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## *Electricity Access in South Africa and Zimbabwe*


**Sub regional technical report by**
**The Energy Research Centre (ERC),**
**University of Cape Town, South Africa**



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# Electricity Access

# Southern Africa Sub-regional Study: South Africa and Zimbabwe

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**GLOBAL NETWORK ON ENERGY FOR SUSTAINABLE DEVELOPMENT**

# EXECUTIVE SUMMARY

Various technological, institutional, financial and policy factors have limited the capacity of African nations to provide modern energy services to the majority of their citizens, and this has hampered progress in achieving their development goals. This deficiency is more pronounced in the electricity sub-sector, in which access to power is around 20 per cent, with many countries having less than 15 per cent access. The situation is worse for the poor in these countries as their access is generally below 5 per cent – and even lower for those in rural areas.

This study 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 the provision of modern energy to the poor in these countries. The study examines the impact on the poor of power sector reforms. Specifically, it makes an assessment of the impact of the electrification programmes in the two countries. The situation in the two countries is discussed separately, followed by a comparative analysis.

South Africa is the most industrialised country in Africa and it is endowed with a wide variety of natural resources. It is currently going through major changes in many spheres of its economy, including energy, following the democratic elections in 1994. An important consideration that is directing all aspects of government policy 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 South African Government launched the first phase of the National Electrification Programme (1994-99), aimed at increasing electrification from 36 per cent to about 66 per cent nationally by 2001 — 46 per cent rural and 80 per cent urban. By the end of 2001, 66.1 per cent of households were electrified, with more than 3.4 million connections made since 1994. Since then, several policies have been introduced in the electricity sector that are of direct relevance to this work. The most important of these concern the restructuring of the electricity supply industry and direct subsidies for the poor and disadvantaged.

The South African Government established a National Electrification Fund to subsidise a portion of the capital costs of new electricity connections under the National Electrification Programme. The 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 subsidy levels differentiated by geographic region, supply technology or other factors.

The Electricity Basic Services Support Tariff (EBSST) is another initiative that the South African Government established in 2002 to provide free electricity of 20-50 kWh per household, per month to the poorest segments of the population. The support tariff is intended to provide an approximate amount of power required for basic lighting, media access and limited cooking. It is worth about ZAR 200 per year to a poor household. The initial cost to government is estimated at about ZAR 630 million annually and it is expected to increase with growth in the rate of electrification. An offgrid electrification programme that mainly involves the dissemination of solar home systems (SHS) to the disadvantaged areas was started in 2000. At present, about 12,000 such systems have been disseminated with over 70 per cent direct subsidy from government.

Levels of community welfare improved in South Africa as a result of these electrification initiatives, although the level improvement differs among households, some of which are 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 lower local and indoor air pollution where electricity is more extensively used for cooking and heating.

Zimbabwe is a landlocked country in Southern Africa and a member of SADC. Independence in April 1980 ended its 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 levels of poverty that are 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 objectives in Zimbabwe include increasing electricity access to previously disadvantaged people through grid electricity expansion and offgrid electrification. The Zimbabwe Electricity Supply Authority (ZESA) is the main utility responsible for the generation, transmission and distribution of electricity. Unfortunately, ZESA generating capacity is not sufficient to meet the national demand and, hence, domestic supply is supplemented by imports from neighbouring countries.

The Government of 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 tariff setting is based on several variables with different weights. Subsidies that apply to the poor in the tariff structure include: (a) a lifeline tariff for lighting and small power applications, about 50 kWh per month, and (b) another for lighting, small power applications (hot plate stove, ironing) and basic heating, about 300kWh per month.

The main factors underlying power sector reforms in Zimbabwe include restructuring as a component of the general economic reforms, as a means to empower historically marginalised groups, as a mechanism to enhance power sector efficiency, and as a vehicle to mobilise finance for capital investments in the power sector. In 1992, the Government of Zimbabwe initiated a Performance Improvement Programme (PIP) whose objectives, among others, were to achieve the total electrification of the country. This resulted in significant increases in electrification levels. For example, a comparison of 1991 and 2000 — the years before and after the implementation of PIP — indicates that the national electrification levels doubled.

The following are the key findings of the study:

- In both countries, data on the electrification of the poor is almost non-existent. Consequently, the findings and conclusions of this study are not wholly conclusive.
- Both countries have a history of apartheid and redressing the inequalities of past racial prejudice forms the basis of their reform programmes. In the pre-independence phases, development strategies in both countries were racially oriented. The democratic governments that emerged after independence embarked on specific reform programmes addressing access to electricity services and poverty alleviation among the formerly underprivileged population – which forms the majority of the poor.
- The reforms undertaken to address access to electricity indicate positive impacts on the poor. However, these impacts appear to be more explicit in South Africa. For instance, a preliminary assessment of EBSST 'poverty tariff' indicates some positive signs of poverty alleviation following the reduction in electricity expenditure. However, additional studies may be required to assess the feasibility of the subsidy due to the significance of its impact on the government's finances.
- The reforms in both countries have ensured the protection of funds for financing the electrification of the poor by ensuring transparency and accountability, albeit in different ways. In South Africa, the National Electricity Regulator (NER) aggressively monitors and makes public the progress of the National Electrification Programme. In Zimbabwe, the Performance Improvement Programme includes explicit rural and urban electrification targets that the utility is obliged to meet and its progress with rural electrification is reported annually.
- Interestingly, both countries, in spite of having gained independence during a time when market oriented reforms such as privatisation of the power sector was sweeping across the continent, did not commence privatisation until after undertaking substantial electrification. From available information, it is difficult to identify the justification or likely benefits of privatisation.

The authors contend that although the proponents of market oriented reforms such as privatisation claim it could lead to increased efficiency, linking efficiency improvements to utility ownership is not the only solution as there are several other options to improve management without privatising. The performance of national utilities in the two countries compares well against regional and international utility performance benchmarks.

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| | |
|---|---|
| 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 organisation |
| 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) |
| REA | Rural Electrification Agency (Zimbabwe) |
| 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 |
| ZAR | South African Rand |
| ZBD | Zimbabwe Dollar |
| ZERC | Zimbabwe Electricity Regulatory Commission |
| ZESA | Zimbabwe Electricity Supply Authority |

## 1.0 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 southern Africa. Modern energy is not only the pivot of national economic development, but it also provides services to meet basic human needs — such as water, sanitation and cooking — is the engine for productive activities of the poor, and the means to provide them essential social services like education and health. The link between access to modern energy services and poverty eradication is, therefore, strong. Poverty indicators, such as high infant mortality, low life expectancy, and high illiteracy and fertility rates, will not improve rapidly unless adequate modern energy services are available to the poor. Also, since the majority of the poor is usually in rural areas, which are generally deprived of basic services, the young and more energetic among them migrate to urban areas in search of improved livelihoods to access these services (including modern energy), which results in an increase of the urban poor.

The provision of modern energy services is, thus, important to poverty eradication or reduction. Unfortunately, the poor depend on traditional biomass (firewood and charcoal) to cook their food. The use of these fuels is problematic because the associated technologies are grossly inefficient and the resultant emissions can cause serious health problems. It is estimated that over 60 per cent of the population of sub-Saharan Africa depends on this fuel source. Reliance on traditional biomass worsens the life of poor and cannot contribute to eradicating or reducing poverty.

In general, providing modern energy services to the poor in southern Africa poses a unique challenge for policy-makers and other stakeholders. Although the sub-region has abundant fossil and renewable energy resources, exploiting them remains a daunting task because of major technological, institutional and financial obstacles. Financial obstacles remain the most important. Inadequate energy investments, an underdeveloped downstream energy sector and poor management of proceeds from the huge fossil fuel exports are some of the barriers affecting the use of modern energy by most inhabitants of southern Africa, particularly the poor. Furthermore, overseas development assistance, (ODA) which has traditionally been used on pro-poor programmes, is dwindling. In addition, the effectiveness of ODA is being questioned. However, donors are now calling for new approaches to their poverty alleviation programmes, including those concerned with energy.

This study focuses on the poor's electricity access in Southern Africa, based on case studies of South Africa and Zimbabwe. The report first provides a brief background of electricity production and use in Southern Africa, followed by the rationale and approach of the study. The two country case studies seek to identify the impacts of specific policies and programmes in the power sector on the poor, with special reference to electricity reforms.

### 1.1 The electricity industry in Southern Africa

Southern Africa's geographical coverage roughly correlates to the region encompassing the Southern African Development Community (SADC). The sub-region is well-endowed with a wide range of modern energy reserves: 61 billion tonnes of coal, 156 million tonnes of oil, and 1,138 billion cubic metres of natural gas (Maya, 2000). However, the locational distribution of these is skewed. Most of the coal reserves are in South Africa with some in Botswana, Zimbabwe and Tanzania. Angola is the only

significant oil producer, while natural gas occurs in a few countries, Angola, Mozambique, Namibia, Tanzania and South Africa. Nonetheless, its overall energy resource endowment enables Southern Africa to be a net energy exporter. In 2000, the region produced 2.3 per cent of the world's primary modern energy, consuming only about 1.4 per cent of it, with the rest being exported. South Africa is dominant in the sub-region's energy sector, accounting for 84.9 per cent of modern consumption and 77.4 per cent of production.

With the exception of South Africa, access to modern energy in the sub-region is limited, the majority depending on firewood and charcoal at the household level. In particular, countries like Mozambique, Zambia and Malawi are heavily dependent on these fuels to meet their household energy demands.

The total installed power generation capacity within the SADC region is about 54.2 GW, and actual generation in 2000 was about 229,000 GWh (EIA 2002). Thermal sources dominate power production, contributing about 80 per cent of the installed capacity, while hydro and nuclear power account for about 17 and 3 per cent, respectively. Although hydro power contributes a relatively small proportion of the total, it has a significant potential in the region. For instance, the Democratic Republic of Congo (DRC) is estimated to have a potential of 100,000 MW, followed by Zambia with 21,400 MW (Table 1). With a total installed capacity of about 8,000 MW, less than 5 per cent of the region's hydro potential has been exploited.

**Table 1: Hydro and Thermal Electricity in Southern Africa**

| Country | Maximum Hydro Generating Capacity (MW) | Hydro Exploitable Potential (MW) | Maximum Thermal Generating Capacity (MW) | Total Gross Electricity Production (GWh) |
|---|---|---|---|---|
| | 2000 | 1994 | 2000 | 2000 |
| Angola | 290 | 16,000 | 296 | 1,404 |
| Tanzania | 377 | 6,000 | 243 | 2,743 |
| Mozambique | 2,180 | 12,500 | 208 | 7,125 |
| Malawi | 283 | 900 | 25 | 825 |
| Zimbabwe | 670 | 13,300 | 1,056 | 6,739 |
| Zambia | 1,670 | 21,400 | 1,211 | 7,717 |
| Botswana | - | - | 217 | 500 |
| Lesotho | 3* | 450 | 2* | 12* |
| Swaziland | 44 | 600 | 87 | 362 |
| Mauritius | 54* | 59 | 306 | 1,285 |
| Namibia | 240* | 120 | 147* | 873* |
| South Africa | 668 | 3,500 | 37,307 | 196,167 |
| DRC | 2,440 | 100,000 | 33 | 5,482 |

* 1996 data

Data Sources: EIA (2002); Maya (2001); Eskom (1996b).

## 1.2 Access to electricity

In general, access to electricity in Africa is extremely low, estimated at 17 per cent — although there are variations among the sub-regions —, as opposed to over 70 per cent access for countries in other developing regions such as East Asia and Latin America (Davidson & Sokona, 2002). Southern Africa (represented by the SADC region) has an average access of about 23 per cent. Howevr, a number of countries in the region have access levels below 10 per cent. Table 2 illustrates household electricity access levels in the SADC region.

**Table 2: Household Access to Electricity in SADC countries: 2000**

| Country | Estimated Population (million) | Access (%) |
|---|---|---|
| Angola | 13.1 | 12.0 |
| Botswana | 1.7 | 29.0 |
| D.R Congo | 50.9 | 6.7 |
| Lesotho | 2.0 | 5.0 |
| Madagascar | 15.5 | 8.0 |
| Malawi | 11.1 | 5.0 |
| Mauritius | 1.2 | 100.0 |
| Mozambique | 17.6 | 8.0 |
| Namibia | 1.7 | 27.0 |
| South Africa | 42.3 | 66.1 |
| Swaziland | 1.1 | 21.0 |
| Tanzania | 33.7 | 10.5 |
| Zambia | 10.2 | 20.0 |
| Zimbabwe | 12.1 | 40.0 |
| **Average** | | **22.8** |

Data source: O'Sullivan & Hamaide (2002)

The percentage of households with access to electricity does not always offer a true picture of the poor's situation 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 use electricity. It has been estimated that SADC has a surplus capacity of over 11,000 MW, while only 23 per cent have access to electricity. Hence, while augmenting the power generation capacity of the country is important, identifying appropriate policies and measures that link electricity availability and access are equally critical. Grid interconnections between and among Southern African countries could play a major role in reducing the uneven distribution of generation capacity in the sub-region. This has been achieved to some extent (see Figure 1), although there is potential for additional connectivity.

**Figure 1: Grid Interconnection in Southern Africa**



Source: Eskom (2002).

## 2. APPROACH OF THE STUDY

### 2.1 Scope of the study

This study examines access to modern energy services by the poor with particular reference to electricity because of the importance of electricity as a secondary energy carrier, its strong link to development and its potential for poverty reduction. In this context, the impact of ongoing power sector reforms is assessed. The key power sector reforms assessed under the study are the electrification programmes in South Africa and Zimbabwe. The study investigates the extent to which the National Electrification Programme in South Africa and the Rural Electrification Programme in Zimbabwe have resulted in increased access to the poor.

### 2.2 Selection of country case studies

The countries covered by the study are South Africa and Zimbabwe, with the former benefiting from greater availability of data. The choice of countries was driven largely by constraints of resources, time and data. While using only two countries as case studies might have certain weaknesses, such as failure to capture national differences, there are commonalities among the poor in most African countries. To an extent, differences between the two countries selected should capture some of the national disparities in the region. For example, South Africa has a relatively more advanced economy as compared to Zimbabwe.

### 2.3 Key indicators and data sources

The study adopts official definitions of poverty by the respective governments in preference to using universal definitions which are usually expressed in quantitative terms and are problematic given country and regional differences. The most common of the latter are the USD 1/day (World Bank) or USD 2/day (UN) poverty lines. These have certain shortcomings, for example, problems associated with exchange rates – such as purchasing power parity. Qualitatively, poverty has been defined by the absence of certain basic needs satisfaction, as typified by UNDP in its Poverty Report of 2000 (UNDP, 2000) which defines poverty as signifying:

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

In this study, quantitative poverty indices, as defined by the respective countries, are used for the analysis.

The assessment of the impacts of electricity sector reforms on the poor is carried out by using the following five indicators:

- National electrification levels;
- National electrification rates;
- Electricity consumption;
- Electricity tariffs; and
- Electricity expenditure.

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

Each indicator is assessed at two levels – at the national level (irrespective of income) and, where possible, by income levels. In most cases, rural data is used as a proxy for data on the poor due to the limited availability of electrification data by income group. Where possible, a qualitative distinction is made by two income bands (poor and non-poor). Data and information for this study are limited to secondary sources (mainly research studies by leading research institutions in the region) since resource and time limits did not allow for primary data collection. Due to data limitations, the findings in this report are not wholly conclusive.

## 3. SOUTH AFRICA

### 3.1 Country situation

South Africa has a population of about 45 million people, living on a land area of 1.2 million sq. kms.. It is well endowed with natural resources, including coal, gold, diamonds, metals and minerals. Its economy is in part reliant on energy production and use, with coal accounting for 75 per cent of the fossil fuel demand and for 91 per cent of electricity generation. South Africa is the most industrialised country in Africa. It 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. Table 3 shows the recent status of the country's key development indicators.

**Table 3: Key Development Indicators for South Africa and the World: 2001**

| 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 | |

Data Sources: World Bank (2003); Statistics South Africa (2003).

The GNI per capita of South Africa as of 2001 was USD 2,820 compared to the global average of USD 5,120, but this is higher than the average for sub-Saharan Africa which is just below USD 500. 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 ZAR 2,160 (USD 311.45) for Africans, ZAR 4,250 (USD 612.81) for coloureds, ZAR 7,083 (USD 1,021.30) for Indians and ZAR 13,166 (USD 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, with a high per capita energy consumption (Table 4), mainly due to the presence of heavy mining industries, such as iron and steel, cement and aluminium. It is one of the most electrified countries in Africa, with over two-thirds of the 45 million population electrified.

**Table 4: Energy Parameters of South Africa: 2000**

| | |
|---|---|
| Population | 42.80 million (44.8 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 |

Source: IEA (2002); Statistics South Africa (2002).

The minimum standard of living in South Africa, defined as the minimum monthly financial household requirement, was ZAR 709 (USD 273) in 1990, equivalent to about USD 9/day using the 1990 exchange rate. In 2002, under the government policy on tariffs aimed at the poor (discussed later), a figure of ZAR 800 was used as the baseline for poor households, equivalent to USD 2.54/day. This clearly shows the discrepancy in using dollar values to determine poverty even if changes in purchasing power are not considered.

May and Govender (1998) define 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 at a monthly household expenditure of ZAR 353 (approximately USD 64 in 1998). This seems to be in agreement with a recent work done in black townships around Cape Town that shows 76 per cent of the households were living below ZAR 352 per month (BBC, 2003). This also demonstrates the discrepancy that the Rand/Dollar exchange rate introduces to defining poverty thresholds.

Poverty in South Africa is strongly linked to the wide disparities in income levels of different racial groups. Although the recent census shows progress in the provision of basic services between 1996 and 2001, the gap between white and black populations remains significant. In general, South African rural areas are far more impoverished than urban areas, mainly because of the past system of sectorian development defined by race. This has destroyed the socio-economic fabric of rural societies, a unique feature compared to other rural areas of Africa.

## 3.2 Background of the power sector

South Africa's electricity sources and an overview of its electricity industry are presented in Tables 5 and 6. Eskom, the national power utility, produces 95.7 per cent of the electricity (NER, 2001). About 93 per cent of this is from coal, representing a total generation capacity of 37,678 MW (Eskom, 2002). The shares of other sources of power generation are nominal, for instance, a sole nuclear power station which accounts for under 6 per cent of total electricity capacity. Natural gas plays a very small role but there are plans to increase it substantially next year when the imported gas from Mozambique comes on stream.

**Table 5: South Africa's Electricity Production Profile: 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 | |

Source: NER (2001).

**Table 6: Statistical Overview of Electricity Supply Industry in South Africa**

| Eskom and Municipalities | Units | 2000 | 1999 | 1998 | % Change 1999-2000 |
|---|---|---|---|---|---|
| **a: Generation** | | | | | |
| Licensed capacity | MW | 43,142 | 43,142 | 43,142 | 0 |
| Net maximum 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, the reduction in Eskom power production was due to the Cahora Bassa being resumed.
2. Increase in number of customers mainly due to electrification.

Source: NER (2001).

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. It 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 co-ordination 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, although setting rational pricing among its member countries remains an obstacle. Eskom, the South African power utility, 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 potential in the longer term.

Regional co-operation in energy development is also a major driver within NEPAD (New Partnership for African Development), 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 ongoing natural gas projects between South Africa and both Namibia and Mozambique, although the latter is far advanced and gas is expected to be available as early as 2004.

### 3.3 Power sector reforms

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 white households forming about 12 per cent 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), the party 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 to the poor) while alleviating negative environmental impacts.

Two key power sector statutes passed during the apartheid era had a profound impact on electricity production and use. These were the Eskom Act, No. 40, of 1987, and the Electricity Act, No. 41, of 1987. The Eskom 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 governments. However, changes to the energy sector started occurring in the late 1980s, leading 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 representatives of stakeholders, with duties including the appointment of Eskom's management board. One of the major tasks of Eskom was to increase electricity access to three million homes by 1996.

Another major change made by the Government was a decision to embark on corporatisation of parastatals, including those in the power sector. Under this arrangement, the Government embarked on a policy to restructure the electricity assets of Eskom through the Eskom Conversion Act. According to the Act, the Government intends to restructure the electricity supply industry (ESI) by selling off 30 per cent of Eskom's generating assets by 2006 without compromising the social and development goals of the country.

Several issues surrounding the proposed sale are part of an ongoing debate. However, the Government has clearly stated in several pronouncements that the sale will mostly be to previously disadvantaged groups (black economic empowerment groups) and employee-participation schemes, with emphasis on the former. The rationale for the Government's decision was that the restructuring should not only increase efficiency but also 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 rationalisation of the electricity distribution industry, and the combining of Eskom and the municipal distributor into six new regional electricity distributors. However, the exact timing of operationalising all these changes is still under discussion. The impact of these changes on access to affordable electricity by the poor communities is yet to be fully studied.

### *3.3.1 Rationale for reforms*

Power sector reforms were necessary in South Africa to address the aforementioned anomalies and inequities and this has an implication for all reform policies. The broad energy policy of the current government is as follows:

a) Addressing the energy requirements of the poor;

b) Enhancing the competitiveness of the economy by providing low-cost but high-quality energy inputs to industrial, mining and other sectors; and

c) Achieving environmental sustainability of natural resources.

Another objective of this broad energy policy is to attract foreign direct investment in the power sector. In the Energy White Paper of 1998, the Government identified the following key policy problems and challenges in the electricity sector that would need attention:

- Approximately 40 per cent of all homes in South Africa, and tens of thousands of schools and clinics, are without ready access to 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 among distribution entities.
- The electricity distribution industry continues to experience high levels of non-payment and electricity theft, resulting in increasing arrears and payment defaults.
- Except for a few notable exceptions, the electrification programmes of most municipal distributors are constrained by difficulties in accessing affordable financing.
- Municipal electricity departments that are expected to make a contribution towards the funding of other municipal services, particularly in the major urban areas, are also faced with the burden of non-payment and the need for significant expenditure on electrification.
- Coal-based electricity generation results in significant pollutant 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 around the year 2007, long capacity expansion lead times require strategies to be in place in the medium term in order to meet the needs of the growing economy.

- While a number of the challenges presented above could place inflationary pressures 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.

### *3.3.2 Legal and institutional framework*

The current legal and institutional framework in South Africa's electricity industry is based on the following legislation:

- Electricity Act 41, 1987, which defines the structure, functions and responsibilities of the Electricity Control Board and assigns the sole right of electricity supply within municipal boundaries to local government authorities.
- The Eskom Act 40, 1987, which defines the responsibilities of ESKOM.
- Electricity Amendment Act 58, 1989, which amends the Electricity Act, 1987 to provide for a levy on electricity so that a licence shall not be required for the generation of electricity; the transfer of servitudes upon the transfer of undertakings; and other incidental matters.
- Nuclear Energy Act 3, 1993, which brings all nuclear activities funded by the State under the control of the Atomic Energy Corporation, with specified exceptions.
- Electricity Amendment Act 46, 1994, which amends 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, 1995, which further changes the Electricity Act of 1987 to establish the National Electricity Regulator with the juristic authority to set up office.
- White Paper on Energy Policy, 1998**,** which clarifies the Government's policy regarding the supply and consumption of energy for the next decade. The topics covered by the paper include the strengthening existing energy systems, development of underdeveloped systems and changes in several other areas. In addition, the paper addresses international trade and co-operation, capacity building, and the collection of adequate information.
- Regulations to the Electricity Act, which sets out the regulation of certain aspects of electricity services.
- Promotion of Access to Information Act 2, 2000, which establishes the 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.
- The Eskom Conversion Act 13 of 2001, which changed Eskom from a statutory body into a public company in July 2002.

### *3.3.3 Eskom's governance*

The Eskom Conversion Act stated that the change was intended to provide an opportunity to review the governance structure of Eskom and to put in place a more effective and streamlined decision-making process. Thus, the number of Eskom committees was reduced and the previous two-tier governance structure of an Electricity Council and a Management Board was replaced by a Board of Directors.

Under this new structure, Eskom embarked on strategic initiatives aimed at making it the pre-eminent energy and related services business institution in Africa. Also, Eskom assumed a global stature and it has, over the years, devised a number of action plans to facilitate the achievement of the new strategy. Eskom has also enlarged its interests in the continent and is now involved in 39 of the African countries.

### *3.3.4 Reforms in the distribution industry*

According to the White Paper on Energy Policy, reforms in the electricity distribution industry were necessary because of constraints to achieving the primary objective of meeting electrification targets, and ensuring high quality supply at low-cost and equitable price to all consumers. The challenges include the following:

- A highly fragmented distribution industry, with more than 120 municipalities that had less than 1,000 customers and more than 90 municipalities with annual revenues of less than ZAR 1 million.
- Substantial differences in the financial status of municipal distributors.
- Wide disparities in the prices paid by different customer segments that could not be fully explained by the costs associated with serving each segment.
- The failure by small distributors to capture economies of scale, skill and specialisation in order to lower average distribution costs.
- Uneven distribution of electrification needs across regions, with some of the poorer regions having the greatest need where, without explicit or transparent funding mechanisms, there would be risks that many distributors would not be able to meet their electrification targets. In addition, since electrification was a national objective, cross-regional subsidisation should be considered an equitable way to fund the electrification programme.
- The financial inability of many distributors although, 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:

a) Ensuring electrification targets agreed to are met;
b) Providing low cost electricity;
c) Facilitating better price equality;
d) Improving the financial health of the industry;
e) Improving quality of service and supply;
f) Fostering proper co-ordination of operations and investment capital; and
g) Attracting and retaining competent employees.

### *3.3.5 National Electrification Programme*

The National Electrification Programme (1994-99) was a government-financed initiative. The programme was to be implemented by Eskom and the municipalities with the key objective of raising national electrification levels to about 66 per cent by 2001 — 46% rural and 80% urban (NER, 2002a). The targets of the programme were mainly the formerly disadvantaged and rural areas, and all schools and clinics. This implied providing electricity to an additional 2.5 million households. Further details of the programme are discussed later.

### *3.3.6 National Electricity Regulator (NER)*

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 Forum presented a set of recommendations in 1994 to the Cabinet. This led to the establishment of NER in April 1995 as a successor to the Electricity Control Board established under Act No. 41 of 1987 to regulate the electricity supply industry in the country. NER was given national jurisdiction and it exercises its power through the licensing of generators, transmitters and distributors across the country. Its self-perceived role is 'to regulate the electricity supply industry to ensure that it meets customer requirements'.

Among the initial tasks of 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 as stated in the Reconstruction and Development Programme (RDP). As a contribution to the RDP, Eskom set itself a target of delivering 1.75 million household connections at the rate of 300,000 per annum.

## 3.4 Impact of National Electrification Programme on the poor

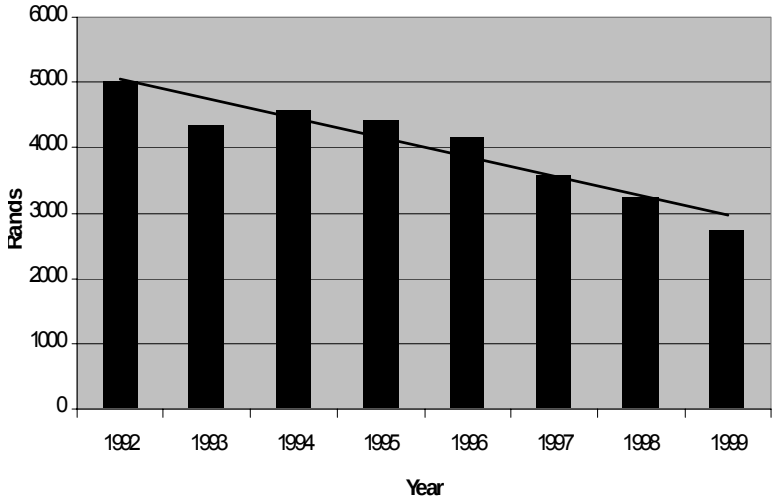
In 1993, only 36 per cent of the population had access to grid electricity. After the 1994 elections, the Government launched the first phase of the internally financed National Electrification Programme for 1994-99. As stated earlier, the programme was to be implemented by Eskom and the municipalities, and it was aimed at increasing electrification to about 66 per cent nationally by 2001. The target was exceeded, with 2.75 million connections achieved in Phase 1 (Borchers et al., 2001).

An offgrid electrification programme was launched in March 1999, aimed at providing 350,000 solar home systems (SHS) in seven concession areas. However, this was later revised to five concession areas, and a sixth was recently awarded by the Government. Under this programme, the government provides a subsidy of ZAR 3,500 to the concessionaire for each installation and the users pay a monthly service fee of ZAR 58 for maintenance. The system provided is of 50Wp capacity, which can power four lights, a radio and a black and white TV, estimated to consume about 6 kWh/month. Recently, the Government has initiated a subsidy programme of ZAR 40 to the users to help alleviate the burden of the monthly service charge, motivated by the recently instituted poverty tariff system that led to a discrepancy in benefits between the users of SHS and grid electricity. The most advanced concession in the programme is the Shell/Eskom joint venture, which installed 6,000 systems by 2000 (DME 2001).

However, the implementation of the programme has encountered many operational problems.

The Schools and Clinics Electrification Programme has provided offgrid energy services using SHS. By 2000, about 1,852 schools and an unspecified number of clinics had been connected (DME 2001). However, the programme has had mixed results. Only 6 per cent of the 1,400 systems installed in 1996 and 1998 were found partially operational in 2000 (Oldach et al., 2001). In an EU-funded project that installed 1,000 systems, 40 per cent were not operating within a year after installation (Mapako & Afrane-Okese 2002). The programme, however, was seen to have had more success in the electrification of clinics than schools.

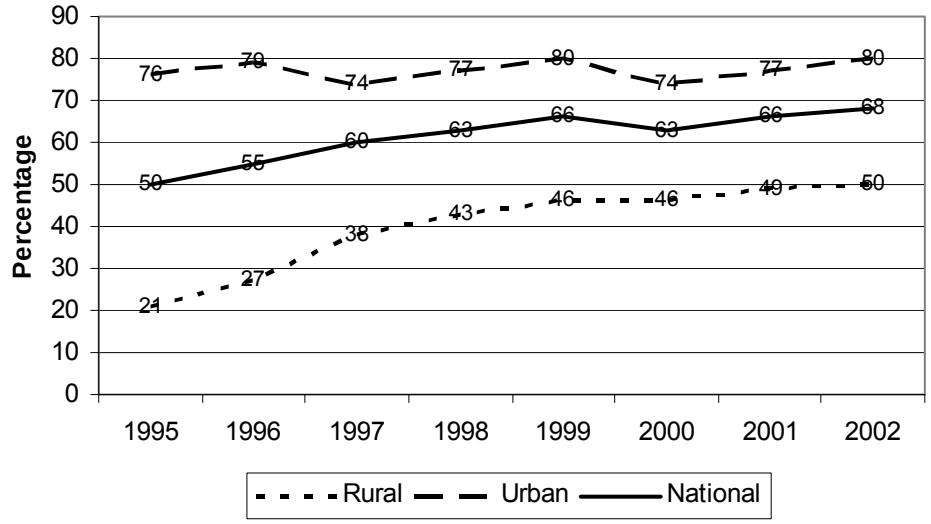
**Figure 2: Electrification Cost Per Connection**




### *3.4.1 Electrification levels and rates*

At the end of 2001, the National Electrification Programme recorded more than 3.4 million connections since 1994. This brought the national electrification level to about 66.1 per cent. According to DME (Department of Minerals and Energy), about 70 per cent of the households are currently electrified. The Government continues the programme with the intent to electrify 300,000 homes annually. It is interesting to note that the cost of connection has been declining steadily during the programme (Figure 2).

**Figure 3: Trends in Electrification of Households in South Africa: 1995-2002**

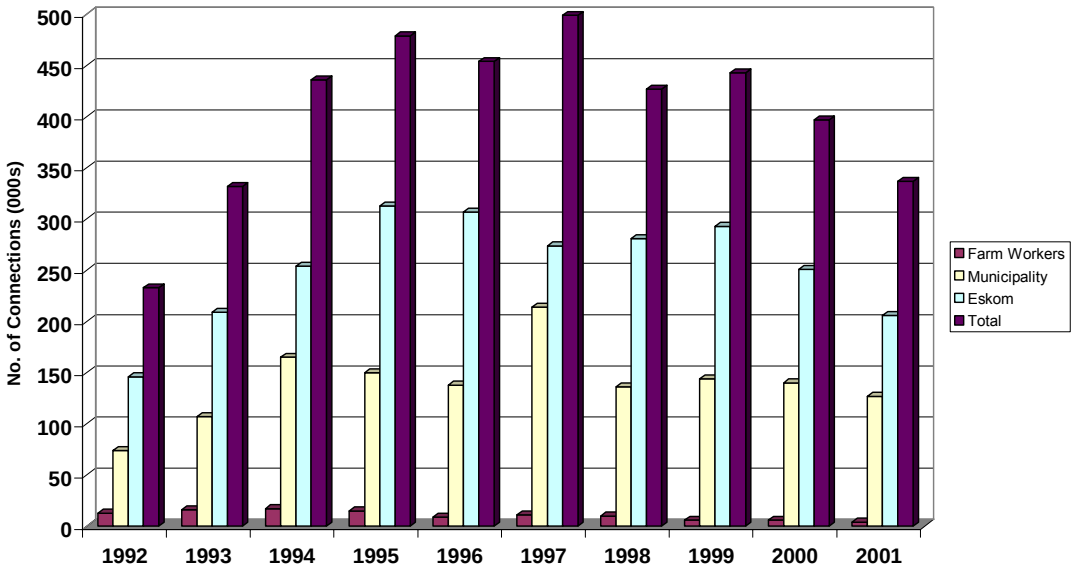



Source: NER (2002b).

The grid electrification programme has targeted mainly rural households, with little changes in the share of electrified urban areas (Figure 3). In spite of the major achievements — such as being self-financed by the country — of the programme, nationally about 30 per cent of the population is yet to be electrified (20% urban and 50% rural), mostly the poor.

The new connections were mostly extended 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 connections to farm workers about 6 per cent or less. As shown in Figure 4, new connections got their impetus from the electrification programme in 1994 which averaged around 450,000 households per year until 2000, when it dropped to 397,000, a trend that continued in 2001. The decline is due mainly to the drop in new connections by Eskom.

**Figure 4: Annual New Household Electricity Connections: 1992-2001**




Source: NER (2001)

In the White Paper on Energy Policy, the Government recognised 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 has, therefore, committed itself to implementing reasonable legislative and other measures within its available resources to progressively realise universal household access to electricity by 2010.

### *3.4.2 Impacts of electrification on the poor*

In general, the welfare of poor communities with access to electricity has improved significantly under both off-grid and grid programmes. However, the levels of improvement differ between off-grid and grid-connected users since the services to the former are limited to only lighting and media. The welfare benefits were greater for grid-connected users, but lower than what was anticipated because the consumption levels were also lower than expected at the start of the programme (Borchers et al., 2001).

Electrification of the poor has also resulted in several additional benefits. These include reduction of fires (particularly in low-income urban areas) from the use of paraffin and candles, and reduction of local and indoor air pollution from firewood use, especially in areas that use these fuels extensively for cooking and heating. Electrification of clinics and schools has yielded significant benefits for communities in the form of improved health-care service provision, involvement of schools in evening adult education, and improved efficiency of school operations through use of equipment, such as photocopiers and computers. In certain cases, electric street lighting may have contributed to reduced crime levels.

The recent direct subsidy to the poor under the electricity basic services support tariff (EBSST), or ‘poverty tariff’, has started showing positive signs although the

programme is still in its early stages. The results of an evaluation by the University of Cape Town show an increase in average monthly saving in household income of about ZAR 21.0 per person per month (UCT, 2002), a slight saving but one which can be significant in communities with limited monetary transactions. In some communities, it has been reported that about 30 per cent of the households have added lights in previously non-electrified rooms. It is also reported that some households started using appliances they owned but were not able to use before the programme was implemented. Responses to queries about the benefits of the electricity subsidy have been 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 indoor pollution due to fuel substitution; and
- Reduced anxiety about electricity being an expensive source of energy.

### *3.4.3 Electricity expenditure and consumption*

Disaggregated data on electricity expenditure trends at the national level are not available. Therefore, figures on sectoral sales of electricity are used to get an indication of expenditure trends. It can be seen from Table 7 that residential sales doubled between 1995 and 2002The significant growth in the residential sector sales was mainly due to the growth in electrified houses which reached 68 per cent of the total by 2002.

**Table 7: Sales of Electricity by Consumer Category (GWh)**

| *Category* | *1995* | *1996* | *1997* | *1998* | *1999* | *2000* | *2001* | *2002* |
|---|---|---|---|---|---|---|---|---|
| Residential | 3,906 | 4,753 | 5,494 | 5,989 | 6,057 | 6,476 | 7,301 | 7,888 |
| Agriculture | 3,383 | 3,239 | 3,402 | 3,725 | 3,890 | 3,816 | 4,224 | 4,009 |
| Commercial | 579 | 654 | 979 | 801 | 817 | 792 | 6,407 | 6,483 |
| Industrial | 42,244 | 47,451 | 52,236 | 53,683 | 54,240 | 55,953 | 48,664 | 51,581 |
| Mining | 31,293 | 31,188 | 33,077 | 31,645 | 31,505 | 31,403 | 31,923 | 32,549 |
| Average price (c/kWh sold) | 11.15 | 11.30 | 11.85 | 12.29 | 12.44 | 13.23 | 13.76 | 14.98 |

Source: Eskom (1996a; 1998; 2000; 2002).

### *3.4.4 Electricity expenditure and consumption by poor households*

As mentioned, data limitations have restricted the level of the analysis on the energy consumption and expenditure patterns of the poor. However, there are a few case studies which can be used to make preliminary assessments of these indicators. One is a study carried out recently by the University of Cape Town on the impact of electricity basic services support tariff (EBSST). However, the study sampled only a few areas in the KwaZulu-Natal province and cannot be seen as representative of the country. Nonetheless, the results of the study provide some useful insights into electricity expenditure and consumption among poor households.

The study consisted of two case studies of Umgaga, a long established peri-urban settlement located about 35 kms. from the centre of Durban, and Antioch, a village located about 180 kms. from the city of Pietermarizburg (UCT, 2002). In spite of both communities being relatively poor (by South African standards), there are major disparities in their electricity expenditure and consumption levels (Tables 8 & 9). The average household income in Antioch is at the margin of poverty standards set by the Government, while that in Umgaga is twice as much (table 8).

**Table 8: Monthly Household Electricity Expenditure and Consumption: 2001**

| Attribute | Antioch | Umgaga |
|---|---|---|
| Average electricity expenditure (ZAR) | 26 | 65 |
| Minimum electricity expenditure (ZAR) | 3 | 15 |
| Maximum electricity expenditure (ZAR) | 101 | 198 |
| ***Estimated Electricity Consumption Based on Expenditure*** | | |
| Average consumption of electricity units (kWh) | 68 | 170 |
| Minimum electricity units consumed (kWh) | 8 | 39 |
| Maximum electricity units consumed (kWh) | 265 | 520 |
| ***Estimated Electricity Consumption Based on Actual Measurements*** | | |
| Average electricity consumption (kWh) | 61 | - |
| Minimum electricity consumption (kWh) | 6 | - |
| Maximum electricity consumption (kWh) | 242 | - |

Source: UCT (2002)

The income difference between the two communities is reflected in the amount of electricity consumed and that the poorer Antioch community spends a substantially higher proportion of their income on energy than their Umganga counterparts (table 9).

**Table 9: Household Monthly Income and Energy (electricity & fuels) Expenditure: Antioch and Umgaga, 2001**

| Attribute | Antioch | Umgaga |
|---|---|---|
| Average number of household occupants | 6 | 6 |
| Average total household income (ZAR) | 817 | 1,678 |
| Minimum total household income (ZAR) | 223 | 0* |
| Maximum total household income (ZAR) | 1,770 | 6,120 |
| Total energy expenditure (ZAR) | 107 | 97 |
| Minimum energy expenditure (ZAR) | 20 | 15 |
| Maximum total energy expenditure (ZAR) | 303 | 255 |
| Total energy expenditure as % of average total household expenditure | 13 | 6 |

* No formal regular income, occasional charity

Source: UCT (2002)

It can be seen from Table 10 that in rural Antioch, 23 households (56%) consumed electricity in the range of 0-50kWh, 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 used electricity primarily for lighting at night and for radios. These results indicate the differences in consumption

patterns between the two areas as the village use is mainly between 0 – 50kWh, while in the township it is mainly between 100 – 300kWh. This is revealing because it supports the policy of free electricity up to 50 kWh for the poor.

**Table 10: 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 |

Source: UCT (2002)

Another study (Thom & Mohlakoana, 2001) shows that poor households use between 20 and 30 kWh per month 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 shows that the consumption levels of the poor are constrained by affordability.

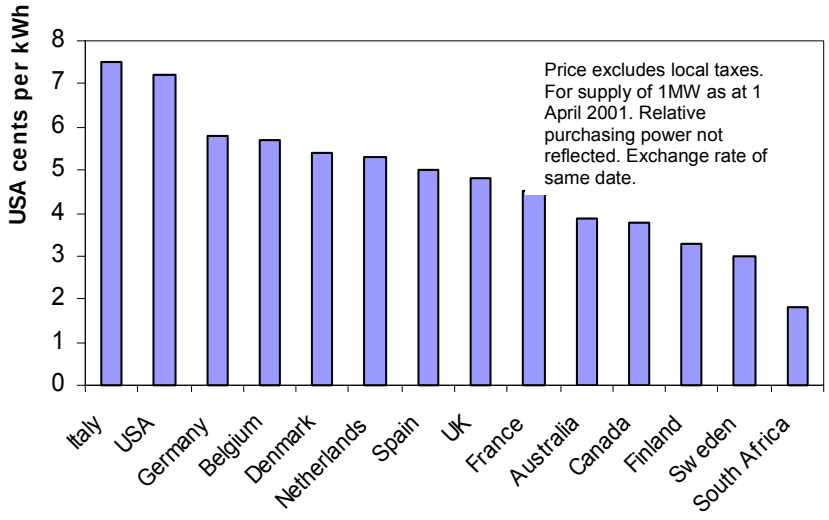
### *3.4.5 Electricity tariffs*

Compared to many other countries, electricity prices in South Africa are low in absolute terms (Figure 5). According to DME, this is due to a number of factors, including the following:

- Cheap coal: Over 90 per cent of the 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 per cent since 1990, leading to a cost reduction of 10 per cent.
- 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 per cent over the past 10 years.

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

**Figure 5: South African Electricity Prices Compared to World Prices**




Source: Eskom (2002).

Eskom charges and tariff structure are categorised depending on various factors. However, the major classifications divide rural or urban customers, residence type and load factors. These are described briefly below.

*a) Connection fees*

The Eskom connection fees shown in Table 11 are the minimum cash amounts payable. In certain cases, there will be additional charges depending on the actual cost policy. This fee is a one-off up-front payment towards the cost of providing supply. In order to give the correct pricing signal to consumers to obtain the appropriate supply size, the connection fee is differentiated by capacity and the number of phases of the supply.

**Table 11: Rural Connection Fees**

| Capacity (kVA) | Conventional (ZAR) | Prepayment (ZAR) |
|---|---|---|
| 5 (single-phase) | 1,403.51 + VAT = 1,600.00 | 1,403.51 + VAT = 1,600.00 |
| 16 (single-phase) | 2,280.70 + VAT = 2,600.00 | 2,280.70 + VAT = 2,600.00 |
| 25 (three-phase) | 3,508.77 + VAT = 4,000.00 | N/A |
| 32 (dual-phase) | 3,508.77 + VAT = 4,000.00 | 3,508.77 + VAT = 4,000.00 |
| 50 (three-phase) | 4,824.56 + VAT = 5,500.00 | 5,701.75 + VAT = 6,500.00 |
| 64 (dual-phase) | 4,824.56 + VAT = 5,500.00 | N/A |

Source: Eskom (2003).

*b) Domestic tariffs (Homelight tariff)*

The Homelight tariff is applicable to single-phase, low-usage residential supplies, but it 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. It has two categories:

- 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 shown in Table 12.

**Table 12: Energy Charges for Homelight Tariff**

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

Source: Eskom (2003).

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.

*c) Rural tariffs*

Nightsave Rural

This is applicable to rural areas and it 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; and
- Seasonal differentiation.

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 utilised capacity of all points of delivery linked to an account. It is a contribution towards Eskom's costs for customer service.

Rural Flex

This is a time-of-use 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; and
- Seasonal differentiation.

**Table 13: Eskom Rural Electricity Tariff: Active Energy Charges**

| | | High-demand season (June – August) | Low –demand season (Sept. – May) |
|---|---|---|---|
| Rural Flex | Peak | 75,80c + VAT = 86,41c/kWh | 21,06c + VAT = 24,01c/kWh |
| | Standard | 19,71c + VAT = 22,47c/kWh | 12,89c + VAT = 14,70c/kWh |
| | Off-peak | 10,50c + VAT = 11,97c/kWh | 9,03c + VAT = 10,29c/kWh |
| Night Save | | 13,85c + VAT = 15,79c/kWh | 10,13c + VAT = 11,54c/kWh |

Source: Eskom (2003)

Land Rate

This is a tariff for rural customers with supplies up to 100 kVA, typical customers being farmers and businesses.

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 14. In certain cases, reportedly due to structural changes, the increases were higher or lower than the average.

**Table 14: Eskom's Average Tariff Increase: 1989-2003**

| 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% |

Source: Eskom (2003).

## 3.5 Subsidies for the poor

The Government set up the National Electrification Fund (NEF) to subsidise a large part of the capital costs of electricity connections under the electrification programme. The Fund derives its income not only from the electricity industry, but also from fiscal allocations, grants and other sources. The cost of the programme was ZAR 8 billion, of which Eskom contributed ZAR 5 billion and local authorities ZAR 2 billion, with Eskom being exempted from corporate taxes. ZAR 1 billion came from other sources.

In previous electrification initiatives, resources were allocated every year to the electrification programme through the mechanism of internal cross-subsidisation and a

surcharge included in the electricity price of Eskom and local authority distributors. These mechanisms have been considered non-transparent, with little room for Government influence over the collection and allocation of the surcharge (DME, 1998). The surcharge included in the electricity price is to be replaced by an electrification levy. This and other changes are not intended to affect the amount of funding for electrification or the level of the electricity tariff. NEF extends its support to non-grid electrification in areas where grid electrification will not be viable for some time.

In 2000, the Government announced its intention to provide the poor with free basic services. The main focus areas were water and electricity (DME, 2003). This policy goes back to 1998 when NER proposed 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. The research focused on the following major areas:

a) Level of the free basic electricity allocation;

b) Identification of recipients of the allocation;

c) Cost implications of such an allocation; and

d) Sustainable sources of funding for the allocation.

Based on the work conducted, it was recommended that 50kWh per month be provided to all poor households connected to the national electricity grid. The decision on 50kWh was arrived at because 56 per cent of the connected households in the country 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 on the poorest sector of the population. Since the Government recognised that there might be difficulties in applying this recommendation, the policy includes some flexibility over a range of 20-50kWh per month.

There are numerous tariff 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 ZAR 20 per month. Applying this subsidy to Eskom tariffs, and assuming that 40 per cent of domestic customers (7.1 million in 2001) would be targeted for EBSST, the cost of the subsidy would result in a revenue loss (excluding VAT) of about ZAR 630 million per year (UCT, 2002). The Government has recently committed itself to spending more than ZAR 0.5 billion annually on this programme.

### *3.5.1 Beneficiaries of EBSST*

While the primary objectives of EBSST were to help alleviate poverty, some key issues need to be resolved. These include:

- Who are the poor the EBSST is intended to reach?
- 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 earlier study on EBSST provided some answers to these questions. It considered the baseline of ZAR 800/mth. to be inadequate in defining poverty and proposed other approaches. One such approach was to extend the support to all households using a self-targeting discipline by those willing to accept a restricted supply of electricity. Under this approach, a 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 was used had problems of excluding some of the poor due to disconnection or non-payment.

### *3.5.2 Adequacy of EBSST*

EBSST offers a good case for analysing the adequacy of electricity subsidies as the subsidy was basically for lighting, media access and limited cooking, and it was expected to play an important role in poverty alleviation by providing appropriate conditions for education and learning, health, and access to news and information. The results of the EBSST study contain more details on the adequacy of this assumption.

The results of two studies that investigated ownership of electric appliances in electrified rural areas showed that most households were using electricity for appliances including radio, television, iron, electric kettle, hotplates/stoves and geysers (Davis and Ward, 1995; Hansmann et al, 1996).

**Table 15: Appliance Ownership Among Electrified Households in Rural Areas**

| % of all households | % of all households | % of households with per capital monthly income of: | | |
|---|---|---|---|---|
| | | <ZAR 130 | ZAR 130 - 270 | > ZAR 270 |
| Geyser | 5 | 0 | 2 | 8 |
| Stove/hotplate | 37 | 10 | 27 | 53 |
| Kettle | 32 | 12 | 25 | 85 |
| Fridge | 43 | 12 | 28 | 65 |
| Television | 47 | 19 | 33 | 67 |
| Radio/Hi-fi | 87 | 79 | 85 | 91 |
| | | | | |

Source: Davis and Ward (1995)

On the basis of results in Table 15, a general framework of power requirements for a household owning some basic electric appliances, as shown in Table 16. It has been assumed that use of the stove would be minimal for such household.

**Table 16: Electricity Consumption of a Household with Common Electrical Appliances**

| Appliance | Units | Electrical Rating (W) | Hours of Use/Day | Units/Month (31 days) (kWh) |
|---|---|---|---|---|
| Light bulbs | 3 | 60 | 5 | 27,90 |
| Radio (portable) | 1 | 6 | 4 | 0.74 |
| 1 plate stove | 1 | 1,000 | 1 | 31.0 |
| Iron | 1 | 1,000 | ¼ | 7.75 |
| Total monthly units | | | | 67.39 |

Adapted from Cowan (2003)

The EBSST is expected to provide poor households free electricity in the range of 20-50kWh per month, but as Table 16 indicates, 50kWh constitutes about 74 per cent

of the electricity consumption of an average household per month for lighting, cooking, radio and ironing. The EBSST study recommended that basic free electricity for poor households should be adequate for two 60W lamps for 6 hrs./night; one radio for 10 hrs./day; and one 1,600W hot-plate for 0.7 hrs./day. This scenario would translate to 60kWh of electricity consumption per month, above the maximum EBSST free electricity. However, the use of efficient compact fluorescent lamps (CFLs) and LPG stoves, if promoted along with the EBSST initiative, could reduce the consumption from 67.39 kWh to about 33-40kWh per month. Under such scenario the LPG stove would replace the electric stove and lighting (15W CFL) would consume 6.98kWh per month. A comparison of monthly costs between use of LPG or electric stove for such households would be necessary.

A study was also conducted to monitor the impact of EBSST on the consumption of electricity in two rural villages and the results are summarised in Table 17.

**Table 17: Expenditure on Electricity in Two Villages: 2001-2002**

| Expenditure | | Garagopola (Rural) | | Antioch (Rural ) | |
|---|---|---|---|---|---|
| | | Before May 2001 | After Feb-Sep 2002 | Before Oct-Nov 2001 | After Oct-Nov 2002 |
| Expenditure on electricity (R/month) | Mean | 47.3 | 39.8 | 28.4 | 20.7 |
| | Std dev. | 28.4 | 41.0 | 23.2 | 28.2 |
| Expenditure on energy including electricity (R/month) | Mean | 92.3 | 81.1 | 123.8 | 98.8 |
| | Std dev. | 68.1 | 77.7 | 87.7 | 109.1 |
| Energy as % of total household expenditure | Mean | 17.9 | 12.2 | 17.6 | 12.0 |
| | Std dev. | 19.3 | 9.5 | 8.7 | 9.9 |

Source: UCT (2003).

While it is recognised that there was a tariff increase from 2001 to 2002, the results of the study show a general decrease in electricity expenditure after the introduction of EBSST. This may be due to many factors, for instance, the average electricity consumption of most poor households may have reached a saturation point based on the affordability of electrical appliances, or the lack of money. In other words, for the decrease in electricity expenditure could be unused electrical appliances because of affordability problems. This aspect was studied and the results are shown in Table 18.

**Table 18: Use of Previously Unused Electrical Appliances[1] as a Result of EBSST**

| 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%) |

Source: UCT (2003).

[1] Many of the high end electric appliances are bought by richer relatives.

Table 18 shows that very few households responded to EBSST by buying and/or using electric appliances previously not used. For such households, EBSST would probably have resulted in the same expenditure on electricity, but with an increased spectrum of electricity services. What is of particular interest is that there were some households with electric appliances that were used only with the introduction of EBSST.

On the other hand, continued suppression of electricity use in the presence of EBSST would imply savings on electricity expenditure, which would enable households to spend more on other items like food and clothing. In 2002, electricity units of 50kWh were equivalent to about ZAR 25 at current electricity prices. The average saving on electricity expenditure was ZAR 7.50 per month, a 5 per cent decrease in total household expenditure per month.

## 4. ZIMBABWE

### 4.1 Country situation

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 sq. kms. Zimbabwe obtained its independence in April 1980 and inherited all the ills of a racially divided society. It has a developed industrial sector and a 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 like 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 19 presents its key development indicators.

**Table 19: Key Development Indicators of Zimbabwe**

| 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 $) | 8.4 billion | 7.2 billion | 9.1 billion |
| GDP growth (annual %) | 2.7 | -4.9 | -8.4 |
| Exports of goods and services (% of GDP) | 37.6 | 29.4 | 21.8 |
| Imports of goods and services (% of GDP) | 44.6 | 27.2 | 20.7 |
| Trade in goods as a share of GDP (%) | 66.8 | 49.6 | 36.5 |
| Foreign direct investment, net inflows in reporting country (current US$) | 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 |

Source: World Bank (2003).

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 the 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 past inequalities. However, as Table 18 illustrates, disparities in all forms of energy between rural and urban remain significant, except in wood fuels – a low quality energy source.

**Table 20: Household Access to Energy Sources in Zimbabwe (%)**

| 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 |

Source: Central Statistics Office (2001).

## 4.2 Background of the power sector

Since attaining independence in 1980, Zimbabwe has embarked on various sector policy reforms, including energy reforms. In the energy sector, the Government has sought to increase energy access to previously disadvantaged people through both grid extension and offgrid electrification. The national energy policy has five main objectives (Munjeri, 2002):

a) Ensuring accelerated economic development;

b) Facilitating rural development;

c) Promoting small-medium scale enterprises;

d) Ensuring environmentally friendly energy development; and

e) Ensuring efficient utilisation of energy resources.

The Zimbabwe Electricity Supply Authority (ZESA) has been responsible for the generation, transmission and distribution of electricity in Zimbabwe. It has five major power stations, with a total capacity of 1,961 MW (Karekezi, *et al,* 2002). These facilities do not meet the country's electricity demand. As a result, Zimbabwe imports 41 per cent of its electricity from neighbouring countries, including DRC (Democratic Republic of Congo), Mozambique, Zambia and South Africa (Table 21).

**Table 21: Zimbabwe Power Imports**

| 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 |

Source: Karekezi *et al* (2002).

Electricity generation in Zimbabwe is mainly from coal and hydro plants, the former with a capacity of 1,170 MW. The largest hydro plant is Kariba, which generates 500 MW (ZESA 2001). An overview of internal electricity supply in Zimbabwe is shown in Table 22.

**Table 22: Overview of Internal Electricity Supply in Zimbabwe**

| Station | Kariba | Hwange | Harare | Bulawayo | Munyati | Total |
|---|---|---|---|---|---|---|
| Plant type | Hydro | Coal | Coal | Coal | Coal | |
| Capacity (MW) | 750 | 920 | 80 | 90 | 80 | 1,920 |
| Available capacity (MW) | 500 | 760 | 55 | 85 | 75 | 1,475 |
| Energy sent out (GWh) | 2,998 | 4,809 | 22 | 48 | 44 | 7,926 |
| Plant load factor (%) | 64.61 | 47.66 | 3.44 | 6.50 | 5.42 | 49.18 |
| Efficiency (%) | 91.42 | 27.80 | 20.18 | 20.91 | 18.38 | 53.77 |

Source: Karekezi *et al* (2002); ZESA (2001)

Zimbabwe has an offgrid electrification programme that is mainly SHS-based. Current estimates indicate that there are about 85,000 SHS in the country, making it one with the largest number of such systems in the continent (Mapako & Afrane-Okese 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 solar technology user-friendly. A major GEF-supported SHS project contributed to this large number of installations.

Biomass is another potential source of electricity in the country. 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 used by the sugar factories. (Karekezi & Ranja, 1997).

## 4.3 Power sector reforms

Zimbabwe's power sector has undergone a number of changes since independence in 1980. In 1985, the Government reformed the structure of power utilities under the Electricity Act. 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, standardization of tariffs and reducing duplication of functions. ZESA became the only legal entity with the right to generate and transmit electricity. It had the option of licensing independent power producers to generate electricity and also the right to set the purchase price of electricity from the producers. The Act did not provide room for third party access, nor for other uses of the grid by third parties (ESMAP, 2000).

In 1992, the Performance Improvement Programme (PIP) was implemented with the assistance of Electricite de France (EdF). The programme consisted of a set of simple maintainable targets that were tied to the new management's contracts covering finance, customer services and management, distribution system, generation plants and system, transmission system, other technical services, and human resources management. Implementation of the programme resulted in ZESA reversing its past trend of losses and achieving net surpluses in the years that followed (Dube, 1999).

In 1996, the Government revised the Electricity Act in order to create room for independent power producers. The response to this was poor, probably because the Act still required independent producers above 100kW level to seek approval from the Government and ZESA. Also the pricing, expenditure, capital budgets, procurement and staffing were to be regulated by the Government.

Also in 1996, the privatisation and expansion of the Hwange power station was proposed. It was recommended that, in order for this project to be economically viable, the long-run marginal cost (LRMC) principle should be adopted. LRMC of the power station was estimated at 6-7 USc/kWh and the average tariff then was 2.47 USc/kWh. The Government agreed in principle to adopt the LRMC, but did not implement the recommendation. As a result, initiatives to privatise several power stations, including Hwange project, were abandoned (Karekezi, *et al*, 2002).

In 1999, the Government started to institute other reforms in the power sector. Programmes under consideration consisted of unbundling of the electricity sector, establishing a regulator, privatisation, and establishing a Rural Electrification Fund based on 1 per cent of all electricity bills collected. The Rural Electrification Fund is reported to have helped in the extension of grid electricity to rural households by contributing towards initial capital investments (Karekezi, *et al*, 2002). However, since its inception in 1999, implementation of the fund has been slow, with only 14 of the targeted 54 rural electrification projects having been completed by April 2000. The failure to achieve the target was attributed mainly to the narrow contractor base used for the rural electrification programme rather than to lack of funds, since the fund had an excess of ZBD 460 million by then (Kayo, 2001).

In November 2001 the Zimbabwe cabinet approved a Rural Electrification Fund Bill that was to pave way for establishing the Rural Electrification Fund/Agency to spearhead the Rural Electrification Programme. The cabinet also approved the

commercialization of ZESA by adopting the Electricity White Paper which provided for power sector reforms. (ZESA 2001).

In January 2002, a new Electricity Act and a Rural Electrification Act were passed whereby the power sector was to have a Regulatory Commission (Zimbabwe Electricity Regulatory Commission, ZERC) and a Rural Electrification Agency (REA). This put in motion the commercialisation of ZESA, and generation, transmission and distribution services were to be unbundled. The Electricity Act of 1985 was to be repealed when these new institutions were established (Mangwengwende, 2002; ZESA 2001).

Generally speaking, four main factors have been behind power sector reforms in Zimbabwe (Turkson, 2002):

- Restructuring as a component of the general economic reforms;
- Reforming parastatals to empower historically marginalised groups;
- Enhancing power sector efficiency; and
- Mobilising finance for capital investments in the power sector.

## 4.4 Impact of Rural Electrification Programme on the poor

The first Rural Electrification Program (REP) was initiated by ZESA in the 1980s, but it had to be abandoned in 1990 because of cash flow problems and the lack of a comprehensive policy on rural electrification. In 2001 the Expanded Rural Electrification Programme (EREP) was initiated, following the introduction of a 1 per cent levy on monthly bills of all electricity accounts. Under the EREP it became mandatory for the government, through ZESA, to allocate resources towards the widespread rural electrification drive without considering the economic merit of the grid extension (Munjeri 2002). The vision of this programme was the total electrification of the country thereby contributing to poverty alleviation by stimulating economic activities that create wealth. However, its coverage was limited to the economically feasible rural growth points.

The long-term objectives of the initial EREP 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 and so on.
- 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.
- Help reversing urban migration and energy-related environmental degradation.

### *4.4.1 Electrification levels*

The Performance Improvement Programme (PIP) initiated by the Government in 1992 had, among others, the objective to achieve the growth of ZESA for total electrification of the country (Mangwengwende, 2002). As a result, access to electricity

grew from 20 to 39 per cent between 1991 and 1999 (Kayo, 2001). Furthermore, between 1999 and 2001, electrification grew from 39 to 42 per cent (World Bank, 2003). Currently, ZESA connects an average of 21,839 new domestic customers annually (Dube, 2003). Table 23 shows the national urban electrification rates from 1990 to 2001.

**Table 23: Urban and Rural Electrification Rates: 1990-2001**

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

Source: World Bank (2003); Kayo (2002).

Recently, greater emphasis has been placed on rural electrification, as reflected in the Rural Electrification Charter of 2002 whereby ZBD 24 billion is to be devoted to rural electrification under a five-year project. It was observed in 2003 that about 100 rural centres were being electrified per month by this initiative (Dube, 2003).

Zimbabwe's experience with offgrid electrification initiatives (mainly SHS) has not been satisfactory when compared to the grid-based Rural Electrification Programme. Although a significant number of these systems have been disseminated in rural areas, a profound problem with them has been the high cost of solar panels and a high failure rate of the systems.

In response to the high cost of solar panels, the Government at some point waived duties on solar technologies, resulting in an increased demand for the systems. Subsequently, however, duties were re-introduced and this had an adverse effect on the rate of dissemination of SHS (Karekezi, *et al*, 2002). With regard to the performance of the systems installed, Zimbabwe has experienced mixed results from the various projects. For example, two years after installation of SHS under the GEF Project, about 30 per cent of the systems had failed (Mapako & Afrane-Okese, 2002). In general, it has been observed that donor-funded projects were more prone to failure than privately implemented ones.

### *4.4.2 Electricity tariffs*

Understanding the situation in Zimbabwe requires an examination of the trend in the exchange rate of national currency against the US dollar because of major changes that have occurred in recent years, with significant impacts on electricity tariffs and subsidies. Table 24 summarises the average ZBD-USD exchange rates between 1995 and 2001. As can be noted, the Zimbabwe dollar depreciated by 500 per cent within a relatively short period from 1995 to 2001, with steep reductions occurring from 1998 onwards.

**Table 24: Exchange Rate, Zimbabwe Dollar per US Dollar**

| Year | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|
| Period average rate | 8.66 | 9.92 | 11.90 | 21.41 | 38.31 | 46.50 | 55.0 | 55.0 |

Note: The rates provided in the table are the official exchange rates. Parallel market exchange rates are much higher. For example, in 2002 the parallel market exchange rate was ZBD 300 = 1 US$

Source: IMF (2002); Karekezi, *et al* (2002)

The Government has the final control in setting tariff levels. There have been occasions in the past when the Government has rejected tariffs recommended by external consultants. Nonetheless, tariffs have been changing annually (Table 25).

**Table 25: Electricity Tariff Trend: 1990-2001**

| Year | Average Price (US c/kWh) | Year | Average 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 |

Source: Karekezi, *et al* (2002).

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 per cent weighting
- Inflation: 11 per cent weighting
- Fuel: 8 per cent weighting
- Autonomous: 10 per cent 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 applications and basic heating – e.g., hot-plate stove, ironing, up to 300 kWh per month.

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

Lifeline tariff subsidies in Zimbabwe entail preferential pricing to domestic consumers with lower consumption (Table 26). However, they are also implicit in the prices charged to higher consumption groups. For example, a flat rate of ZBD 3.21 is charged to consumers above the 1,000kWh block, but this charge is less than the ZBD 4.13 per kWh required to meet the cost of service and returns for system expansion. Subsidies are also extended to 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 per cent of the total revenue (Dube, 2003).

**Table 26: Electricity Tariffs for the Domestic Sector**

| Consumption Block | Tariffs/kWh (ZBD) | Tariffs/kWh (USD)* |
|---|---|---|
| *Year 2001* | | |
| Up to 50 kWh | 0.99 | 0.018 |
| Up to 300kWh | 1.10 | 0.020 |
| Up to 1,000kWh | 3.09 | 0.056 |
| Above 1,000kWh | 3.21 | 0.058 |
| *October 2002* | | |
| Up to 50 kWh | 2.78 | 0.050 |
| Up to 300kWh | 3.06 | 0.055 |
| Up to 1,000kWh | 7.18 | 0.130 |
| Above 1,000kWh | 7.45 | 0.135 |
| *November 2003* | | |
| Up to 50 kWh | 5.48 | 0.007 |
| Up to 300kWh | 6.01 | 0.007 |
| Up to 1,000kWh | 14.09 | 0.017 |
| Above 1,000kWh | 14.60 | 0.018 |

Source: Adapted from Dube (2003; 2004)

### *4.4.3 Electricity consumption and expenditure*

According to a study on electricity expenditure in urban areas (Dube, 2003), poor households spent a higher proportion of their income on electricity than non-poor households (Table 27). Based on electricity consumption patterns and the available subsidies to domestic consumers, it was observed in the study that the removal of subsidies would result in an increase in the share of electricity expenditure in total household income by 41 per cent for the non-poor, 87 per cent for the moderately poor and 77 per cent for the extremely poor (Table 28).

**Table 27: Electricity Consumption Patterns of Urban Households**

| 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 |

Adapted from Dube (2003).

**Table 28: Significance of Electricity Subsidies**

| Household Category | Electricity Cost Without Subsidy (ZBD) | Subsidy Amount (ZBD) | 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 |

Source: Adapted from Dube (2003).

# 5.0 KEY FINDINGS AND THE WAY FORWARD

## 5.1 Key findings of the study

In both countries, data on the electrification of the poor is almost non-existent – a key limitation of this study. Although, for instance, the National Electricity Regulator in South Africa keeps track of rural electrification, the data is not categorised by poor and non-poor users. Therefore, the study relied on secondary sources, mainly studies undertaken by research institutions like EDRC and the University of Cape Town for the South African case study, and AFREPREN in the case of Zimbabwe. Because of these data limitations, the findings and conclusions of this study are not conclusive. Nonetheless, there appear to be several similarities and differences between the electrification programmes in South Africa and Zimbabwe.

Both South Africa and Zimbabwe have a history of apartheid and it is the respective Government's policy to redress the inequalities of past racial prejudice that forms the basis of their reform programmes. In the pre-independence phases, development strategies in both countries were racially distinguished. Most benefits accrued to the white population (around 11% of the total), while the black population was denied services, including energy. Hence, at independence (1980 for Zimbabwe and 1994 for South Africa), the democratic Governments that emerged embarked on specific reform programmes addressing access to electricity services and poverty alleviation among the formerly underprivileged population – which also happens to form the majority of the poor.

The reforms undertaken to address access to electricity indicate positive outcomes, particularly under the grid-based electrification programmes. In South Africa, national electrification rates more than doubled from 34 to 70 per cent between 1994 and 2001, as they also did in Zimbabwe, growing from 20 to 42 per cent between 1980 and 2001. However, the Government-funded electrification programme in South Africa took a shorter time and reached a much larger proportion of the population.

In an attempt to reach the poor in remote locations, both countries focused on the establishment of offgrid programmes centred on SHS powered by solar PV technology. However, evaluations of the PV-based offgrid programmes have raised some fundamental questions over the technology. For example, the PV-based offgrid programmes in both countries have encountered serious technical problems. In South Africa, it is reported that about 94 per cent of the PV systems installed by the RDP project have failed (Oldach et al., 2001). In Zimbabwe, under the GEF project, about 30

per cent of the systems were inoperative within only two years of installation (Mapako & Afrane-Okese, 2002).

Off-grid programmes based on solar PV home systems require an urgent review as they are focused on lighting, which is not the highest priority (Davidson & Youba, 2002), even if all the operational and financial problems are resolved. Designing energy programmes for the poor must address cooking needs as a priority over lighting, along with motive power for income-generating activities.

In both countries, the reforms have attempted to make electricity affordable to the poor but using different approaches. South Africa has introduced special subsidies on electricity consumption including some free electricity. Zimbabwe has established a rural electrification fund to subsidise rural electrification schemes. These approaches appear to have been instrumental in supporting their respective electrification programmes and positively impacted on electricity access among the poor.

The EBSST subsidy in South Africa which supplies 20-50kWh of free electricity to the poor in selected areas seems to have had a more direct impact on the poor. It had some positive impact on poverty alleviation following the reduction in electricity expenditure. However, this is a very recent development and additional studies may be required to assess the feasibility of the subsidy due to the significance of its impact on the Government's coffers – the programme at present is costing the South African Government about ZAR 630 million annually.

The reforms in both countries have ensured the protection of funds for financing the electrification of the poor by ensuring transparency and accountability, albeit in different ways. In the South African case, the National Electricity Regulator (NER) aggressively monitors and makes public the progress of the National Electrification Programme through the NER's annual reports. In Zimbabwe, the Performance Improvement Programme includes explicit rural and urban electrification targets that the utility is obliged to meet. The progress of the Rural Electrification Programme is reported in ZESA's annual reports.

An interesting observation is that both countries, in spite of having gained independence during a time when market oriented reforms such as privatisation of the power sector was sweeping across the continent, did not commence privatisation until after undertaking substantial electrification. At the same time, available information does not facilitate an identification of the justification or the likely benefits of privatisation. While proponents of privatisation claim it could lead to increased efficiency, linking efficiency improvements to ownership of the utility is not the only solution as there are several other options to improve management without privatising. In addition, the performance of national utilities in the two countries broadly compares well against international utility performance benchmarks. Indeed, other African utilities benchmark their performances against the two utilities in South Africa and Zimbabwe owing to their relatively good performance.

## 5.2 The Way Forward

It is recommended that the following areas be further investigated:

- A proper understanding, through participatory approaches, of the associated social and economic characteristics of the poor.
- Innovative technological approaches to reduce connection fees and distribution costs, to reduce the overall cost of increasing access to electricity, especially by the poor.
- Further assessment of the use of renewable energy, especially SHS, as a poverty alleviation tool.
- Improvement in the overall information and understanding of intended users in order to maximise the social benefits of grid and offgrid expansion.
- Development of local management and control schemes of energy investments, including an exploration of public-private management schemes that could benefit the poor.

## 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 per cent of production occurs. South African coal is low in sulphur content (less than 1%), but high in ash (up to 40%). It is used for electricity generation (56%), synthetic fuel production (34%) and metallurgy (6%). Domestic and other uses of coal rank at 4 per cent (EDRC, 1996).

### *Natural gas*

South Africa has a total gas reserve of about 780 billion cubic feet. It currently produces natural gas at the rate of 194 Mmcf/d and 9,500 bbl/d of condensate. South Africa has also discovered offshore natural gas 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 the way for increased production of electricity by gas turbines, such as in the Cape Power Project that includes a 1,200-2,000 MW combined cycle gas turbine power plant near Cape Town to serve the metropolitan area and industrial plants. A 400 MW plant is planned in Namibia to supply Western Cape Town in addition to supplying Namibia. Currently, Eskom generates 342 MW 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 with Sasol, is well ahead with the pipeline construction and its delivery of gas is expected to start in the first half of 2004. This project hopes to develop the gas fields of Pande and Temane in Mozambique. It is very important for South Africa because of its potential 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 private actors for gas distribution.

### *Nuclear power*

Like many African countries, South Africa has uranium. But it is the only African country with a nuclear facility that produces electricity from a 1,930 MW plant. Eskom plans to develop and build a new generation of pebble bed modular reactors of about 100 MW size for export and domestic power generation. The initial feasibility phase for a pilot plant is completed but the government is yet to approve 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 for electricity accounts for less than 2 per cent of installed capacity in South Africa and generates less than 0.2 per cent of the total generation. Existing installations include windmills and wind turbines (pumps, small offgrid and mini grid power systems), solar heating systems (domestic heaters, water

and pool heaters, commercial water heaters), PV systems (for lighting and home appliances, water pumps, telecommunication, education, health and refrigeration), hydropower (grid pump storage, micro and mini hydro), biogas, landfill gas and solar heat engines (grid -connected systems and solar chimney plants). Other renewable energy sources for electricity production include wind, hydro, and wave action. Several estimates have been made of the theoretical potential of renewable energy in South Africa. Table A1 summarises three of them.

**Table A1: Estimates of Theoretical Potential for Renewable Energy for Electricity Production in South Africa**

(PJ/year)

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

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

### *Hydroelectricity*

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

Currently, there are six small hydro schemes of under 10 MW in the country. Eskom runs two of these (6 MW First Falls and 2 MW Ncora), municipal generators three (2 MW Lydenburg, 1 MW Ceres and 1MW Piet Retief) and one privately owned facility (3 MW Friedenheim). Eskom also runs the Second Falls scheme which has a capacity of 11 MW; the next station by capacity being Collywobbles at 42 MW. The total hydro capacity, including two large dams, is 661 MW.

### *Pumped storage*

A similar concept to hydropower, pumped storage involves the pumping to and storage of water to a higher water head during offpeak hours and releasing it to generate electricity during peak hours. Eskom's pumped storage generation capacity is 1,400 MW.

### *Biomass*

There are five bagasse-/coal-fired power stations run by private generation companies. These are all sugar companies, which use sugar cane residues primarily for their own consumption. Coal is used as a back-up fuel in the sugar plants, but 73 per cent of the net energy produced is self-consumed. Other sources of biomass for power generation include the timber industry, which produces 18 PJ per year.

### *Wind energy*

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

Eskom is developing 100-200 MW of 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 5 MW 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. The annual 24–hr. global solar radiation has been estimated at 220 $W/m^2$, 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/yr., solar photovoltaic (PV) energy of up to 144,000 PJ/yr. and solar water heating energy of 2 PJ/yr. (DME 2002)**.**

## APPENDIX 2
## South African Currency Against the US Dollar

**Table A2: South African Rand Against the US Dollar: 1997-2003**

| | Rand per 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 |

Source: South African Reserve Bank (2001; 2003).

## APPENDIX 3
## Eskom Urban Connection Fees and Tariffs

**Table A3: Urban Connection Fees**

| 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 or 5% of actual project costs. | N/A |

Source: Eskom (2003).

### *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 the energy rate. The network charge is for recovering a 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 upfront 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*

ZAR 48.98 + VAT = ZAR 55.84 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 and so on.

### *Network charge*

ZAR 43.37 + VAT = ZAR 49.44 payable each month for each point of delivery, whether electricity is consumed or not. It 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 a 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 hrs. on weekdays and the on entire Saturdays, Sundays and public holidays. It is also seasonally differentiated. A service fee is charged per account and is based on the sum of the utilised capacity of all points of delivery linked to an account, whereas the administration fee is determined by, and payable for, the utilised 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

**Table A4: South Africa's Annual Electricity Connections: 1997-2002**

| Year | Type of Area | Population | Houses | Houses Electrified | Houses Not Electrified | % Electrified | % Not Electrified |
|---|---|---|---|---|---|---|---|
| 2002 | Rural | 21,565,933 | 4,436,604 | 2,231,924 | 2,204,680 | 50.3 | 49.7 |
| | Urban | 23,888,278 | 6,547,045 | 5,225,063 | 1,321,982 | 79.8 | 20.2 |
| | Total | 45,454,211 | 10,983,650 | 7,456,987 | 3,526,663 | 67.9 | 32.1 |
| 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** |

Source: NER (2002/2003; 2001).

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