW, while only 20% have access to electricity. Hence, the power generation capacity of the country is important, but identifying appropriate policies and measures that link electricity availability and access is equally important. Both access and affordability are of concern to the sub-region, and therefore to this paper. Interconnection between and among the Southern African countries could play a major role in reducing the uneven distribution of generation capacities in the sub region. Grid interconnection has been achieved to some extent as shown in Figure 1, though the potential exists for more.

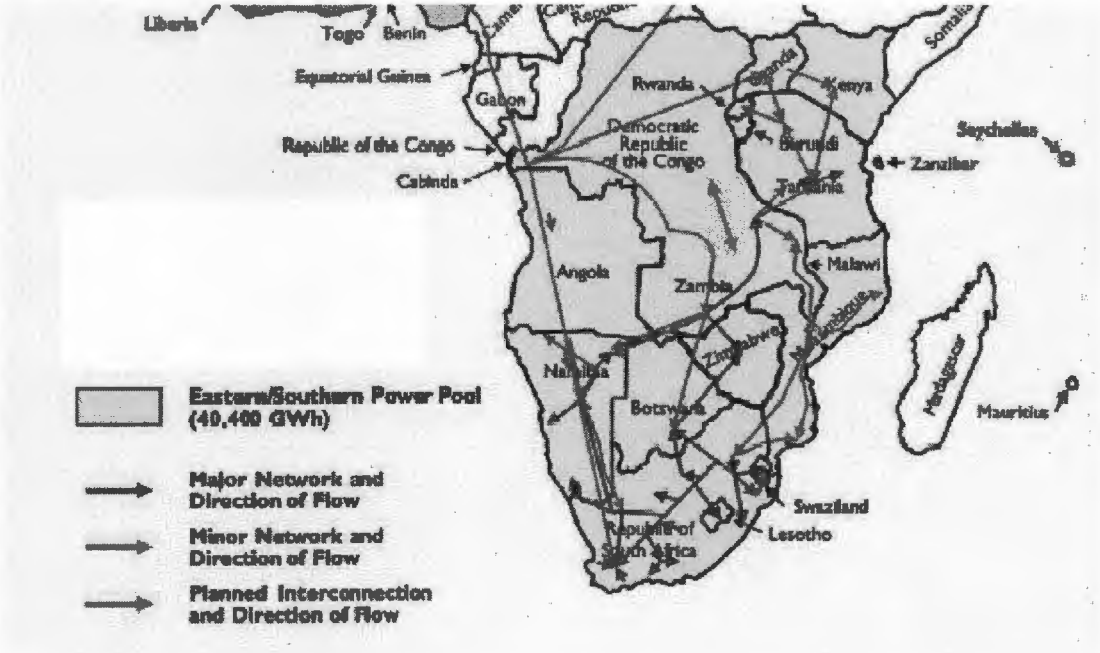

Figure 1: Grid interconnection in Southern Africa
Source: Eskom (2002)

2. THE APPROACH OF THE STUDY

2.1 Methodology

This paper looks at the access of modern energy services to the poor with particular reference to electricity, because of the importance of electricity as a secondary energy carrier and its strong link to development. Hence, the impact of on-going power sector reforms along with other policies will be studied. Power sector reforms in the context of this paper are defined as any major measures, interventions or changes in the mode of operation instituted in the electricity sector by governments, internally or externally initiated with the intention of improvement, in terms of access, affordability and efficiency. Therefore this paper will investigate if such action(s) resulted in the increase in access to the poor in the respective countries studied. The study will be limited to major reform programmes as they are expected to have the most significant impact.

The assessment of impacts on the electricity sector reforms and other policy and measures will be done by using the following five indicators:

- national electrification levels;
- national electrification rates;
- electricity consumption per capita;
- electricity tariffs;
- electricity expenditure.

The first three indicators refer to access while the last two refer to affordability.

All these indicators have advantages and drawbacks and these will be highlighted in the paper. Each indicator will be assessed at two levels – firstly, at national level (irrespective of income); and, secondly, by income levels. In most cases, proxy data will be used to substitute for poverty data because of data available are limited. In some cases, qualitative differentiation is used as two income bands (poor and non-poor).

Poverty is defined in this work using definitions formulated as by the respective governments, because using a universally definition which is usually given in quantitative terms is problematic, given country and regional differences. The most common of the latter are US$1/day (World Bank) or US$2/day (UN). These definitions have deficiencies, for example, problems associated with exchange rates – such as purchasing power parity.. Qualitatively, poverty has been defined by the absence of certain basic needs. The most useful has been the definition given by UNDP in their Poverty Report of 2000 (UNDP 2000b). The factors they suggested were:

- lack of income necessary to satisfy basic food needs;
- lack of income to satisfy essential non-food needs – such as clothing, energy and shelter, as well as food needs;
- Lack of access to goods, services and infrastructure – energy, sanitation, education, communication, drinking water – necessary to sustain basic human capabilities.

However, in this study quantitative poverty indices, as defined by the respective countries, will be used for the analysis.

2.2 Country studies

2.2.1 Focus area of study

The countries studied are South Africa and Zimbabwe, with the former benefiting from the location of the study and so more data available. While the overall objective is to look at the impact of power sector reforms on the poor, it will also comment on the electricity services and technologies available to the poor. Power sector reforms are continuing in nearly all countries of the region, some internally induced, others externally driven – mostly by the World Bank/IMF.

The choice of countries was driven largely by constraints of resources, time and data. While it is realised that using only a limited number of countries as case studies may lead to certain weaknesses, such as failing to capture some national differences, there are commonalities among the

poor in most African countries. Further, differences between the two selected countries will assist in capturing some of the national disparities in the region, in that South Africa has a relatively advanced economy than Zimbabwe.

2.2.2 Data and information sourcing

Data and information for this study were limited to those from secondary sources, as resources and time did not allow for collection of field data; there are limitations, therefore, in capturing the advantages of field data, such as level of aggregation and specificity. However, the secondary data available for these countries assists in minimising this problem.

3. SOUTH AFRICA

3.1 Country circumstances

South Africa has a population of 45 million people, living on a land area of 1.2 million square kilometres (Census 2003). South Africa is well endowed with natural resources including coal, gold, diamonds, metals and minerals. Its economy is highly hinged on energy production and use, with coal accounting for 75% of the fossil fuel demand and for 91% of electricity generation. South Africa is the most industrialized country in Africa. Table 3 shows, comparatively, some key development indicators.

Table 3: Key development indicators for South Africa and the world, 2001
Source: World Bank (2003), Statistics South Africa (2003)

Indicator	*South Africa*	*Sub-Saharan Africa*	*World*
Population, total	44.8 million	673.9 million	6.1 billion
Population growth (annual %)	0.8	2.3	1.3
Illiteracy total (% age 15 and above)	14.4	37.7	
Illiteracy female (% of age 15 and above)	15.0	45.7	
GNI, Atlas method (current US$)	121.9 billion	311.2 billion	31.4 trillion
GNI per capita, Atlas method (current US$)	2,820.0	460.0	5,120.0
GDP (current $)	113.3 billion	315.7 billion	31.1 trillion
GDP growth (annual %)	2.2	2.9	1.1
GDP implicit price deflator (annual % growth)	7.5	-	-
Fixed lines and mobile telephones (per 1 000 people)	364.3	40.6	
Telephone average cost of local call (US$ per three minutes)	0.1	-	
Personal computers (per 1 000 people)	68.5	9.9	
High-technology exports (% of manufactured exports)	5.0	-	
Foreign direct investment, net inflows in reporting country (current US$)	7.2 billion	13.8 billion	
Present value of debt (current US$)	23.4 billion	-	
Total debt service (% of exports of goods and services)	11.6	11.2	

South Africa is still undergoing profound changes after the democratic elections of 1994, which led to the change of government from an apartheid system to a more democratic form of government, resulting in new directions in almost all aspects of government and public life.

The GDP per capita of South Africa as of 2001 was $3 160 compared to the global average of $5 040, but it is relatively higher than the average for Africa which is less than a thousand dollars. However, there are major internal differences between the different races in the country, a reflection of the previous political system. Average monthly incomes for households in 2000 were R2 160 ($311.45) for Africans, R4 250 ($612.81) for coloureds and R7 083 ($1 021.30) for Indians and R13 166 ($1 898.40) for whites, according to government classifications (Statistics South Africa 2002).

In general, South Africa has a very energy-intensive economy by African standards, the highest per capita energy consumption, mainly due to the presence of heavy mining industry (iron& steel, cement, aluminium, etc). It is one of the most electrified countries in Africa, with above two-thirds of the 45 million-strong population electrified – hence the importance of the energy sector.

Table 4: Energy parameters of South Africa, 2000
Source: IEA (2002); Statistics South Africa (2002)

Population	42.80 million (45 million)
Energy production	144.47 Mtoe
Total primary energy supply (TPES)	107.60 Mtoe
Electricity consumption	194.02TWh
TPES/population	5.51toe/cap
TPES/GDP(ppp) (toe/000 95US$ppp)	0.29
Electricity consumption/pop.	4533.12kWh/cap

3.1.1 Poverty in South Africa

The minimum standard of living in South Africa, defined, as the minimum monthly financial household requirement was R709 (US$273) in 1990, equivalent to about US$9/day using the 1990 exchange rate. In 2002, in the government policy on tariffs aimed at the poor (to be discussed later), R800 was used as the baseline for poor households, which is equivalent to US$2.54/day. This clearly shows the discrepancy in using dollar value to determine poverty even if changes in purchasing power are not considered.

In 1998 May and Govender defined poverty in South Africa as the inability to obtain a minimal standard of living, measured in terms of basic consumption needs or the income required to satisfy basic needs. Using this definition, they estimated the poverty line as monthly household expenditure of R353 (approximately US$1.96 in 1998) (May & Govender 1998). This seems to be in agreement with a recent work done in black townships around Cape Town that shows that 76% of households were living below R352 per month (BBC 2003). However, this further shows the discrepancy in using a rand/dollar exchange rate.

Poverty in South Africa is strongly linked with the wide disparities in income levels and between racial groups. Despite the recent census shows progress in the provision of basic services between 1996 and 2001, the gap between white and black remains significant. In general, South African rural areas are far more impoverished than urban areas, mainly because of the past system of sectional development according to race.

3.2 Background of the power sector

3.2.1 South Africa's electricity sources

South Africa's electricity sources are shown in Table 5. Eskom produces 95.6% of the electricity (NER 2000), and about 93% is from coal – a total generation of 37 678 MW (Eskom 2001).

Table 5: South Africa's electricity production profile, 2001
Source: NER (2001)

Source	*Net energy sent out (MWh)*				
	Eskom	*Municipal*	*Private*	*Total*	*% of total*
Coal	175 222 884	609 676	7 440 075	183 272 635	93.7%
Nuclear	10 718 623			10 718 623	5.5%
Pumped storage	-769 295	-67 545		-836 840	-0.4%
Hydro	2 194 071	9 690	14 288	2 218 049	1.1%
Bagasse			306 878	306 878	0.2%
Gas	-725	5 710		4 985	0.003%
Total	187 365 558	557 531	7 761 241	195 684 330	

Table 6: Statistical overview of the electricity supply industry of South Africa
Source: NER (2003)

Eskom and municipalities	*Units*	*2000*	*1999*	*1998*	*% change 1999- 2000*
a: Generation					
Licensed capacity	MW	43 142	43 142	43 142	0%
Net max. power produced	MW	35 324	34 471[1]	35 665	2.5%
Gross energy sent out	GWh	198 206	190 144	193 086	4.2%
Own use (Synchronous condenser operations and pumped storage)	GWh	3 744	3 757	3 615	-0.3%
Net sent out	GWh	194 461	186 387	189 471	4.3%
Energy sent out by municipal and private generators, directly to own distributors	GWh	8 392	7 827	9 608	7.2%
Via Transmission by Eskom and municipalities	GWh	186 069	178 561	179 863	4.2%
b: Transmission (including international trading)					
Eskom peak demand	MW	29 188	27 813	27 803	4.9%
Imported from SAPP utilities	GWh	5 294	6 657[1]	2 629	-20.5%
Transmitted	GWh	191 363	185 218	182 492	3.3%
Exported to neighbouring countries (SAPP utilities)	GWh	3 967	3 128	3 197	26.8%
Energy losses	GWh	6 313	8 667	7 388	-27.2%
Transmitted to SA distributors	GWh	181 083	173 423	171 906	4.4%
c: Distribution					
Customers	No.	6 794 383	6 780 299[2]	6 072 764	-0.9%
Energy purchased from municipal and private generators	GWh	8 392	7 827	9 608	7.2%
Gross energy received	GWh	189 475	181 250	181 514	4.5%
Energy losses	GWh	12 071	8 688	10 301	38.9%
Energy sold for end use	GWh	177 405	172 561	171 214	2.8%
Energy exported by distributors	GWh	756	856	896	-11.7%
Sold for end use in South Africa	GWh	176 649	171 805	170 318	2.8%

1. The large increase in energy imports and hence, reduction in Eskom power produced was due to the Cahora Bassa being resumed.
2. Increase in number of customers mainly due to electrification.

3.2.2 Diversifying energy supply sources

South Africa is interested in the development of different energy resources for electricity production in the Southern African region, especially as SADC countries have considerable hydropower and natural gas potential. South Africa is a member of the Southern African Power Pool (SAPP), created in 1995 with the aim of linking SADC member states into a single electricity grid. At present, SAPP comprises utilities from Angola, Botswana, DRC, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, with an operational coordination centre in Harare. SAPP intends to facilitate increased electricity trading in the sub-region as its vision is to become a power exchange facility over time, though setting rationale pricing among countries is still an obstacle. Eskom, the utility in South Africa, has identified more than 9 000 MW potential for regional imports, even without considering the massive export potential of the Grand Inga scheme in the DRC of over 40 000 MW in the longer term. Regional co-operation on energy development is also a major driver within NEPAD, of which South Africa's President Mbeki is one of the main proponents. South Africa is also interested in natural gas development in the sub-region. There are on-going natural gas projects between South Africa and both Namibia and Mozambique, though the latter is far advanced and gas is expected to be available as early as 2004.

3.3 Electrification programme

In 1993, only 36% of the population had access to grid electricity. After the 1994 elections, government launched the first phase of an internally financed National Electrification Programme for 1994-99. The programme was to be implemented by Eskom and the municipalities and it aimed at increasing electrification to about 66% nationally by 2001, 46% rural and 80% urban. (NER 1999), which meant providing electricity for an additional 2.5 million households. The target was mainly previously disadvantaged and rural areas, and for all schools and clinics. The target was exceeded, with 2.75 million connections achieved in Phase 1 (Borchers et al 2001).

An off-grid electrification programme was launched in March 1999, aiming at providing 350 000 SHS in seven concession areas. However, this was later revised to providing for only five concession areas, and a further sixth one was recently just awarded by government. In this programme, the government gives a subsidy of R3 500 to the concessionaire for each installation, and the users pay a monthly service fee of R58 for maintenance. The system provided is 50Wp and is capable of producing electricity for four lights, a radio and a black and white TV, estimated to be equivalent to about 6 kWh/month. Recently, the government has initiated a subsidy programme of R40 to the users to help alleviate the burden of the monthly service charge, motivated by the recently instituted poverty tariff system that led to discrepancy in benefits between the user of SHS and grid electricity. The most advanced concession in the programme is the Shell/Eskom joint venture which had installed 6 000 systems by 2000 (DME 2001a). However, the implementation of these systems has encountered many operational problems.

The Schools and Clinics Electrification Programme provided off-grid energy services with solar PV systems to these institutions. By 2000, 1 852 schools and an unspecified number of clinics had been connected (DME 2001a: 97). However, these projects have mixed results. Only 6% of the 1 400 systems installed in 1996 and 1998 in the RDP project were found partly operational in 2000 (Oldach et al 2000). In the EU-funded project that installed 1000 systems, 40% were not operating within a year after installation (Mapako & Afrane-Okese 2002).

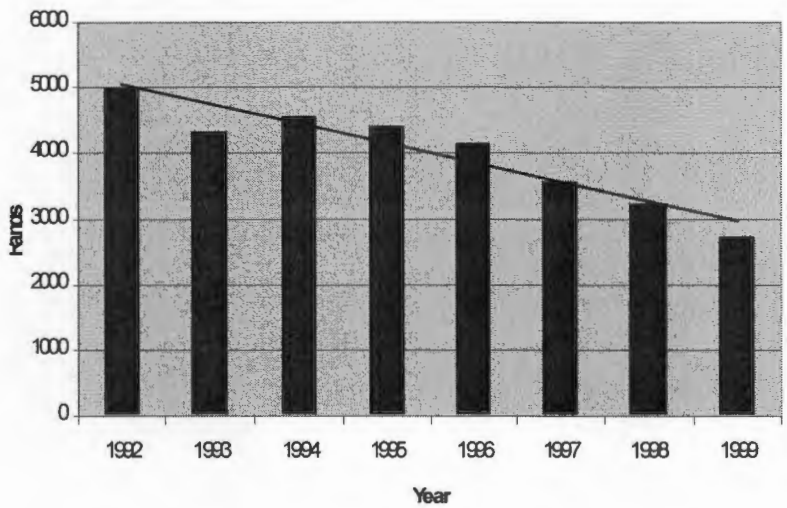

Figure 2: Electrification cost per connection

3.3.1 Level and rate of electrification

At the end of 2001, 66.1% of households were electrified, more than 3.4 million connections since 1994; the DME now records 70% of households as electrified. The government continues the programme with the intention to electrify 300 000 homes annually. It is interesting to note that the cost of connection has been declining steadily during the electrification programme, as illustrated in Figure 2 above. The grid electrification programme has targeted mainly rural households, with little changes in the share of electrified urban areas, as shown in Figure 3. It should be noted that, despite the major achievements of the programme, such as being self-financed by the country, nationally about 30% of the population are yet to be electrified (about 20% urban and 50% rural), mostly the poor.

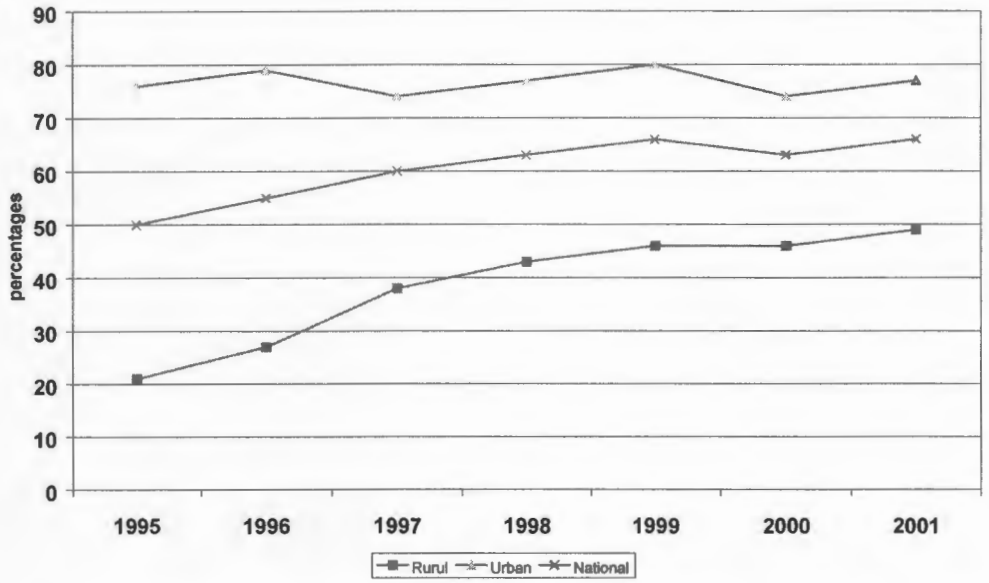

Figure 3: Trends in electrification of households in South Africa, 1995-2001
Source: NER (2003)

The new connections were mostly done by Eskom and the municipalities, but large-scale farmers were asked to connect workers where necessary. Eskom accounted for about two-thirds, while the municipalities did most of the rest, with the farm workers being about 6% or less. It can be noticed that the new connections really got impetus by the electrification programme in 1994 and has largely continued around 450 000 households until 2000 when it dropped to 397 000, a trend that continued in 2001. The drop is mainly due to the drop in new connections by Eskom. These features are illustrated in Figure 4 below.

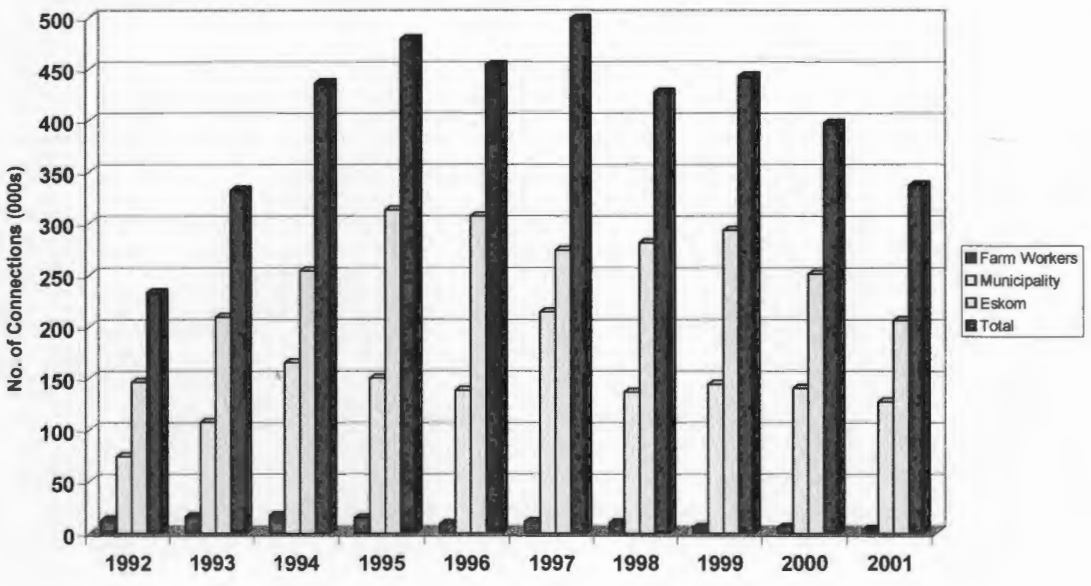

Figure 4: Annual new household electricity connections, 1992-2001

In the Energy White Paper, the government recognized that household access to adequate energy services for cooking, heating, lighting and communication is a basic need. While these needs could be met by various fuel-appliance combinations, without access to electricity human development potential will be constrained. The government thus committed itself to implementing reasonable legislative and other measures, within its available resources, to progressively realize universal household access to electricity by 2010.

3.3.2 Electricity tariffs structures

Compared to many countries, electricity prices in South Africa are low in absolute terms, as shown in Figure 5 below. The low prices are due to a number of factors, as advanced by DME. These include:

- Cheap coal – over 90% of electricity is produced from cheap low-grade coal and the unit cost of coal has been declining, thus leading to lower cost of production.
- Ageing assets – most of the generating units are older than 15 years and depreciation costs are lower than for newer assets. Unit depreciation has been reduced by 25% since 1990, leading to 10% cost reduction.
- Declining debt – due to declining investments, Eskom has been progressively reducing its debt burden, and so lowering interest payments. Unit finance cost has been reduced by 77% over the past 10 years.

However, prices may be increased in the medium-to-long term, as being advocated by Eskom to the government. The need for plant replacement by 2007 is the reason given for the expected increase, as existing surplus capacity will be run out by then.

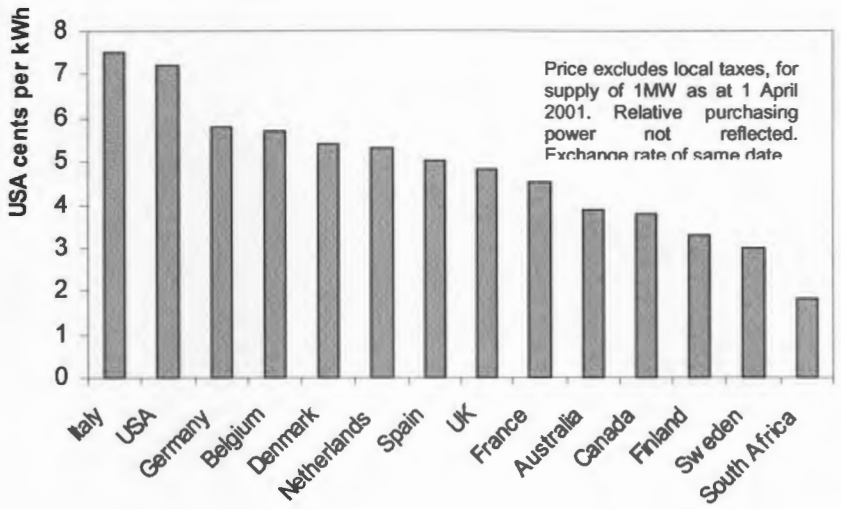

Figure 5: South Africa electricity prices compared to world prices
Source: Eskom (2002)

Electricity customers in South Africa are categorized into six major groups (with those that do not fall under any of these groups regarded as general customers) (see Table 7). In 2000 the domestic sector had the largest number of customers, at 6 264 068, followed by commercial customers, at 210 914. In terms of electricity sales, however, manufacturing industry ranked as the highest electricity user, at 75 201 091MWh, with the domestic sector the second largest at 36 087 583MWh.

Eskom directly distributes electricity to approximately 33% of South African electricity consumers, who account for approximately 60% of all electricity sales. The remaining 76% of the country's customers (and 40% of total sales) are supplied predominantly by local government electricity distributors, about 237 in number, with different tariff structures. This creates considerable disparities in the tariff structures, an issue that the NER is trying to remedy. The tariffs were structured to stimulate industrial growth, so industrial tariffs are lowest while domestic ones are the highest. In 2000, the average domestic tariffs were 25.07 c/kWh, while commercial and agriculture sectors were 23.84 c/kWh, and the mining and manufacturing sectors 12.68c/kWk, the lowest.

Table 7: Overview of NER electricity customers' category and tariffs
Source: NER (2003)

2000	*Average sales price (c/kWh)*	*Number of customers*	*MWh Sales*
Agriculture	23.90	101	4 213 447
Commercial	23.77	210 914	16 448 672
Domestic	25.07	6 264 068	36 087 583
General	29.66	97 748	9 373 437
Manufacturing	12.80	80 778	75 201 091
Mining	12.55	21 754	32 065 725
Transport	16.84	17 193	5 605 056
Total	17.28	6 794 383	188 648 346

Generally, electricity tariffs are set for the different categories, while the provinces have mandates within a certain regulatory framework to set up their own electricity tariffs. The government noted in the Energy White Paper of 1998 that as a result of the fragmentation of the electricity distribution industry there were more than 1100 domestic tariffs in place. It was also been noted that residential areas directly adjacent to each other often experience wide variations in tariffs and levels, hence creating unnecessary confusion for domestic consumers, and being difficult to regulate.

Affordability of domestic electricity prices is a problem to many South Africans, especially as a result of the policy of cost-recovery. Significant number of the poor cannot afford to pay an electricity bill of R15/month (approximately US$2 in March 2003) (James 1997; Fiil Laugesen 2000).

According to recommendations given in guidelines for tariffs in South Africa (NER 1995), the tariff structure should have the following attributes, in order of importance:

- Tariffs should enhance economic efficiency and be cost-reflective.
- Within limits, customers should be free to choose from a range of applicable tariffs.
- All distributors should apply a defined national cost of supply methodology so as to ensure equity and fairness between customers serviced by different suppliers. Wide tariff differentials between different/neighbouring suppliers must be prevented and where they occur they will have to be justified.
- An effort should be made to establish and publicize the average level of cross subsidy between customer categories so that customers are made aware of it.

Also, NER advised that tariffs should take account of a number of other factors, such as the need; to be easily and economically administered, to reflect the cost of differing levels of quality of supply, to facilitate the use of appropriate technologies and ensure stability, simplicity and understandable.

However, it would appear these above factors were not fully considered in the overall tariff system in the country as a general framework targeting poor households was absent. However, NER did propose a poverty tariff in September 1998, aiming at poor households that were defined as those with a monthly income of less than R500. This forms the basis of the current poverty tariff just administered. As explained above, the tariff system is very diverse, and so difficult to discuss as there are more 200 electricity distributors and all have different tariffs. Hence, only that from Eskom will be discussed, as it is by far the largest electricity distributor in the country, although the case of one municipality will also be discussed.

Eskom charges and tariffs

The Eskom charges and tariff structure is categorized depending on various factors, but the major classifications divide rural or urban customers, residence type and load factors. These different factors are shown below.

Connection fees

Eskom fees shown below are the minimum cash amounts payable. In certain cases there will be additional charges depending on their actual cost policy. This fee is paid once off and up-front as a contribution towards the cost of providing the supply. In order to send out the correct pricing signal

to take an appropriate supply size, the connection fee is differentiated on the capacity and number of phases of the supply.

Table 8: Rural connection fees
Source: Eskom (2003)

Capacity	*Conventional*	*Prepayment*
5 kVA (single-phase)	R1 403.51 + VAT = R1 600.00	R1 403.51 + VAT = R1 600.00
16 kVA (single-phase)	R2 280.70 + VAT = R2 600.00	R2 280.70 + VAT = R2 600.00
25 kVA (three-phase)	R3 508.77 + VAT = R4 000.00	N/A
32 kVA (dual-phase)	R3 508.77 + VAT = R4 000.00	R3 508.77 + VAT = R4 000.00
50 kVA (three-phase)	R4 824.56 + VAT = R5 500.00	R5 701.75 + VAT = R6 500.00
64 kVA (dual-phase)	R4 824.56 + VAT = R5 500.00	N/A

Domestic tariffs

Homelight
The Homelight range of tariffs is applicable to single-phase, low-usage residential supplies, but can also be applied to churches, schools, halls or similar premises with low usage. The tariff has different energy rates based on the supply capacity required and provides for a subsidy to low-usage customers.

There are basically two categories of the tariff:

- Homelight 1: Lower connection fee with higher energy charges.
- Homelight 2: Higher connection fee with lower energy charges.

For a new connection, an up-front payment may be applied in addition to the standard tariffs in order for Eskom to recover capital costs that are not covered by the tariff. The energy charges are as shown in Table 9.

Table 9: Energy charges for Homelight tariff
Source: Eskom (2003)

Homelight 1	2.5 A	38.13c + VAT = 43.47c/kWh
	20 A	38.13c + VAT = 43.47c/kWh
	60 A	42.89c + VAT = 48.89c/kWh
Homelight 2	20 A*	33.11c + VAT = 37.75c/kWh
	60 A	37.87c + VAT = 43.17c/kWh
** This tariff rate is also applicable in selected urban areas for 60 A supplies.*		

Within the Homelight tariff category, any combination of appliances can be used at the same time as long as the power limit does not exceed a maximum of 525 W for 2.5A-limited supply, 4 200 W for 20A-limited supply and 12 500 W for 60A-limited supply.

Rural tariffs

Nightsave Rural
Applicable to rural areas and has the following attributes:

- Notified maximum demand of at least 25 kW/kVA.
- Supply voltage less than or equal to 22 kV (33 kV in some instances).
- Demand tariff with peak and off-peak periods.
- Seasonally differentiated.

The service charge in Nightsave Rural is a fixed charge payable every month, whether electricity is consumed or not, based on the sum of the utilized capacity of all POD's linked to an account. It is a contribution towards Eskom's costs for customer service.

Rural Flex
This is a time-of-use electricity tariff for rural customers with 3-phase supplies. It has the following major characteristics:

- Notified maximum demand of at least 25 kW/kVA.
- For supplies from 400 V up to and including 22 kV (33 kV in some instances).
- Time-of-use (TOU) tariff with peak, standard and off-peak periods.
- Seasonally differentiated.

Land Rate
This is an electricity tariff for rural customers with supplies up to 100 kVA.

Eskom tariff increases
In January of each year Eskom's average electricity price is increased. The average tariff increases for the last 15 years are indicated in Table 11. In certain cases, reportedly due to structural changes, there were higher or lower increases than the average tariff increase.

Table 11: Eskom's average tariff increase for the last 15 years
Source: Eskom (2003)

Year	*Average tariff increase*	*CPI*
1989	10.00%	14.51%
1990	14.00%	14.29%
1991	8.00%	15.57%
1992	9.00%	13.67%
1993	8.00%	9.87%
1994	7.00%	8.82%
1995	4.00%	8.71%
1996	4.00%	7.32%
1997	5.00%	8.62%
1998	5.00%	6.87%
1999	4.50%	5.21%
2000	5.50%	5.37%
2001	5.20%	5.70%
2002	6.20%	(projected) 9.40%
2003	8.43%	(projected) 7.40%

3.3.3 Municipal tariffs
As mentioned in preceding sections, there are numerous tariffs charged by municipalities. One case example will therefore be used to give an overview of the electricity charges by municipalities. Table 10 shows the different electricity tariffs charged by the city of Cape Town municipality.

Table 10: Cape Town City electricity tariffs

Domestic 1 (above 500 units per month)	*Present (excluding VAT)*	*From 1 July 2003 (excluding VAT)*
Monthly service charge	R30.00	R31.50
Daily service charge	R0.9825	R1.036
Energy charge (c/kWh)	27.80	29.19
Domestic 2 (below 500 units per month)		
Energy charge (c/kWh)	34.05	35.75

3.4 Power sector policy

Under the apartheid system, which prevailed until 1994, development progressed on racial lines, and this principle pervaded the energy industry. In general, the focus of electricity provision was on heavy industry, mining, and the white households forming about 12% of the total population. At the democratic elections held in 1994, the provision of electricity to the disadvantaged, mostly blacks, was a major issue. 'Access to electricity for all' was an election slogan for the African National Congress (ANC) that won the elections. This promise was perceived as *grid* electricity for all – including in remote areas of the country. The expected development path of the ANC government, as outlined in the Reconstruction and Development Programme (RDP) in 1994, pivoted around economic growth, job creation and access to key services including energy. In general, therefore, energy policies that emerged after 1994 were aimed at achieving these goals. The Energy White Paper released in 1998 provided a framework and guidelines for the government to achieve the stated energy objectives, of which one was universal household access to electricity (with priority for the poor) while alleviating negative environmental impacts.

3.4.1 Power sector reforms

Two key power sector statues made during the apartheid era that had a profound impact on electricity production and use were the Escom Act, No 40 of 1987, and the Electricity Act, No 41 of 1987. The Escom Act defined the responsibilities of Eskom to provide electricity in the most cost - effective manner, but did not give it a public mandate to supply electricity to all (Eberhard & van Horen 1995). The Electricity Act defined the structure, functions and responsibilities of the Electricity Control Board and assigned the sole right of electricity supply within municipal boundaries to local government. However, changes to the energy sector started occurring in the late 1980s, which led to negotiations between the government and the democratic movement in 1992. Eskom was then established (originally Escom) in terms of the Electricity Act of 1992, to be controlled by an Electricity Council made up of representative of stakeholders, with duties including appointing Eskom's management board. One of the major tasks to Eskom was to increase electricity access to three million homes by 1996.

Another major change by the government was a decision to embark on corporatisation of parastatals, including the power sector. The government then embarked on a policy to restructure the electricity assets of Eskom by the Eskom Conversion Act. According to the Act, the government intends to restructure the electricity supply industry (ESI) by selling off 30% of Eskom's generating assests by 2006 without compromising the social and development goals of the country. Several issues surrounding this proposed sale are an ongoing debate, but the government in several pronouncements has clearly stated that the sales will go to mostly to previously disadvantaged groups (black economic empowerment groups) and employee-participation schemes, with the emphasis on the former. The rationale for government's decision was that the restructuring should not only increase efficiency but provide the opportunity to correct previous imbalances in management and operations in the electricity sector. Hence, the Conversion Act may pave the way for new independent power producers. Another aspect of the Act was the continuing corporatisation of Eskom, changing it from a parastatal to a public company. Other plans include the rationalization of the electricity distribution industry, combining Eskom and municipal distributor into six new regional electricity distributors. However, the exact timing of operationalising all these changes is still under discussion. The impact of all these changes on access to affordable electricity by the poor communities is yet to be fully studied. Generally, however, reforms in Africa have, in fact, led to higher electricity tariffs and reduced access. Putting emphasis on increased efficiency do not always lead to increased access and lower tariffs in a society of significant suppressed demand and large number of poor communities (Davidson & Sokona 2002).

3.4.2 Rationale for reforms

Power sector reform was necessary in South Africa to address the anomalies already expressed and this has an impact on all reform policies. The broad energy policy of the current government is as follows:

- addressing energy requirements of the poor;
- enhancing competitiveness of the economy by providing low-cost high-quality energy inputs to industrial, mining and other sectors; and
- achieving environmental sustainability of natural resources.

Among other aspect of the broad energy policy is attraction of direct foreign investment in the power sector. In the Energy White Paper of 1998 the government identified key policy problems and challenges in the electricity sector that would need attention, these are as follows:

- Approximately 40% of all homes in South Africa, and tens of thousands of schools and clinics, are without ready access to an electricity supply.
- The distribution sector of the industry is highly fragmented, with more than 400 distributors, resulting in low efficiencies, high costs, wide disparities in tariffs, and financial viability problems in many distributors.
- The electricity distribution industry continues to experience high levels of non-payment and electricity theft, resulting in increasing arrears and payment defaults.
- Apart from a few notable exceptions the electrification programmes of most municipal distributors are limited by difficulties in accessing affordable finance.
- Municipal electricity departments are expected to make a contribution towards the funding of other municipal services, particularly in the major urban areas, but are also faced with the burdens of non-payment and the need for significant expenditure on electrification.
- Coal-based electricity generation results in significant polluting emissions, with potential long-term effects on the environment.
- In some cases electricity is used inefficiently, perhaps because of a consumer perception that electricity is cheap, thus wasting scarce energy and capital resources.
- Although growth in electricity demand is only projected to exceed generation capacity by approximately the year 2007, long capacity-expansion lead times require strategies to be in place in the mid-term, in order to meet the needs of the growing economy.
- While a number of the challenges presented above could place inflationary pressure on prices, South Africa has to maintain the competitive advantage of low, stable and cost-reflective electricity prices.

In the White Paper, the government called for measures to address these challenges while maximising all potential for adequate, reliable, and low-cost electricity for the people and industries of South Africa.

3.4.3 Issues of reform

Reforms in the distribution industry

According to the Energy White Paper, reforms in the electricity distribution industry were necessary because of limitations to achieve the primary objective in meeting the electrification targets set, of ensuring high quality supply that is low-cost and equitably priced to all consumers. However, the stated challenges in the distribution industry include the following:

- A highly fragmented distribution industry, with more than more than 120 municipalities that had less than 1000 customers and more than 90 municipalities with revenue of less than R1 million per annum.
- Substantial differences in the financial status of municipal distributors.
- Wide disparity in the prices paid by customer segments that could not be fully explained by the costs associated with serving the segments.
- The failure by small distributors to capture economies of scale, skill and specialization in order to effect average distribution costs.
- Uneven distribution of electrification needs across regions, with some of the poorer regions having the greatest need, whereby without explicit or transparent funding mechanisms there would be risks that many distributors would not be able to fund their electrification targets. In addition, it was seen that since electrification was a national objective, cross-regional subsidization should be considered as an equitable way to fund the electrification programme.
- Financial inability of many distributors whereas, collectively, the industry was able to fund both the supply of electricity and electrification over the long-term.

The objectives of restructuring the distribution industry were stated as:

- ensuring agreed-to electrification targets are met;
- providing low-cost electricity;
- facilitating better price equality;
- improving the financial health of the industry;
- improving quality of service and supply;
- fostering proper co-ordination of operations and investment capital; and
- Attracting and retaining competent employees.

Eskom governance

The Eskom Conversion Act 13 of 2001 changed Eskom from a statutory body into a public company in July 2002. It was stated that the change was envisaged to provide an opportunity to review the governance structure of Eskom to a more effective and streamlined decision-making process. Thus the Eskom committees were reduced and the previously two-tier governance structure of having the Electricity Council and the Management Board was replaced by a Board of Directors.

With this new structure, Eskom embarked on strategic initiatives with an intention to become the pre-eminent African energy and related services business institution in Africa. Also, Eskom assumed a global stature, and has over the years initiated a number of action plans to facilitate the achievement of this new strategy. Eskom has also enlarged its interests in the continent and now is involved in 39 out of the 53 African countries.

National Electricity Regulator

In an attempt to address the apartheid challenges facing the country, the government established the National Electrification Forum in May 1993. After a period of deliberations and consultations with various stakeholders, the National Electrification Forum presented a set of recommendations in 1994 to cabinet, and this led to the establishment of the NER in April 1995 as a successor to the Electricity Control Board that was established in Act No, 41 of 1987 to regulate the ESI in the country. NER was given national jurisdiction and exercises its power through the licensing of generators, transmitters and distributors of electricity in the country. In many documents NER sees its role as 'to regulate the electricity supply industry to ensure that it meets customer requirements'.

Among the initial tasks of the NER was the development of financial models for the national electrification programme which led to the establishment of a national electrification target of 2.5 million household connections by the end of 1999, with schools and clinics as priority as stated in the RDP. As a contribution to the RDP, Eskom set a target of delivering 1.75 million household connections at 300 000 per annum.

3.4.4 Institutional changes

The current institutional framework in South Africa electricity industry is based on the following major institutional developments.

- ***Electricity Act 41 of 1987*** - Defining the structure, functions ad responsibilities of the Electricity Control Board ad assigning the sole right of electricity supply within municipal boundaries to local government authorities
- ***The Escom Act 40 of 1987*** - Defining the responsibilities of ESKOM
- ***Electricity Amendment Act 58 of 1989*** - Amending the Electricity Act, 1987 to provide levy on electricity so that a license shall not be required for the generation of electricity, and to provide for the transfer of servitudes on the transfer of undertakings; and other incidental matters.
- ***Nuclear Energy Act 3 of 1993*** -Bringing all nuclear activities funded by the state under the control of the atomic energy, with specified exceptions
- ***Electricity Amendment Act 46 of 1994*** – Amending the Electricity Act of 1987 by deleting or substituting certain definitions to provide for the continued existence of the Electricity Control Board as the National Electricity Regulator, and to apply certain provisions of the Act to other institutions and bodies.

- ***Electricity Amendment Act 60 of 1995*** – Amending further the Electricity Act of 1987 to establish the National Electricity Regulator with the juristic authority to set up the office.
- ***White Paper on Energy Policy, 1998*** – Clarifying government policy regarding the supply and consumption of energy for the next decade. Areas covered include strengthens existing energy systems, development of underdeveloped systems and suggestions for changes in many areas. In addition, it addresses international trade and co-operation, capacity building, and the collection of adequate information.
- ***Regulations to the Electricity Act*** - Stating regulation of certain aspects of electricity services.
- ***Promotion of access to information Act 2 of 2000*** - Setting constitutional right to access of information held by the state or another person for the exercise of protection of any rights or to provide for matters connected therewith.

3.5 Power sector reforms and impacts on the electricity industry

Electricity supply
Key development aspects of electricity supply were given by NER as;

- eliminating monopolies in the generation and sales/supply sectors;
- rationalizing end-use prices and tariffs;
- giving customers the right to choose their electricity supplier;
- creating an electricity market;
- introducing competition into the industry, especially in the generation sector;
- addressing the impact of generation, transmission and distribution on the environment;
- permitting open, non-discriminatory access to the transmission system;
- levelling of the playing fields between distributors of electricity; and
- Encouraging private sector participation in the industry.

Electricity generation
There are currently 14 generation licensees in South Africa, generating from 53 licensed power generation stations. They are distributed as: Eskom – 95.9%, local government – 1.0%, and the private sector – 3.1%. The total energy produced from these power stations amounted to 197 TWh in 2000 (190 TWh in 1999). The net electricity sent out by generators in the year 2000 was 187.7 TWh. The difference is due to own use of generation and the use of pumped storage schemes. There is an excess of generation capacity in South Africa, but this margin will be used up due to increase in demand. Also, power is imported to South Africa on favourable terms, mainly from the Cahora Bassa hydroelectric power generation scheme on the Zambezi River in Mozambique.

Electricity transmission
Eskom holds the licence as the National Transmitter for South Africa. The Transmission License provides for:

- non-discriminatory access by generators being dispatched centrally;
- offering a transmission service to parties who are in a position to take supply directly off the transmission system;
- central dispatch of power stations participating in the national power pool;
- organising the exports and imports of electricity.

A private transmission company, Motraco, was licensed to provide a specific transmission service from the National Transmission System to specific supply points in Mozambique and Swaziland.

Electricity distribution

The electricity distribution industry is controlled by Eskom's distribution department and the electricity departments of more than 400 municipalities. However, the government has decided to form six financially viable regional electricity distributors (REDs). An interim body, called EDI Holdings will oversee the transition period until the distribution system becomes independent, and will be responsible for the distribution of electricity and collection of revenue.

3.5.1 Impacts on access to electricity

Impacts of the National Electrification Programme

Phase I of the National Electrification Programme commenced in 1994 and was completed at the end of 1999 at a total cost of about R8 billion resulted in an increase in electrification from about 36% to 66% nationally. This programme was unique because it was nationally financed and the motive was more social than economic, to satisfy the needs of the country. The project was envisaged to generate 8 000 jobs annually, though it did generate jobs but more study is required to establish the exact number of jobs created.

The Programme mainly targeted electrifying households and social services such as schools and clinics but not productive activities such as small-scale industries or commercial activities, though the latter had sprung up, as is common with such programmes. Targeting income-generating activities needs further consideration in future programmes, as this will directly stimulate economic activities and so lead to real improvements in the quality of life of the energy users. Also, the electrification programme could be improved if the programme is part of a broad strategy and that needs to be included with other sectors in the planning stage.

In an independent evaluation of the electrification programme, sponsored by government, it was stated that the programme was successful in meeting its target in the given timeframe and provides a precedent for replication outside South Africa. Also, during the programme innovative approaches and technologies were pioneered which can provide many lessons, such as reducing the cost of connection. The evaluation shows that the programme improved the welfare of households, but benefits are more limited where electricity is used for only lighting and media, compared to cases where electricity is also used for cooking and heating. It was shown that household monthly consumption was just over 100kWh, which was far lower than the expected 350kWh that was envisaged at the onset of the electrification programme. The report recorded benefits from the programme to schools and clinics as it improves the overall learning improvement and medical services supplied. Small enterprises such as workshops, food retailers and entertainment are also benefited from the programme. However, from an economic perspective the programme is not sustainable because operational costs were not covered by revenue generated, and the average cost was found to be higher than the NER target, and non-technical losses were higher (DME 2001).

In general, electricity access is a function of income and this is clearly shown for South Africa before the electrification programme (see Table 12). Unplanned homes in urban areas and scattered rural settlements hardly had any access to electricity while the wealthy had complete access. However, with the electrification programme, marked improvement was achieved, as shown in Table 13, because according to Figure 3, electricity access to rural households was around 20% and 50% for urban, but by Table 13, which largely corroborates Figure 3, electrification increased to 50% and over 65% respectively.

Table 12: South African population by housing type and access to electricity, 1992
Source: Eberhard and van Horen (1995)

Housing category	*No. of houses*	*Percentage access*
High income formal	2 100 000	100
Low income formal	800 000	72
Planned informal	600 000	12
Unplanned informal	500 000	0
Backyard shack	700 000	17
Rural farm workers	900 000	15
Rural dense	1 150 000	4
Rural scattered	1 150 000	1
Total	**7 900 000**	**39**

Table 13: Access to network electricity according to household income, 2002
Source: UCT (2002)

Quintile	*Urban households*		*Rural households*		*Number not electrified*	
	Number	*% electrified*	*Number*	*% electrified*	*Urban*	*Rural*
1 (Poor)	483 201	54%	1 525 820	38%	223 505	952 543
2	845 603	65%	1 169 135	46%	297 355	636 526
3	1 328 804	74%	693 555	61%	342 774	272 679
4	1 691 205	85%	336 869	72%	250 671	93 174
5 (Wealthy)	1 751 605	100%	277 422	99%	0	2 169
All quintiles	**6 100 418**	**83%**	**4 002 801**	**51%**	**1 057 750**	**1 957 090**

Impacts of the non-grid rural electrification programme

The non-grid electrification programme initially undertook to electrify some 50 000 households with SHSs over a seven-year period – later changed to five years. The concession off-grid rural electrification programme was planned to start in June 1999 but delayed to October 2000 because of lack of preparedness by government institutions to start the programme. This programme initially involved two concession areas, KwaZulu-Natal and Eastern Cape that are operated by Eskom/Shell. At the end of 2001, two more concessions were operational by Solar Vision and RAPs(NuRa) in the Limpopo province and Northern KwaZulu-Natal respectively. EDF and Solar Energy Africa have recently started operating in KwaZulu-Natal and Eastern Cape respectively. The major component of this programme is the direct subsidy by government of R3500 per system installed to the concessionaire. In addition, the user pays R58 to the concessionaire as a monthly service fee. So far, three of the five concessions are being evaluated, Eskom/Shell, Solar Vision and RAPS(NuRa).

At a recent meeting of the Parliamentary Portfolio Committee in which hearings were held on the SHS electrification programme, the representatives of rural users of SHS reported that these systems were useful in providing improved lighting and media, but users were dissatisfied with the monthly service payment when compared with those with access to grid electricity. The SHS users pay R58 per month for only lighting and media, while their counterparts with grid electricity pay an average of about R30 monthly. The grid users can occasionally use cooking stoves and other appliances in addition to lighting and media that is enjoyed by SHS user. This clearly gives the grid user an advantage over the SHS user. The flexibility of the grid and opportunity for longer-term use were added advantages to the grid user. (Afrane-Okese & Muller 2003).

Major problems of the off-grid electrification programme identified by Afrane-Okese et al, (2001) are:

- Insufficient planning/research, affected the implementation of the prgramme.

- Inflexible levels of service to accommodate different categories of customers that have needs beyond the four lights, radio/ hi-fi and black and white TV offered by the SHS.
- Lack of adequate after installation services of the SHS.
- Theft and vandalism of the systems.
- Lack of ownership of the systems as the systems belong to the concessionaires.
- Lack of infrastructural support such as accessible roads for easy servicing, transport, health, water, telecommunication and industrial development. Hence the need for integrated programmes rather than stand-alone SHS projects.
- Lack of sufficient training of community based technicians. Provision of training would also create jobs and promote awareness within the rural communities.
- Misrepresentation by the SHS installers especially about the capacity of the system which created unreasonable expectations among the communities about the capability of the SHSs (Afrane-Okese & Mohlakoana 2001).

Impacts of electricity access on the economy

Generally, increased electricity access stimulate business establishment. In the programmes in South Africa, explicit measures were not targeting income generating activities but evidence shows that some business were developed due to increased electrification.

3.5.2 Impacts of electrification on the poor

Generally, it has been shown that the welfare of communities with electrification has improved significantly for both off-grid and grid programmes. However, the levels of improvement differ especially between off-grid and grid connected as the services to the former were limited to only lighting and media. The welfare benefits were greater for grid connected users but were lower than anticipated because the consumption levels were also lower than expected at the start of the programme (Borchers et al 2001).

Electrification to the poor also resulted in community-wide benefits. These include reduction of fires (particularly in low-income urban areas) from use of paraffin and candles as electrification reduces their use as well as reduction of local and indoor air pollution from firewood use especially in areas that uses these fuels extensively used for cooking and heating. Electrification of clinics and schools has also resulted in significant benefits for communities, with improved health-care service provision and enabling schools to become involved in evening adult education as well as improving the efficiency of school operations, through use of equipment such as photocopiers and computers. In certain cases electric street lighting may contributed to reduced crime levels.

The recently direct subsidy to the poor under the electricity basic services support tariff "poverty tariff" (EBSST) has started showing positive signs though the programme was only introduced recently. In an evaluation done by the University of Cape town, the results show an increase in average monthly household income, from R4.80 to R5.50 per person per day (UCT 2002). In some communities it was reported that about 30% of households had added lights in previously non-electrified rooms and in another, 33% of households started using appliances that they owned but were not able to use before the programme was implemented. Responses to queries about the benefits from the electricity subsidy were reported as follows:

- able to use more electric light;
- able to cook more efficiently;
- able to use electricity for the whole month;
- able to use more electrical appliances;
- schoolchildren can study for longer periods with better lighting;
- able to use radio and television for longer periods;
- able to spend money saved from electricity on food;
- reduced fuelwood collection journeys for women and children;
- reduced indoor pollution due to fuel substitution;
- reduced anxiety about electricity being an expensive source of energy.

3.5.3 Impacts on electricity expenditure

Electricity expenditure at national level

Disaggregated data on trends on electricity expenditure at national levels are not available and so the analysis on trends will be limited. As a result, sectoral sales of electricity will be used to give an indication. It can be seen from Table 14 that residential sales grew substantially between 1995 and 2000, almost 40% in absolute terms, followed by the industrial sector that increased by just over 20% in the same period. Figure 6 shows the significant growth in the residential sector which is due to the growth in electrified houses that reached 68% of total.

Table 14: Sales of electricity to categories of customers (GWh)
Source: Eskom (1996; 1998; 2000)

Category	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Residential	3 906	4 753	5 494	5 989	6 057	6 476
Agriculture	3 383	3 239	3 402	3 725	3 890	3 816
Commercial	579	654	979	801	817	768
Industrial	42 244	47 451	52 236	53 683	54 240	55 953
Mining	31 293	31 188	33 077	31 645	31 505	31 403
Average price (c/kWh sold)	11.15	11.30	11.85	12.29	12.44	13.23

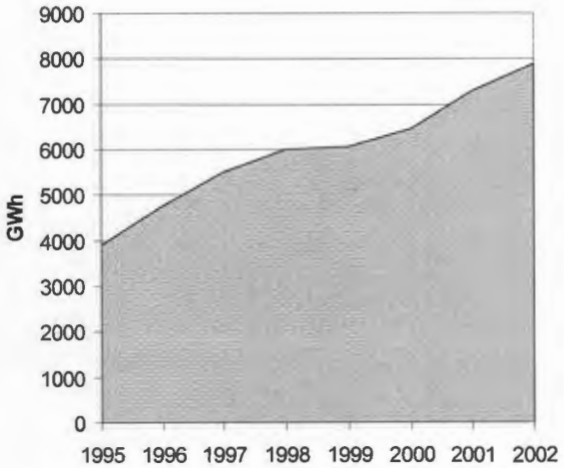

Figure 6: Trends in Eskom residential electricity consumption, 1995-2002

Electricity expenditure by poor households

Similarly, as was said previously in this report, data limitations will restrict the level of analysis on the energy consumption and expenditure patterns of the poor. However, there are few studies which can be used to give an indication of these parameters. A major recent study done by the University of Cape Town that undergo a preliminary evaluation of the impact of electricity basic services support tariff "poverty tariff" (EBSST) in South Africa can be used as an indicator of these parameters because only sample areas were studied and cannot be taken as true representative of the country. In this study, two case studies in KwaZulu-Natal province were used. The results from these studies are therefore used as used as indication for poor households. The communities were Umgaga, a long established peri-urban settlement located about 35 kilometres from the centre of Durban, and Antioch, a village located about 180 kilometres from the city of Pietermarizburg (UCT 2002).

Tables 15 and 16 show that despite both societies are poor (South African standards), there are major disparities between the two areas in terms of electricity expenditure and consumption levels. The average income of Antioch is in the margin of poverty as described by the government and average

income in Umgaga doubles that value. This difference is reflected in the amount of electricity consumed but the poor in the village spends substantially higher share of their income for electricity.

It can be seen from Table 17 that in rural Antioch, 23 households (56%) consumed electricity in the range of 20-50kWh, while in peri-urban Umgaga, 2 households (4.5%) consumed electricity within this range. The study further shows that households that consume less than 25kWh per month are used primarily for lighting at night and for radios. These results clearly shows that consumption patterns between the two areas as the village use is largely skewed towards 50 kWh, while in the township it is around 200 kWh. This very revealing because it does not only give more credence to the policy of free electricity up to 50 kWh, but show that in the township with unrestricted electricity, users are limited by affordability. In another study (Thom & Mohlakoana 2001), it was shown that poor households use between 20 and 30 kWh per month which provided services for two lights for three hours each day; one light for 1.5 hours each morning; and one radio for 16 hours each day. This study also show that the consumption of the poor is constrained by affordability.

Table 15: Household income and expenditure: Antioch and Umgaga, 2001

Attribute	*Antioch*	*Umgaga*
Average number of household occupants	6	6
Average total household income	R817	R1 678
Minimum total household income	R223	R0
Maximum total household income	R1 770	R6 120
Total energy expenditure	R107	R97
Minimum energy expenditure	R20	R15
Maximum total energy expenditure	R303	R255
Energy expenditure as % of total household expenditure	17%	12%

Table 16: Monthly household electricity expenditure and consumption, 2001

Attribute	*Antioch*	*Umgaga*
Average expenditure	R26	R65
Minimum expenditure	R3	R15
Maximum expenditure	R100	R200
Average consumption of electricity units (from expenditure)	68kWh	170kWh
Minimum consumed units	8kWh	39kWh
Maximum consumed units	265kWh	520kWh
Average consumption (from measurements)	61	-
Minimum consumption	6kWh	-
Maximum consumption	242kWh	-

Table 17: Distribution of household electricity consumptions, 2001

Electricity consumption (kWh/month)	*No. of household in Antioch (based on measured load)*	*No of households in Umgaga (based on reported expenditure)*
0-25	14	0
25-50	9	2
50-75	5	7
75-100	6	5
100-150	3	11
150-200	2	4
200-300	2	11
300-400	0	0
400-500	0	2
> 500	0	2
Total	41	44

3.6 Subsidies to the poor

Electrification subsidies

The government set up the National Electrification Fund (NEF) to subsidize a portion of the capital costs of electricity connections in the electrification programme. This Fund derives its income not only from the electricity industry, but also fiscal allocations, grants and other sources. A standard connection subsidy is given to the backlog as well as new households under the national electrification programme, with differentiation in subsidy level on the basis of geographic region, supply technology or other factors.

In previous electrification initiatives, resources were allocated every year to the electrification programme through the mechanism of internal cross-subsidization and surcharge included in the electricity price of Eskom and local authority distributors. These mechanisms have been seen as non-transparent and with little room for government influence over the collection and allocation of the surcharge (White Paper 1998). The surcharge included in the electricity price was envisaged to be replaced by an electrification levy. It was intended that these changes should not affect amount level of funding of electrification or the level of the electricity tariff. NEF extends to non-grid electrification where grid electrification will not be viable for some time.

3.6.1 Basic electricity support tariff

In 2000, the South African government announced its intention to provide to the poor with free basic services. The main focus areas were water and electricity (DME 2003). This policy went back to 1998 when NER made a proposal for implementing a 'poverty tariff' for South Africa. Based on a Cabinet decision of January 2001, DME in October 2001 commissioned studies for formulating the EBSST policy framework. Research focused on the following major areas:

- level of the free basic electricity allocation;
- identification of recipients of the allocation;
- cost implications of such an allocation;
- sustainable sources of funding for such allocations.

Based on work conducted, it was recommended that 50kWh per month be provided to all poor households connected to the national electricity grid. The decision relating to 50kWh was arrived at because 56% of connected households in South Africa consume an average of less than 50kWh/month, and this is expected to meet the needs for lighting, media access, limited water heating and basic ironing or cooking for a poor household. It was therefore seen as an initiative to alleviate the burden of the poorest sector of the population. As the government recognized that there

might be difficulties in applying this recommendation, the policy include some flexibility of a range of 20-50kWh per month.

There are numerous tariffs settings in South Africa, making it difficult to translate the 20-50kWh into monetary terms. Using the Eskom tariff for domestic customers the 50kWh subsidy in 2002 translated to about R20 per month. Applying this subsidy to Eskom tariffs, and assuming that 40% of domestic customers (7.1 million in 2001) would be targeted for EBSST, the cost of the subsidy would result in a revenue loss (exclusive of VAT) of about R630 million per year (UCT 2002). The government has recently committed itself to spend more that half a billion Rands annually on this programme.

Beneficiaries of the EBSST

While the prime objectives of the EBSST were to help in the alleviation of poverty, but some key issues need to be resolved. These include:

- Who are the poor the EBSST intended to reach with an electricity subsidy?
- What contribution can electricity make to the alleviation of poverty?
- Is access to electricity a basic right?
- Can EBSST, in conjunction with an electrification programme, make meaningful progress towards the reduction of poverty and the improvement of living conditions?

The study on EBSST previously discussed provided some answers to these questions. The study considered the baseline of 800 Rands/month as inadequate in defining poverty and use different approaches. One such approach was to extend the support to all households and using a self-targeting approach to those willing to accept a restricted supply of electricity. In this approach, the poor household would either apply for a limited electricity supply and then become eligible for the free basic electricity allocation, or the service provider would identify households consuming less than a pre-determined amount of electricity per month and then automatically apply the free electricity allocation. However, whichever approach used had problems of excluding some of the poor due disconnection or non-payment.

Adequacy of EBSST

EBSST provides a good case for analysing the adequacy of electricity subsidies as the subsidy was basically for lighting, media access and limited cooking, and they are expected to play an important role in poverty alleviation. It will provide appropriate conditions for education and learning, health and access to news and information. The results of the EBSST study give more details on the adequacy of this assumption. The consumption of commonly used electrical appliances is given in Table 18.

Table18: Electricity consumption of a household with common electric appliances

Appliance	*Units*	*Electrical rating*	*Hours of use/day*	*Units/month (31 days) kWh*
Light bulbs	3	60W	5 hours	27.90
Television 37" (colour)	1	50W	6 hours	9.30
Radio (portable)	1	6W	4 hours	0.744
2 plate stove	1	2000W	2 hours	248.0
Iron	1	1000W	¼ hours	7.75
Kettle	1	2000W	¼ hours	15.50
Total monthly units				309.194

The EBSST is expected to give poor households free electricity in the range of 20-50kWh per month, but Table 16 suggests that 50kWh only constitutes about 16% of the electricity consumption of an average household per month, amounting to electricity for lighting, television, radio, ironing and for an electric kettle. Using a two-plate stove would exceed the amount of the units given under the EBSST. The EBSST study recommended that basic free electricity for poor household should be enough for two 60W lamps for 6 hours/night; one radio for 10 hours/day; and one 1600W hot-plate for 0.7 hours/day. This scenario would translate to 60kWh of electricity consumption per month,

above the maximum EBSST free electricity. However, the use of higher-efficiency lighting and efficient cookers, if promoted along with the EBSST initiative would help, as use of compact fluorescent bulbs (CFLs) and efficient cookers could reduce the consumption from 60kWh to 35-40kWh per month.

A study was also conducted to monitor the impact of the EBSST on the consumption of electricity in four rural villages and the results are shown in Table 19.

Table 19: Expenditure on electricity in four rural villages, 2001-2002
Source: UCT (2003)

Expenditure		*Garagopola (Rural)*		*Antioch (Rural)*		*Ikgomotseng (Peri-urban)*	*Maqongqo (Rural)*
		Pre May '01	*Post Feb-Sep '02*	*Pre Oct/Nov '01*	*Post Nov 01-Oct 02*	*Pre Sep '02*	*Pre Sep '03*
Expenditure on electricity (R/month)	Mean	47.3	39.8	28.4	20.7	14.8	35.4
	Std dev.	28.4	41.0	23.2	28.2	15.5	23.6
Expenditure on energy including electricity (R/month)	Mean	92.3	81.1	123.8	98.8	77.6	78.3
	Std dev.	68.1	77.7	87.7	109.1	47.5	45.3
Energy as % of total household expenditure	Mean	17.9	12.2	17.6	12.0	16.5	8.7
	Std dev.	19.3	9.5	8.7	9.9	9.6	6.8

While it is recognized that there was a tariff increase from year 2001 to 2002, results from Table 19 show a general decrease in electricity expenditure after the introduction of EBSST. This may be due many factors, such as the average electricity consumption of most poor households having reached the saturated point based on affordability, or lack of money. Decreased expenditure shows that there could be unused electrical appliances and that saturated demand could be a factor. This feature was studied and the results are given in Table 20.

Table 20: Use of previously unused electric appliances as a result of EBSST
Source: UCT (2003)

Previously unused electric appliances	*Garagopola (Households)*			*Antioch (Households)*		
	Count	*Yes*	*No*	*Count*	*Yes*	*No*
Has household been able to use previously unused appliances since EBSST	50	4 (8.0%)	46 (92.0%)	27	9 (33.3%)	18 (66.7%)
Has household bought new appliances since EBSST	50	6 (12.0%)	44 (88.0%)	28	11 (39.3%)	17 (60.7%)
Appliances newly utilized						
Electric kettle		2			1	
1-plate hotplate		1			0	
2-plate hotplate		1			0	
2-plate stove with oven		0			1	
Electric fridge		0			1	
Electric non-steam iron		0			4	
Steam iron		1			0	
Electric heater		0			1	
Total		5			8	

Table 20 shows that very few households responded to EBSST by buying and /or using electric appliances previously not used. For such households, a response to EBSST would probably result in the same expenditure on electricity even after introduction of EBSST, but with an increased spectrum of electricity services in the house. What is of particular interest is that there were some households with electric appliances that they started using only with the introduction of the EBSST, a typical case of suppressed electricity demand on the part of poor households.

On the other hand, continued suppression of electricity use in the presence of EBSST would imply savings on electricity expenditure. This would imply that households would be able to spend more on other household matters like food and clothing. In 2002 electricity units of 50kWh were equivalent to about R25 by 2002 electricity prices. The average saving on electricity expenditure was R7.50 per month, an average of a 5% decrease in total household expenditure per month.

4. ZIMBABWE

4.1 Country circumstances

Zimbabwe is a member of SADC and a landlocked country in Southern Africa, bordered by South Africa, Mozambique, Botswana and Zambia. It has a population of about 12.8 million people (2001) and a land area of 390 800 square kilometres. Zimbabwe obtained independence in April 1980 and inherited all the ills of a racial divided society. It has a developed industrial sector and better infrastructure than most of its neighbours, but the economy relies heavily on agricultural crops such as tobacco, cotton, and sugarcane, and on manufacturing industries such as steel, textiles and sugar production. Mining is a major activity, primarily gold. The Zimbabwean economy after independence continued to perform quite well, but ran into problems due to several internal and external problems including the disparities in access to resources, a legacy of the past, persistent droughts and economic reforms. As a result, the economy has suffered from fiscal problems and unemployment. Table 21 shows some key development indicators.

Table 21: Key Zimbabwe development indicators
Source: World Bank (2003)

Indicator	*1997*	*2000*	*2001*
Population, total	11.9 million	12.6 million	12.8 million
Population growth (annual %)	1.9	1.5	1.1
Illiteracy total (% age 15 and above)	13.7	11.3	10.7
Illiteracy female (% of age 15 and above)	18.3	15.4	14.5
Energy use per capita (kg of oil equivalent)	824.0	809.3	-
Electricity use per capita (kWh)	872.3	845.2	-
GDP (current $)	8.4 billion	7.2 billion	9.1 billion
GDP growth (annual %)	2.7	-4.9	-8.4
Exports of goods and services (% of GDP)	37.6	29.4	21.8
Imports of goods and services (% of GDP)	44.6	27.2	20.7
Trade in goods as a share of GDP (%)	66.8	49.6	36.5
Trade in goods as a share of goods GDP (%)	130.9	98.9	-
Foreign direct investment, net inflows in reporting country (current US$)	135.1 million	23.2 million	5.4 million
Present value of debt (current US$)	0.0	3.6 billion	3.5 billion
Total debt service (% of exports of goods and services)	22.2	22.1	6.8
Short-term debt outstanding (current US$)	977.0 million	563.0 million	495.3 million

4.1.1 Poverty in Zimbabwe

Poverty issues in Zimbabwe are closely related to the country's history of governance by the minority white government, particularly after the unilateral declaration of independence, and subsequent international isolation. These events resulted in economic and political benefits to whites, while ignoring the black majority. Racial division and economic inequality still pervade the Zimbabwean economy. After independence the government embarked on policies aimed at redressing economic imbalances, against a background of the private sector remaining in the hands of minority whites and multinational companies. The social sector was accorded a high proportion of government expenditure, including access to modern forms of energy with the hope of redressing the past inequalities. However, as Table 22 illustrates, the disparities in all forms of energy between rural and urban remains significant, except woodfuel – a low quality energy source.

Table 22: Household percentage access to energy sources in Zimbabwe
Source: Central Statistics Office (2001)

Energy source for cooking	*Urban areas*		*Rural areas*		*National*	
	Poor	*Non-poor*	*Poor*	*Non-poor*	*Poor*	*Non-poor*
Electricity	73.1	81.9	2.1	11.0	19.0	52.8
Kerosene	39.7	33.7	1.0	13.5	10.2	25.4
Wood or coal	12.7	5.4	98.6	80.6	78.1	36.3

4.2 Background to the power sector

Since attaining independence in 1980, Zimbabwe has embarked on various sector policy reforms including the energy sector. In the energy sector, the government embarked on a path of increasing energy access to previously disadvantaged people, including grid electricity expansion and off-grid electrification. Table 23 indicates some basic energy statistics.

Table 23: Zimbabwe energy picture, 2000
Source: IEA (2002)

Energy production	18.71 Mtoe
Total primary energy supply	10.22 Mtoe
Electricity consumption	10.67TWh
TPES/population	0.81toe/cap
TPES/GDP(ppp) (toe/000 95US$ppp)	0.32
Electricity consumption/population	844.78kWh/cap

Energy policy issues of Zimbabwe fall under five main objectives (Munjeri 2002):

- ensuring accelerated economic development;
- facilitating rural development;
- promoting small-medium scale enterprises;
- ensuring environmentally friendly energy development; and
- ensuring efficient utilization of energy resources.

4.2.1 Electricity sources in the country

The Zimbabwe Electricity Supply Authority (ZESA) is the nucleus of the generation, transmission and distribution of electricity in Zimbabwe. Zimbabwe has five major power stations, with a capacity of 1961 MW (Energy Policy, 2002). These facilities do not meet electricity demand and Zimbabwe imports 41% of its electricity from neighbouring countries, including the DRC, Botswana, Mozambique, Zambia and South Africa. Electricity generation in Zimbabwe is mainly from coal and hydro plants, the former with a capacity of 1295 MW, while the Kariba hydropower plant generates 666 MW (ZESA 2001).

Table 24: Power stations in Zimbabwe
Source: Energy Policy (2002)

Station	*Plant type*	*Capacity (MW)*	*Available capacity (MW)*
Kariba	Hydro	666	470
Hwange	Coal	920	800
Harare	Coal	135	60
Bulawayo	Coal	120	90
Munyati	Coal	120	60
Total		**1961**	**1620**

Table 25: Zimbabwe power imports
Source: Energy Policy (2002)

Country	Interconnection voltage (kV)	Maximum capacity (MW)	Available capacity (MW)
Mozambique	400	500	500
South Africa	400	500	150-500
Zambia	330	700	100-200
DR Congo	220 (to Zambia)	250	150
Botswana	220	100	Nil

Zimbabwe has an off-grid electrification programme that is mainly based on SHSs. Current estimates indicate that Zimbabwe has about 85 000 SHSs, making it one of the countries with the largest number of such systems in the continent (Mapako 2002). One reason for this has been the low-cost silicon-type solar modules imported from Botswana and South Africa. Some companies in Zimbabwe have also been known to sell do-it-yourself solar kits, thus making the dissemination of the solar technology user friendly. The major GEF-supported SHS project contributed to this large number of installation.

Zimbabwe has an estimated 200 biogas digesters, and in the south there are two sugarcane-crushing mills that use more than 1.3 million tonnes of bagasse to generate electricity that is used by the sugar factories. Animal power is a relatively significant source of energy in Zimbabwe, and estimates put the equivalent national animal power use in the agricultural sector at about seven million litres of diesel annually (Karekezi & Ranja1997).

4.2.2 Electricity tariffs, subsidies and expenditure

Understanding the situation in Zimbabwe requires a look at the trend in the local currency against the US dollar because of the major changes that occur in recent years, which will have significant effect on electricity tariffs and subsidies in Zimbabwe. Table 26 gives the exchange rate between 1995 and 2001.

Table 26: Exchange rate, Zimbabwe dollar per US dollar
Source: IMF (2002)

Year	1995	1996	1997	1998	1999	2000	2001
Period average rate	8.66	9.92	11.90	21.41	38.31	46.50	55.0

The government in Zimbabwe has final control in setting the level of tariffs, and there have been cases in the past when the government has rejected tariffs recommended by external consultants. Tariffs have been changing annually, as shown in Table 27.

Table 27: Electricity tariff trend, 1990-2001
Source: Energy Policy (2002)

Year	Av. price (US c/kWh)	Year	Av. price (US c/kWh)
1990	2.50	1996	3.29
1991	2.48	1997	3.49
1992	2.29	1998	1.40
1993	3.74	1999	2.35
1994	2.89	2000	4.06
1995	2.94	2001	4.86

In August 1999 an automatic tariff adjustment formula was introduced, whereby the tariff setting is based on several variables with different weights:

Exchange rate : 71% weighting

Inflation: 11% weighting

Fuel: 8% weighting

Autonomous: 10% weighting

Subsidies that apply to the poor in the tariff structure include the following:

- Lifeline tariff for lighting and small power applications, about 50 kWh per month.
- Lifeline tariff for lighting, small power and basic heating – e.g. hot-plate stove, ironing, about 300kWh per month.

These tariffs are based on an assessment of ability to pay and cost of alternative fuels. The ability to pay is taken within a range of 5-10% of take-home pay (*Energy Policy* 2002). There is a limit, however, on the level of subsidies that can be applied to domestic consumers, based on protection of lower-income groups while reducing the subsidy of high-income groups.

Lifeline electricity tariff subsidies in Zimbabwe entail preferential pricing to domestic consumers with lower consumption (Table 28). A flat rate of Z$3.21 is charged to units above the 1000kWh block, but this charge is less than the actual charge of Z$4.13 per kWh that is required to meet the cost of service and returns for system expansion. Subsidies are also extended to the connection fees, whereby ZESA charges below the true connection cost. Total ZESA annual electricity subsidies are reported to be in the range of 53.51% of the total revenue (Dube 2003).

Table 28: Domestic consumer subsidy structure
Adapted from Dube (2003)

Consumption block	*Tariffs/kWh (Z$)*
Up to 50 kWh	0.99
Up to 300kWh	Z$ 1.10
Up to 1000kWh	Z$ 3.09
Above 1000kWh	Z$ 3.21

According to the results of a study on electricity expenditure in urban areas (Table 29), poor households showed a higher percentage expenditure on electricity than non-poor households.

Table 29: Electricity consumption patterns of urban households
Adapted from Dube (2003)

Household Category	*Electricity consumption (kW)*	*Monthly cost as % of income*
All households	426	6.4
Non-poor households	574	4.6
All-poor households	335	7.6
Moderately poor households	350	5.2
Extremely poor households	302	10.4

Looking at the electricity consumption pattern and the available subsidies to domestic consumers, it was observed that removal of subsidies would result in increase of share of electricity expenditure to total income of 41% to the non-poor, 87% to the moderately poor and 87% to the extremely poor, as depicted in Table 30.

Table 30: Significance of electricity subsidies
Adapted from Dube (2003)

Household category	*Electricity cost without subsidy (Z$)*	*Subsidy amount (Z$)*	*Subsidy as % of energy expenditure*	*Subsidy as % of total income*
All households	1 695	681	67	4
Non-poor households	2 285	662	41	2
All-poor households	1 333	600	84	7
Moderately poor households	1 393	666	87	6
Extremely poor households	1 202	527	77	8

4.3 Power sector reforms

The power sector in Zimbabwe has been through different reforms since independence in 1980. In 1985, the government reformed the structure of power utilities under the Electricity Act. The five publicly owned power utilities were amalgamated to form the current ZESA with the aim of streamlining the administration of the electricity sector, improving efficiency, and reducing duplication of functions. ZESA became the only legal entity with the right to transmit and generate electricity. ZESA had the option of licensing independent power producers to generate electricity, but has the right to set the purchase price for purchasing electricity from the producer. The Act did not provide room for third party access nor other uses of the grid by third parties (ESMAP 2000).

In 1996, the government revised the Electricity Act in order to create room for independent power producers. Little response was achieved, probably because the revised Act still required independent producers above 100kW level to apply and seek approval from government and ZESA, and also the pricing, expenditure, capital budgets, procurement and staffing was to be regulated by government.

In 1996 too, the privatization and expansion of the Hwange power station was proposed. It was also recommended that in order for this project to be economically viable the long run marginal cost (LRMC) principle should be adopted as the cost was estimated at 6-7 US c/kWh and the average tariff then was 2.47 US c/kWh. The government agreed in principle to adopt the LRMC, but did not implement the recommendation. As a result, initiatives to privatize several power stations, including Hwange project, were abandoned (*Energy Policy* 2002).

In 1999 the government started to institute other reforms in the power sector. Programmes under consideration were unbundling of the electricity sector, establishing a regulator, privatization programme, and establishing a rural electrification fund based on 1% of all electricity bills collected. This fund is reported to have helped in the extension of grid electricity to rural households by contributing towards the initial capital investments (*Energy Policy* 2002). Since its inception in 1999, implementation of the rural electrification fund has been slow, and by April 2000 only 14 of the targeted 54 rural electrification projects had been completed. The failure to achieve the target was attributed mainly to the narrow contractor base used for the rural electrification programme rather than lack of funds, since the fund had an excess of Z$460 million by then (Kayo 2001).

In January 2002 a new Electricity Act and Rural Electrification Act was passed, whereby the power sector was to have a Regulatory Commission, a Rural Electrification Agency and unbundling of power supply to generation, transmission and distribution. Other changes are the privatization and establishment of the Rural Electrification Fund. The Electricity Act of 1985 was to be repealed when these new institutions were established (Mangwengwende 2002)

Generally speaking, four main factors have been seen to be behind power sector reforms in Zimbabwe (Turkson 2000):

- restructuring as a component of the general economic reforms;
- restructuring parastatals to empower historically marginalized groups;
- restructuring to enhance power sector efficiency; and
- restructuring to mobilize finance for capital investments in the power sector.

4.4 Electrification programmes

In line with power sector reforms, the government took initiatives to improve electricity access, especially to the rural areas. The Rural Electrification Programme was initiated in the 1980s, but it had to be abandoned in 1990 because of cash flow problems and lack of comprehensive policy on rural electrification. Under the Expanded Rural Electrification Programme, ZESA had the obligation to extend grid electrification to rural areas, based on development rather than economic merits. The vision of the programme was total electrification of the country (Bhagavan1990), thereby contributing to poverty alleviation by stimulating economic activities that create wealth. Long-term objectives of the programme were stated as:

- improving accessibility of electricity by all rural communities;
- improving the quality of life through the delivery of modern social services such as health, education etc;
- stimulating investment in rural areas so as to create employment and increase incomes;
- improving the general economic and social status of people in rural areas;
- helping to reverse urban migration and energy-related environmental degradation.

The first phase of the electrification programme was allocated a budget of US$500 million. The programme would involve electrification of areas within five kilometres of the network, followed by 5km distances increments, up to phase 4 when the extension distance would be 20km from the existing network (Munjeri 2002).

4.4.1 Impacts of reforms on electrification

In the first three years of operation of the reform programme, the expected improved efficiencies were not achieved and ZESA was operating at a loss and was forced to curtail some of their initiatives on rural electrification. In 1992, the government initiated a performance improvement programme whose objectives, among others, were to achieve growth of ZESA for total electrification of the country (Mangwengwende, 2002). As a result, access to electricity grew from 20% to 39% between 1991 and 1999, while distribution increased from 7% to 8.9% (Kayo 2001). Further, between 1999 and 2001 electrification grew from 39% to 42% (World Bank 2003). Currently, ZESA connects an average of 21,839 domestic customers per annum (Dube 2003).

Table 31: Power sector performance from 1999 to 2001
Source: World Bank (2003)

Indicator	*1999*	*2000*	*2001*
Total system losses (% sent out) target 10 – 12%	12.8	13.3	14.6
Generation plant availability (%) (target 90%)	65.8	72.5	75
Days for new connections (target 30 – 45 days)	35	23	32

Table 32: Urban and rural national electrification rates 1990 to 2001
Source: World Bank (2003), Kayo (2002)

Electrification level (%)	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
Urban rate	-	-	69.0	67.0	69.0	72.0	70.0	74.0	78.0	80.0	-	-
Rural rate	-	-	11.0	14.0	15.0	14.0	17.0	16.0	15.0	18.0	-	-
Total	20.0	20.0	28.0	29.0	31.0	32.0	34.0	35.0	36.0	39.0	40.0	42.0

The situation was different for off-grid electrification programmes. SHSs were installed in the rural services areas for health and education. Table 33 depicts the trend in number of installed systems in a GEF PV project. Between 1993 and 1997, more than 8 500 institutions and homes out of a total of over 2.5 million had been electrified under the project.

Table 33: Trends in number of installed GEF PV systems (45W equivalent)
Source: UNDP-GEF (1997)

End user	*1993*	*1994*	*1995*	*1996*	*1997*
Households	7	404	917	842	1 400
Clinics	0	300	400	1 000	781
Schools	1	20	115	200	600
Small business	0	67	200	523	470
Others	0	8	72	200	15
Total	8	799	1 704	2 765	3 266

More emphasis on rural electrification in Zimbabwe was reflected in the Rural Electrification Charter of 2002 whereby Z$24 billion would be devoted to rural electrification in a five year project. It was observed in 2003 that about 100 rural centres were being electrified per month by this initiative (Dube 2003).

4.4.2 Limitations in available energy services and technologies for the poor

The Zimbabwean government has had in place good plans for improvement of energy access. Most of the energy access plans have, however, been donor-driven, as indicated by Table 34.

One significant problem with dissemination of SHSs has been the high cost of solar panels. In response to this, the government at some point decided to waive duties on solar technologies, and this resulted in an increased demand for the systems. Later, duties were re-introduced, and this had an adverse effect on the rate of dissemination of SHS (*Energy Policy* 2002). Zimbabwe has experienced mixed results from the various SHS projects. For example, two years after installation of SHS in the GEF Project, about 30% of the systems had failed (Mapako 2002). In general, it was observed that that the donor-funded projects were more prone to failure than the private systems.

Table 34: International assistance received to deploy renewable energy
Source: Munjeri (2002)

Donor	*Area of support*	*Project cost*
UNESCO	Schools and colleges training programme in RE Solar heating for tobacco curing	 ZIM$900 000
GTZ	Solar water pumping (Masvingo province) (1992-1994)	DM 9 million
UNDP-GEF	Solar PV programme (1994-1998)	US$7 million
CIDA	Rusitu mini-hydro (ENDA) (1994-1996)	C $5 million
Australian Aid	Promotion of solar water heaters, plant oils (1996-1999)	ZIM$5 million
JICA	Installation of clusters of PV systems (1997-1999)	US$10 million
UNDP-GEF -PDF	Removal of barriers to energy efficiency in Zimbabwe's industry (1998-2000)	US$250000
Italian Gov.	Lighting of rural schools and clinics (yet to start)	ZIM$400 million
DANIDA	Rural afforestation Phase II	DKr 18 million
FAO/FARMESA	Solar crop dryers, biogas for agricultural production (1997-8)	US$20K
E7	Mini hydro in Manyuchi (1996-) (dropped)	US$1.8 million

1. 1US$= 55 ZIM$(2000)

5. COMPARATIVE ANALYSIS AND RECOMMENDATIONS

5.1 Comparing South Africa and Zimbabwe

There are many similarities and differences between the electrification programmes in South Africa and Zimbabwe. Both had a history of apartheid which prompted their reform programmes. Their tariff structures had similar objectives, but were structured differently. Both countries achieved higher levels of electrification, although South Africa's programme had some distinct features. Specific attempts were made in both countries to increase electricity access in rural areas. While the grid programme seems promising, the off-grid programmes are fraught with operational difficulties in the two countries. However, these features call for more discussions on their similarities and differences. The following discussion will be carried out in terms of the overall motive that drives their electricity development programmes, the tariffs, the power sector reforms, and the differences between their grid and non-grid electrification programmes.

In the pre-independence phases, development strategies in both South Africa and Zimbabwe were oriented around the different races. Most benefits were for the white population (around 11% of the population), while blacks were denied services, including energy. Hence, at independence (1980 for Zimbabwe and 1994 for South Africa), the democratic governments that emerged had to embark on specific programmes to restore balance in access to basic services, including energy, and this motivates the thinking behind power sector reforms in both countries.

The tariff structure until recently in South Africa had no specific programme for the poor, though there was a general objective reflected in both countries to address the poor by subsidising tariffs of the lower-income groups, as electricity bills claimed a significant portion of their incomes. An initial study of the specific poverty tariff (EBSST) programme in South Africa reported very positive signals, though further studies on its operation and relationship to the off-grid programmes are needed.

Both countries underwent major reform programmes in their electricity sectors, with differences. While Zimbabwe started after independence with five companies and had to merge them after a few years, South Africa had a major well-run utility with an infrastructure to cope with major programmes. Both countries are discussing privatisation in the power sector, but from available information it is difficult to identify the driver of this trend, justification or likely benefits from such privatisation schemes. The discussion advanced in both countries favouring privatisation has been to increase efficiency, but linking efficiency improvements with ownership of the utility is not always advisable as there are several other options to improve management without privatising. In weak economies that have very little capacity to cope with failures, privatisation which is largely experimental is not advisable. However, by introducing self-financed electrification in South Africa, electrification grew from 34% to 70% between 1994 and 2001, while in Zimbabwe it grew from 20% to 42%, also more doubling, between 1980 and 2001. However, the one in South Africa took a shorter time, was self-financed, and related to a much larger population.

The off-grid programmes in both countries were centred on SHS systems powered by PV technology – raising some fundamental questions regarding the usefulness of this technology in satisfying the needs of the poor. The 50 Wp system that was supplied was far from adequate to satisfy the greatest need, cooking; furthermore, operational problems are numerous in areas with weak infrastructure. Hence, even if the systems were distributed freely, their success is doubtful. These systems need further investigation before they can be considered as matured technologies.

5.2 Technology policy development

The technological bases of African countries are generally low compared with other developing regions, even with South Africa, one of the most industrialised countries in the continent. Significant technology inputs are required within the energy sector and related sectors for the continent to achieve its development goals of increased productivity and poverty reduction. Another aspect of the technology regime in the continent of direct relevance to this study is the disparity in technological base among countries. Zimbabwe, for example, has a higher industrial base than many African countries but it is base is lower than that of South Africa. Developing policies that will facilitate

technology promotion and transfer will useful in assisting the poor. Technology-specific policies are required in consideration of national circumstances.

Major areas for policy attention include institutional, information, financial and markets. These areas are inter-related and overlaps between them are possible.

5.2.1 Institutional aspects

Institutional aspects include technology infrastructure support – institutions, universities, industries, testing and quality control, monitoring and evaluation, etc. Innovative policies are required to enhance exchange and collaboration with third parties to ensure that these institutions are available in both countries. South Africa has some of these institutions which could be of importance to Zimbabwe, and setting collaborative and exchange programmes between these two countries could be important. An area that needs collaboration is technological standards. Both countries have national standards, but inorder to promote trade and future development, harmonising standards between these countries will be very useful. South Africa can benefit from the standards on SHS that was created during the SHS project in Zimbabwe (Davidson 1997). The area that is most important for collaboration is R&D. Both countries have postgraduate programmes in the area of energy. Collaborating will produce optimum results as R&D is getting more expensive and competitive.

5.2.2 Information aspects

Information policies aiming at influencing technological information flows in the respective countries and across countries are very important for either to participate in technology development, because of the major strides now made in this area, including the field of energy. This will assist to keep personnel adequately equipped to cope with the numerous challenges in the area of energy in their country and the continent. Well-planned science and technological forums in the form of workshops, seminars, exhibitions with adequate follow-up programmes are needed. The optimal use of international information networks is critical to widening knowledge of policy makers, technical teams, academic institutions, private organizations and NGOs.

5.2.3 Financial aspects

Financial policies are needed to mobilise both national and external finances that will help to boost the energy sector. However, these finances will be more useful if well designed programmes reflecting national issues and agenda are available. The optimal use of financial instruments, such as taxes and incentives can be achieved through adequate financial policies. Policy areas on financial aspects could include:

- tax incentives on technology imports with special considerations for rural energy rural projects;
- tax deductions to promote energy R&D projects;
- promote finance schemes for energy technology especially rural energy projects;
- financing schemes to mobilise national and international energy investments;
- co-ordinating mechanism for monitoring and evaluating external financing in energy.

All these policies should aim at promoting benefits to the overall economy. Aspects which should be considered are job creation, rewards to local employees, job security, and skills enhancement. Special attention is required in the rural areas as they are usually deficient in many aspects that support technology development and growth.

5.2.4 Technology market

Policies are required to stimulate technology markets by assisting the creation of the necessary facilitating institutions, such as innovation systems, testing and standards facility, suitable regulatory regimes, information brokers, etc. Some of these facilities exist for most of the modern energy systems, but not for renewable energy, whose widespread use is relatively recent. Market promotion policies based on well-tried practices that establish technological maturity may be required in both countries. Technology learning schemes using international expertise may be needed, as significant progress has been achieved outside the continent. Using all these facilities will lessen the effect of ills of the market place such as technology dumping, slow growth of local expertise, and irrational pricing. Developing local entities to be active participants in the technology cycle is very important. Sub-contracting is now a very good policy in technology development, as it has significant labour

savings. The policy regime should include promotion of technology diffusion with the aim of reducing technology imports.

There are some examples which can be replicated in other projects, such as the wind projects in South Africa and Zimbabwe which demonstrate the manufacture of local energy technology machines of relatively small capacity (6-10kW) (Schaffler 2002). Other current initiatives in African countries, such as work in Sudan and Namibia to develop solar PV systems, also need to be replicated.

5.3 Energy and poverty alleviation policies

Overcoming poverty requires policies to promote the use of reliable high quality energy services, as this will facilitate other necessary services such as health, food, water, housing, and transport. Embarking on off-grid programmes based on SHS requires urgent attention regarding their impact and use regarding alleviating poverty. The main problem is that they are focused on lighting, which is not the highest priority, even if all the operational and financial problems are resolved. Designing energy programmes for the poor must address cooking capacity as a priority over lighting, along with motive power for productive activities.

UNDP suggested some strategies in addressing sustainable development in the energy area. These include the following (UNDP 2002):

- Reducing arduous human labour for domestic activities and agriculture.
- Modernizing biomass as a modern energy source.
- Transform cooking into a safe, healthy and less unpleasant activity.
- Providing safe water.
- Electrifying homes.
- Providing energy for income generation in households, farms and village industries.

This list gives an indication of some aspects worth considering by African countries in general as they strive to improve the standard of living of its inhabitants and increase their productivity.

5.4 Power sector liberalization

Energy sector governance in Africa has been highly criticized by international finance institutions and other bodies for inefficiency and poor performance. However, there are major differences in the approaches to cure identified problems, especially given discouraging results from those that have been attempted.

In general, criticisms have centred on three issues: monopolistic government ownership of energy utilities; energy subsidies; and management issues. The general approach which has been actively supported by international bodies, including the financial ones, has been liberalization and privatization. While these could be useful concepts, their application to the power sector is yet to be adequately demonstrated in an economically constrained environment that cannot cope with economic failures – recent crises in developed countries have been directly or indirectly related to liberalization and privatization, but their financial capacity prevented total collapse. In general, the involvement of the private sector requires a strong regulatory regime, and a competitive environment. Using major private entities in a generally weak policy environment in a monopolistic regime is disastrous. This would be the situation in many African countries.

Another aspect that needs attention is the strong linkage between ownership and efficiency, and many African countries have been advised by the World Bank since 1993 to sell off government generating assets to the private sector. The valuation of these assets poses serious problems, as can the performance of the buyers using sovereign guarantees through World Bank-supported loans to keep high tariffs, which can reduce access rather than improve market performance (Davidson & Sokona 2002). However, the problem is more one of identifying innovative financing schemes for the power sector. Existing dependence on World Bank or World Bank guarantee funds has yet to demonstrate its usefulness.

Increased access to modern energy services, especially for poor communities, will require finding new sources for financing new energy projects and at the same time improving the level of

management of public utilities. The relative success of corporatisation, as demonstrated by Eskom and Electricité de France, provides some lessons that countries can learn from.

Coordination and collective effort can be used to tackle some of these energy challenges because it increases bargaining power and assists to optimize resources. Maximizing bilateral arrangements can also help, provided the national framework for accepting assistance is well developed. It is therefore of critical importance that African countries strengthen regional economic organization, which would play a major role in increasing energy services. While bilateral agreements can be one of the areas for sourcing funding for new energy projects, emphasis should be on regional cooperation and initiatives like NEPAD and sub regional bodies. The role of government subsidies in the energy access sector will continue to be important in Africa.

5.5 Power sector liberalization and effects on access and poverty

One consensus from a high-level regional meeting on energy and sustainable development in Africa, held in Nairobi in January 2001, was that power sector reforms in Africa so far have not improved poor people's access to electricity, nor are they likely to do so in their current forms (Clark 2001). It has therefore been argued that in order for power sector reforms to succeed in Africa they need to be formulated to include significant growth in access in addition to system and economic improvements, while considering prevailing situations. Power sector reforms imposed on African countries by the international development agencies are unlikely to impact positively on the poor since the general objective is to transform national utilities from bodies with a social welfare focus into profit-making commercial entities *(Energy Policy* 2002), an objective which may not be useful at early stages of development.

Policies that encourage local small independent power producers can have positive outcomes on poverty alleviation associated with power sector reforms, provided the programmes are well planned and the beneficiaries are included at the different stages of development. The trend of the majority of the power sector reforms in the area of independent power producers has been to marginalize local participation by setting a stage for only large-scale investments.

6. CONCLUSIONS

From their background history of racial bias on modern energy access, South Africa and Zimbabwe have embarked on power sector reform using rapid and aggressive programmes. South Africa depended on internal financing, mostly from the government and Eskom, whereas Zimbabwe was dependent on donor funding. In both cases, there was a mixture of grid and off-grid systems. However, while the grid showed major improvements in increasing access though at different rates, the impact of off-grid electrification in increasing access is at best marginal. Further studies may be required to establish the extent of these marginal gains.

The governments of both countries have tried to address specific issues relating to poverty, but with different approaches. South Africa has embarked on special tariffs, while Zimbabwe established a fund to assist rural development schemes. It should be noted that reliance on self-funding in South Africa and the rural levy in Zimbabwe have been very instrumental in supporting programmes that have demonstrated positive impacts on increasing electricity access to the poor. Some specific conclusions are made below.

6.1 Tariffs and subsidies implications

In general, electricity subsidies to the poor have been used historically to alleviate economic hardships. The issue of concern has been their adequacy and implementation. Hence, targeting the subsidy and ensuring that it is a sustainable practice is needed when designing subsidy schemes.

The EBSST in South Africa, which supplies 20-50kWh of free electricity to selected areas, has shown some positive signals in the alleviation of poverty – especially given that most poor households' electricity consumption is low, but a more detailed study may be required to achieve the conclusions required for replication. Areas such as level of subsidies and government affordability to support such programmes are ones that need further investigation. This programme at present is costing the South African government about R630 million annually, and it is prepared to spend up to a billion Rands annually. Few developing countries can afford to make such commitments. Innovative schemes in meeting such costs should be investigated.

Another area that needs investigation is policies on connection fees and their relationship to affordability, flexibility and choice (Thom 2002). Some of the specific recommendations on tariffs and connection fees include the following (Wentzel 1998; James 1997):

- For increasing affordability and wider spectrum of choice, a variety of tariffs and connection fees, linked to specific supply levels, should be available.
- Flexibility on arrangement for connection fees can reduce barriers to poor households.
- There should be adequate and appropriate information dissemination on costs and fees.

6.2 Way forward

This study has identified several areas that require further investigation. These areas can be summarised as follows:

- Innovative technological approaches to reduce connection fees, technical and non-technical losses, distribution costs, etc are needed to reduce the overall cost of increasing access to electricity, especially for the poor.
- The use of renewable energy, especially SHSs, as a poverty alleviation tool needs proper investigation. The importance of education, adequate training and information to the poor are crucial in realising any expected benefits.
- Maximisation of the social benefits of grid and off-grid expansion requires improvement in the overall information and understanding of the intended users.
- The role of different economic and financial instruments in increasing energy access to the poor needs careful study and sensitive consideration in order to link the poor to modern society.

- The associated characteristics of the poor need proper understanding and this would require participatory approaches.
- Development of local management and control schemes of energy investments is needed. Public-private management schemes can be explored.

APPENDIX 1

Energy sources for electricity generation in South Africa

Coal

South Africa has a proven reserve of 49 520 million tonnes of coal, the seventh largest in the world (BP 2002). Coal in South Africa is concentrated in the north-east, where 90% of production occurs. South African coal is low in sulphur content (less than 1%), but high in ash (up to 40%). In South Africa coal is used for electricity generation (56%), synthetic fuel production (34%), and metallurgy (6%). Domestic and other uses of coal rank at 4% (EDRC 1996).

Natural gas

South Africa has a total gas reserve of about 780 billion cubic feet (EIA 2000). It currently produces natural gas at a rate of 194 Mmcf/d and 9 500 bbl/d of condensate. South Africa has also found offshore natural gas discovery near Namibia which is believed to be in the same reservoir as the Kudu project in Namibia. The new discoveries together with the proven Kudu gas reserve off the Namibian coast might pave way for increased production of electricity by gas turbines such as the Cape Power Project that includes a 1 200-2000 MW combined –cycle, gas turbine power plant near Cape Town to serve the metropolitan area and industrial plants. Further, a 400 MW plant is planned in Namibia to supply Western Cape Town in addition to Namibia. Currently, Eskom generates 342MW from gas turbine power plants. South Africa is presently investing significantly in natural gas development in Mozambique and Namibia. The Mozambique project which is jointly developed by The Governments of South Africa and Mozambique, and with Sasol is well ahead with the pipeline being constructed and it is expected delivery of gas will start in the first half of 2004. This project hopes to develop gas fields of Pande and Temane in Mozambique. This project is very important for South Africa because it impact on its existing synthetic fuels and chemical programme that converts coal to liquid. Sasol intends to switch its Salsolburg plants to use natural gas to supplement coal. There are plans to include other stakeholders in this project as well as privatization actors for gas distribution.

Nuclear power

South Africa, like many African countries, has uranium, but is the only country with a nuclear facility that produces electricity, a plant that generates 1 930MW. Eskom has plans to develop and build a new generation of pebble bed modular reactor of sizes about 100 MW for export and domestic power generation. The initial feasibility phase for a pilot plant is completed and the government is yet to give approval for testing. If approved, construction will start in 2005 and be completed by 2008. Interested customers include Japan, USA and Britain. South Africa intends to export about 10 such units annually.

Renewable energy sources

Currently, renewable energy on electricity in South Africa accounts for less than 2% of installed capacity and generate less than 0.2% of total generation. Existing installations include windmills and wind turbines (pumps, small off grid and grid power systems), solar heating systems (domestic heaters, water & pool heating, commercial water heaters), PV systems (SHS, water pumps, telecommunications, education, health and refrigeration), hydropower (grid pump storage, micro & mini-hydro), biogas, landfill gas and solar heat engines (grid -connected systems & solar chimney plants).

Other renewable energy sources for electricity production include wind, hydro, and wave action. Only several estimates of the theoretical potential of renewable energy in South Africa have been made.

Table A1: Estimates of theoretical potential for renewable energy for electricity production in South Africa

Sources: Howells (1999); DME (2000a; 2000b)

	DANCED / DME	*Howells*	*RE White Paper*
Resource	*PJ / year*		
Wind	6	50	21
Hydro	40	20	36
Solar	-	8 500 000	

Hydroelectricity

South Africa has an average annual rainfall of about 500mm and can therefore be classified as being generally dry with small potential for hydropower generation. Some rivers however, provide possibilities of micro-hydro potential, and these are concentrated on the Eastern escarpment and the Western Cape.

There are currently six small-hydro schemes in South Africa, taking 10 MW as the cut-off. Eskom runs two of these (First Falls, 6MW licensed capacity; Ncora 2MW), municipal generators three (Lydenburg 2MW, Ceres 1MW and Piet Retief 1MW) and one privately owned facility (Friedenheim 3MW). Eskom also runs second Falls with 11MW; the next station by capacity being Collywobbles at 42MW. Total hydro capacity, including two large dams, is at 661MW.

Pumped up storage

A similar concept to hydropower is Eskom's pumped up storage electricity generation, whereby, water is pumped to storage at a higher water head then released to generate hydroelectricity. Eskom's generation from pumped up storage is 1 400MW

Biomass

There are also currently about five bagasse/coal fired power stations run by private generation companies. These are all sugar companies, using sugar cane residues primarily for their own consumption. Coal is used as a back-up fuel in the sugar plants, but 73% of net energy produced is consumed in own use.

Other sources of biomass include the sugar industry, which provides 40PJ per year, and timber industry, at 18 PJ per year.

Wind energy

South Africa coastal line provides conducive environment for wind energy harvesting. Average wind speeds are 4m/s and in several areas wind speeds exceed 6m/s. Total energy available from wind has been estimated at 30,000MW (Diab cited in Eberhard & Williams 1988).

Eskom is developing 100-200MW renewable electricity demonstration projects using wind and solar thermal power. These would be the largest such investments ever in South Africa. The proposed Darling Wind Farm, a 5MW wind facility on the West Coast, was named a National Demonstration Project by the energy minister.

Solar energy

South Africa has one of the highest solar insolation rates in the world. Annual 24 hour global solar radiation has been estimated at 220 W/m^2, with the equivalent to about 280 000 GW (Eberhard & Williams 1988). According to DME's draft White Paper on Renewable Energy, it is estimated that this resource could be converted through various technologies to solar thermal electricity of up to 72 000 PJ / year, solar photovoltaic (PV) up to 144 000 PJ / year and solar water heating of 2 PJ / year (DME 2002b).

APPENDIX 2

South African currency against the dollar

Table A2: South African rand against the dollar, 1997-2003
Source: SA Reserve Bank (2001, 2003)

	Rand to the US dollar
1989	2.6222
1990	2.5877
1991	2.7609
1992	2.8516
1994	3.5497
1995	3.6270
1996	4.2964
1997	4.6073
1998	5.5316
1999	6.1131
2000	6.9353
2001	8.6031
2002	10.5165
2002 March	11.4938
2002 July	10.1137
2003 January	8.6816
2003 February	8.3031
2003 March	8.0439
2003 April	7.7068

APPENDIX 3

Eskom connection fees and tariffs

Table A3: Urban connection fees
Source: Eskom (2003)

Capacity	*Conventional*	*Prepayment*
5 kVA or ≤ 80 A (single-phase)	R877.19 + VAT = R1 000.00	R877.19 + VAT = R1 000.00
16 kVA	R877.19 + VAT = R1 000.00	R877.19 + VAT = R1 000.00
25 kVA	R3 157.89 + VAT = R3 600.00	R4 035.08 + VAT = R4 600.00
50 kVA	R3 596.49 + VAT = R4 100.00	R4 473.68 + VAT = R5 100.00
100 kVA	R4 210.53 + VAT = R4 800.00	N/A
200 kVA	R5 964.91 + VAT = R6 800.00	N/A
315 kVA	R6 403.51 + VAT = R7 300.00	N/A
500 kVA	R10 701.75 + VAT = R12 200.00	N/A
> 500 kVA	The greater of R10 701. 75 + VAT oR5% of actual project costs.	N/A

Urban tariffs

Home Power Bulk
The 2003 Homepower tariff for bulk customers was restructured because of the difference in the cost of supplying a single house and multiple housing units. It was designed typically to cater for sectional title developments and multiple housing units, such as townhouse complexes. It has a voltage surcharge that would make high voltage supplies less expensive than lower voltage supplies. The surcharge is applicable to both the network charge and energy rate. The network charge is for recovering part of the fixed network cost associated with the provision of network capacity required by the customer.

Home Power Standard
This is a tariff for medium to high-usage residential customers.

Capital costs
For a new connection, a monthly connection charge and/or up-front payment may be applied in addition to the standard tariff in order for Eskom to recover capital costs that are not covered by the tariff.

Basic charge
R48.98 + VAT = R55.84 payable each month for each point of delivery, whether electricity is consumed or not. It is a contribution towards Eskom's fixed costs, such as meter reading, billing, customer service, etc.

Network charge
R43.37 + VAT = R49.44 payable each month for each point of delivery, whether electricity is consumed or not, and is a contribution towards Eskom's fixed network capital costs.

Energy charge
A single energy charge of 23.01c + VAT = 26.23c/kWh linked to each unit of energy (kWh) consumed.

Nightsave Urban
This is eelectricity tariff for urban customers with a notified maximum demand. of at least 25 kW/kVA. It is applicable to customers who can move all or part of their electricity demand to Eskom's off-peak period between 22:00 and 06:00 on weekdays and the entire Saturday, Sunday and public holidays. It is also seasonally differentiated. A service fee is charged per account and is based

on the sum of the utilized capacity of all points of delivery. linked to an account, whereas the administration fee is determined by, and payable for, the utilized capacity of each POD linked to an account.

Megaflex
Megaflex is a tariff applicable to urban customers with supplies greater than 1 MVA and who can shift their load to defined time periods. It is a time-of-use (TOU) tariff with Peak, Standard and Off-peak periods. Like the Nightsave tariff, it is seasonally differentiated.

Miniflex
Miniflex is a tariff applicable to urban customers with supplies of 100 kVA to 5 MVA and who can shift their load to defined time periods.

APPENDIX 4

South Africa's annual electricity connections, 1997-2001

Table A4: South Africa's annual electricity connections, 1997-2001
Source: NER (2003)

Year	*Type of area*	*Population*	*Houses*	*Houses electrified*	*Houses not electrified*	*% electrified*	*% not electrified*
2001	Rural	20 832 416	4 267 548	2 095 229	2 172 319	49.10	50.90
	Urban	23 723 327	6 503 427	5 023 186	1 480 241	77.20	22.80
	Total	**44 560 743**	**10 770 975**	**7 118 415**	**3 652 560**	**66.10**	**33.90**
2000	Rural	19 967 564	4 267 548	1 952 494	2 315 054	45.75	54.25
	Urban	23 357 452	6 503 427	4 828 103	1 675 324	74.24	25.76
	Total	**43 325 016**	**10 770 975**	**6 780 597**	**3 990 378**	**62.95**	**37.05**
1999	Rural	20 009 245	3 873 990	1 793 193	2 080 797	46.29	53.71
	Urban	23 045 062	5 745 180	4 585 185	1 159 995	79.81	20.19
	Total	**43 054 307**	**9 619 170**	**6 378 378**	**3 240 792**	**66.31**	**33.69**
1998	Rural	19 550 322	3 785 454	1 612 168	2 173 286	42.59	57.41
	Urban	22 580 078	5 636 392	4 322 820	1 313 572	76.69	23.31
	Total	**42 130 400**	**9 421 846**	**5 934 988**	**3 486 858**	**62.99**	**37.01**
1997	Rural	19 111 522	3 700 494	1 409 681	2 290 813	38.09	61.91
	Urban	22 115 078	5 520 200	4 097 981	1 422 219	74.24	25.76
	Total	**41 226 600**	**9 220 694**	**5 507 662**	**3 713 032**	**59.73**	**40.27**
	Total	**41 226 600**		**5 507 662**	**3 713 032**	**59.73**	**40.27**

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