Electricity Access to the Poor: A study of South Africa and Zimbabwe

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ABSTRACT

Electricity access in sub Saharan Africa is only 17%, the lowest worldwide, but is even worse for rural areas that house most its poor which is estimated at around 5%. This paper looks at this issue for two countries in Southern Africa, Zimbabwe and South Africa

South Africa and Zimbabwe offer two different cases of how government policy intervention can help to improve access to modern energy services. The energy policies in South Africa and Zimbabwe evolved under different sets of national circumstances. South Africa is a highly industrialised country in Africa endowed with a wide variety of natural resources. The country is currently going through major changes in many spheres of its

economy, including energy, following the democratic elections in 1994, with emphasis placed on redirecting key aspects of government policy to address the enormous disparities in income levels and living conditions between the different racial groups, a result of apartheid. Zimbabwe, on the other hand, is a landlocked country with an economy that relies heavily on agriculture, with higher levels of poverty that are closely related to the country's history of governance by the minority white government. After independence in 1980, the Government of Zimbabwe embarked on policies aimed at redressing the economic imbalances of the past, including reforms in the power sector. These included increasing electricity access to previously disadvantaged people through grid electricity expansion and off-grid electrification.

The paper examines the impact of power sector reforms on the poor, with a specific reference to the electrification programmes in the two countries.

1. Introduction

Most African including those in the Southern sub-region faces a major challenge inn trying to achieve their development and social obligations because of serious lack of modern energy services. Electricity access clearly demonstrates this deficiency because it is only 17% for sub Saharan Africa as a whole and less than 5% in rural areas (Davidson & Sokona, 2002). This situation needs major changes for not only because of development demands but for the region and its sub regions to be competitive with other developing regions of the world.

Another area of regional concern is the strong links between modern energy service provision and poverty reduction in the region. For the region to achieve the Millennium Development Goals (MDG) it agreed to at the WCSD held in Johannesburg in 2002, it needs substantial increase in modern energy service provision, especially affordable, reliable and adequate electricity. Improving on the current high infant mortality, low life expectancy, and high illiteracy and fertility rates of the region (World Bank, 2003) will require substantial electricity provision, particularly for the poor that are very much deprived of these services.

Unfortunately, recent report suggests that the share of the poor in the region is growing and may continue to do so if no major policy intervention is introduced (ref). Increase poverty has been mainly a result of neglect in rural areas and growing urban poor as a result of high migration rates. Developing policies, especially in the energy and power sector to cope with these challenges is very important for the overall net productivity of the region as whole.

Providing electricity to the poor in southern Africa which this paper is restricted poses unique policy challenges because although the sub-region has abundant fossil and renewable energy resources, exploiting these resources remains a daunting task because of major technological, institutional and financial obstacles, but financial obstacles remain the most important. Inadequate energy investments, an underdeveloped downstream energy sector and poor management are some of these barriers, and the poor are the most affected. Furthermore, overseas development assistance, (ODA) which has been traditionally used by many countries in the sub-region on pro-poor programmes, is dwindling (ref). However, in recent times there has been call from both donors and recipients for new approaches to ODA programmes including those of energy (Davidson and Zheng, 2003).

Due to the fragmented nature of the sub-region resulting in many countries, this paper will concentrate of two most industrialised countries in the sub-region. Together, they account for over 50% of the population and 80% of the electricity produced and used. However, the findings and general remarks will include comments on the sub-region as a whole. The paper discusses briefly, the background of electricity production in the two countries, before looking at their reform programmes. The impact of these programmes on the poor are analysed using five indicators as guide. These are levels of electrification, rates of electrification, consumption that are more associated with access, while the other two, tariffs and expenditure are related to affordability. Data limitations in the sub-region restricted the level of analysis but empirical methods were utilised to reduce this deficiency.

1.1 Background on Zimbabwe and South Africa

Zimbabwe is landlocked with a population in 2003 estimated at 13 million and a land area of 390,800 sq. kms. Its economy is heavily dependent on agriculture and mining. Zimbabwe obtained its independence in April 1980 and inherited all the ills of a racially divided society, but with a developed industrial sector and a better infrastructure than most of its neighbours. The economy is heavily dependent 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, in spite of constraints due to several internal and external problems, including the disparities in access to resources. However, the country has suffered from persistent droughts which has had negative impacts on its economy.

According to a recent census, 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 more industrialized than Zimbabwe, and is the most industrialised country in Africa. Like Zimbabwe, it is still undergoing profound changes after the democratic elections of 1994 which led to the transformation from an apartheid system to a more democratic form of government, resulting in new directions in almost all aspects of government.

The development history of these two countries is similar in some ways which has serious impact on poverty though their overall incomes are different. The GNI per capita of South Africa as of 2001 was USD 2,820, which is higher than the average for

sub-Saharan Africa (just below USD 500), while the GNP per capita in Zimbabwe in 2001 was USD 688. However, in both countries the incomes between the different races differ significantly, especially in South Africa that became independent more recently. For example in South Africa, average monthly incomes for black households in 2000 were half of that of coloureds and about a quarter of the whites (Statistics South Africa, 2002).

These differences in South Africa make poverty strongly linked to the wide disparities of income levels of different racial groups. In general, the rural areas are far more impoverished than urban areas, mainly as a result of the past system of sectorian development defined by race. South African government defined minimum standard of living as ZAR 709 (USD 273) in 1990, which was equivalent to about USD 9/day using the 1990 exchange rate. In 2002, ZAR 800 which is equivalent to USD 2.54/day was used to describe poor households. This clearly shows that using USD 1/day as baseline will lead to discrepancy in the analysis.

Poverty issues in Zimbabwe are closely related to the country's history of governance by the minority white government, which resulted in economic and political benefits to the whites, while ignoring the black majority. Economic inequality still pervades 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. In Zimbabwe as in most African countries, access to modern energy services is very income dependent as shown in table 1.

Table 1: Household Access to Energy Sources in Zimbabwe (%)

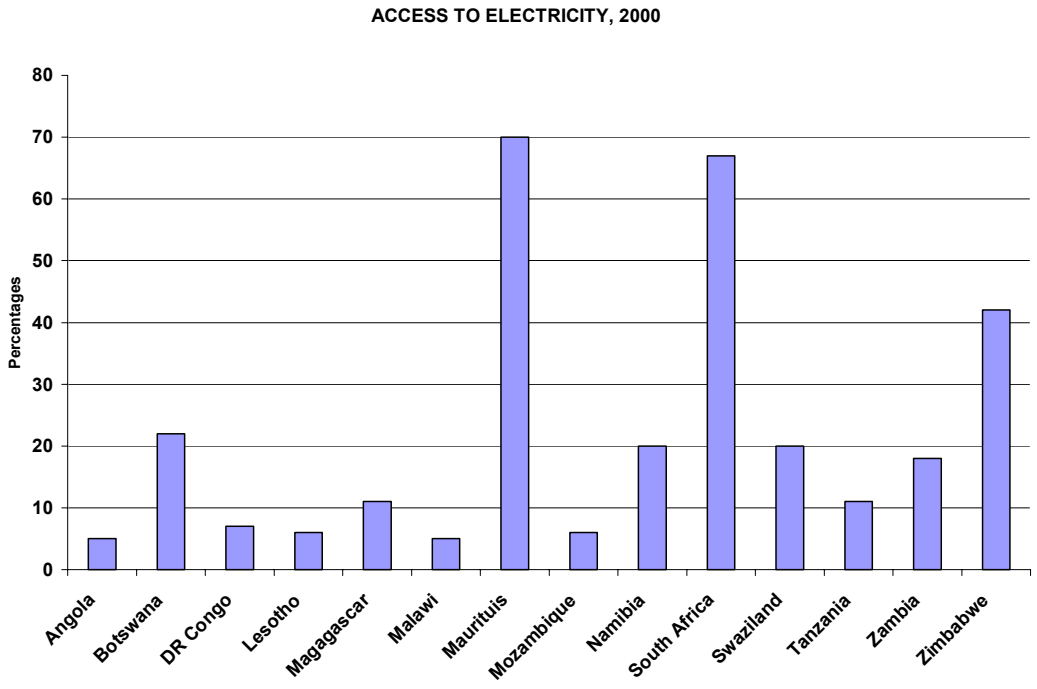
Energy Source for Cooking	Urban Areas		Rural Areas		National	
	Poor	Non-poor	Poor	Non-poor	Poor	Non-poor
Electricity	73.1	81.9	2.1	11.0	19.0	52.8
Kerosene	39.7	33.7	1.0	13.5	10.2	25.4
Wood or coal	12.7	5.4	98.6	80.6	78.1	36.3

Source: Central Statistics Office (2001).

2. The Electricity Industry

Electricity generation in the 13 countries that form the Southern African region is dominated by thermal generation, about 81% with hydropower accounting for around 15%, the remaining being nuclear. However the distribution of generation which is consumed within the region is largely skewed, with South Africa accounting for about 35 GW of the total 43.8 GW generated in 1997 and Zimbabwe 2.07 GW, the remaining 11 countries only 6.6 GW (USDOE, 2000). Also, Coal that dominates power production is mainly by South Africa and Zimbabwe. Hence, studying the electricity situation in these two countries will cover over 80% of electricity production and use in the sub-region. A unique feature of the energy sector in the sub- region is the relatively active energy committee of the Southern Africa Development Community (SADC). This has led to many sub regional energy programmes such the Southern African Power Pool (SAPP) which will be discussed later. Access to electricity in the sub-region is very low except for a few countries as shown in fig.1 below. Only three countries have access to electricity significantly above the average for Sub Saharan Africa which is 17%, Mauritius, South Africa and Zimbabwe. However as previously mentioned this paper will be restricted to South Africa and Zimbabwe.

Figure. 1



Source: World Bank, 2000

The key parameters describing the energy sector of both countries are summrised in table 1.

Table 2: Energy Parameters of South Africa and Zimbabwe

Indicator	South Africa (2000)	Zimbabwe (2001)
Population (million)	42.80	12
Energy production	144.47 Mtoe	8.7 (2000)
Electricity consumption (TWh)	194.02TWh	9.813
TPES/GDP(ppp)	0.29	0.96
Electricity consumption/pop. (kWh/cap)	4533.12	910

TPES - Total primary energy supply

Source: IEA (2002); Statistics South Africa (2002); Helio-Zimbabwe (2002)

2.1 The power sector in South Africa

An overview of South Africa's electricity sources is presented in Table 3. Eskom, the national power utility, produces 96 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 expand its contribution substantially are expected soon with gas from Mozambique expected in 2004.

Table 3: South Africa's Electricity Production Profile: 2001

Source	Net Energy Sent Out (GWh)				
	Eskom	Municipal	Private	Total	% of Total
Coal	175,222.8	609.6	7,440.0	183,272.6	93.7%
Nuclear	10,718.6			10,718.6	5.5%
Pumped storage	-769.2	-67.5		-836.8	-0.4%
Hydro	2,194.0	9.6	14.2	2,218.0	1.1%
Bagasse			306.8	306.8	0.2%
Gas	-0.7	5.7		4.9	0.003%
Total	187,365.5	557.5	7,761.2	195,684.3	

Source: NER (2001).

However, South Africa is interested in the development of different energy resources for electricity production in the wider Southern African region. These sources include hydropower from the Grand Inga river in the Democratic Republic of Congo (DRC)

estimated at over 40,000 MW potential. Most of these interests is in the massive power exports within the SADC region within the SAPP that was created in 1995 with the aim of establishing a single electricity grid in the sub-region. At present, SAPP comprises utilities from Angola, Botswana, DRC, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, and its vision is to become a power exchange facility in SADC.

2.2 The power sector in Zimbabwe

The Zimbabwe Electricity Supply Authority (ZESA) has been responsible for the generation, transmission and distribution of electricity in Zimbabwe for a long time now. 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, Mozambique, Zambia and South Africa (as shown in Table 4). 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 4: 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).

Table 5: 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)

3. Power sector reforms

3.1 Power sector reforms in South Africa

Under the apartheid system, which prevailed until 1994, development progressed on racial lines, and this pattern pervaded the energy industry. Consequently, the focus of electricity provision was on heavy industry, mining and white households which formed about 12 per cent of the total population. The ANC government that won the democratic elections held in 1994, made the provision of electricity to the disadvantaged, mostly blacks, the cornerstone of its development policy under the slogan 'Access to electricity for all'. This promise was perceived as *grid* electricity for all – including people in the remote areas of the country. The Energy White Paper released in 1998 (DME, 1998) provided a framework and guidelines for the Government to achieve national energy objectives, of which one was universal household access to electricity (with priority to the poor) while alleviating negative environmental impacts.

Rationale for power sector reforms

According to the White paper, the broad energy policy of the 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;

c) Achieving environmental sustainability of natural resources; and,

d) Attracting foreign energy investments.

The key policy problems and challenges in the electricity sector as identified by government are:

- 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 120 municipalities that had less than 1,000 customers and more than 90 municipalities with annual revenues of less than ZAR 1 million resulting in low efficiencies, high costs, wide disparities in tariffs, and the problem of financial viability among distribution entities. Also, the industry is experiencing high levels of non-payment and electricity theft, resulting in increasing arrears and payment defaults.
- The electrification programmes of most municipal distributors are constrained by difficulties in accessing financing. Hence, the need for higher electrification expenditure.
- Coal-based electricity generation results in significant pollutant emissions, with potential long-term effects on the environment.
- Major inefficiencies in the electricity sector, thus wasting scarce energy and capital resources.
- Although growth in electricity demand is only projected to exceed generation capacity around the year 2007, lengthy capacity expansion medium term strategies to be in place in order to meet the needs of the growing economy.
- While a number of the aforementioned challenges could stimulate inflationary pressures on prices, the government has to maintain the competitive advantage of low, stable and cost-reflective electricity prices.

The reforms which were put in place was nationally initiated and financed. The components of these reforms are mainly, the governance of Eskom, distribution industry and regulation.

National Electricity Regulator (NER)

The Government established the National Electricity Regulator (NER) in April 1995 as a successor to the Electricity Control Board established under Act No. 41 in 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 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.

Eskom's governance

The government embarked on corporatisation of corporatisation of parastatals, including those of the power sector. Hence under this arrangement, a policy to restructure the electricity assets of Eskom through the Eskom Conversion Act was made. 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.

The rationale for restructuring was not only to increase efficiency but also provide the opportunity to correct previous imbalances in management and operations of the electricity sector. This Conversion Act may pave the way for new independent power producers. In parallel to in-country changes, Eskom has embarked on certain strategic initiatives aimed at making its energy and related services as a business institution in Africa, and is now involved in 39 other African countries.

Reforms in the distribution industry

The electricity distribution industry was going to reformed to address the 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 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.

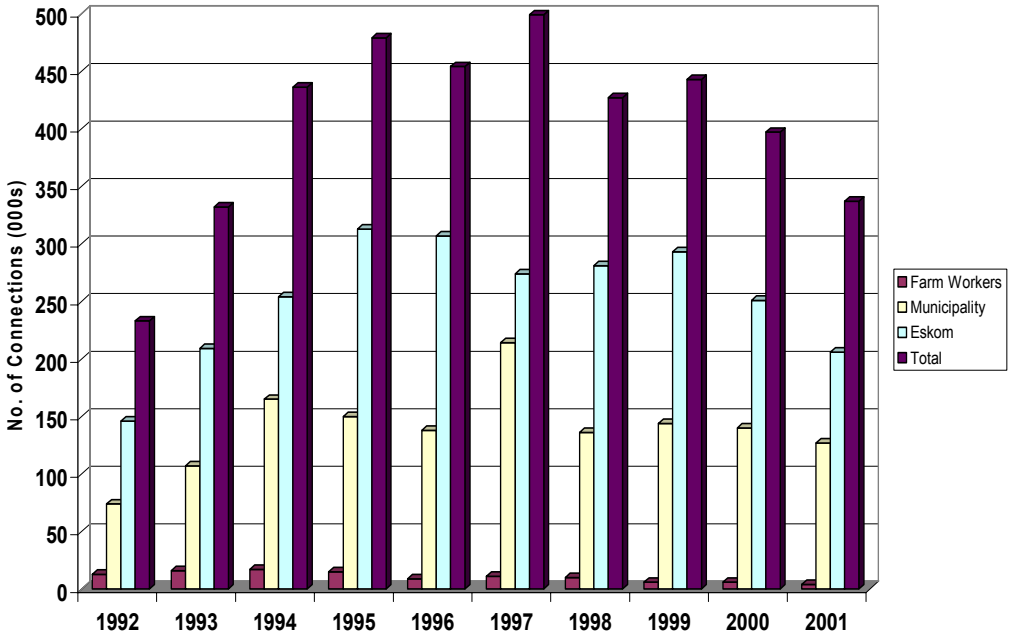
National Electrification Programme in South Africa

The South Africa National Electrification Programme (1994-99) was a government-financed initiative. The programme was implemented by Eskom and the municipalities with the key objective of raising national electrification levels to about 66 per cent by

2001 with 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. This programme provided the basis of looking at the electrification levels and rates to the poor of South Africa.

The new connections were mostly extended by Eskom and the municipalities, but large-scale farmers also connected their farm workers where necessary, but Eskom accounted for about two-thirds, while the municipalities only account for about 6% as shown in fig.3. However, there has been a slight drop in new connections which averaged around 450,000 households per year between 1994 and 2000 to 397,000 in 2001. The decline is due mainly to the drop in new connections by Eskom.

Figure 3: Annual New Household Electricity Connections: 1992-2001



Source: NER, 2001b

3.2 Power Sector reforms in Zimbabwe

Since attaining independence in 1980, Zimbabwe has embarked on various sector policy reforms, including energy sector reforms. The Government has sought to increase energy access to previously disadvantaged people through both grid extension and off-grid electrification. The national energy policy has five main objectives (Munjeri, 2002. Two of the objectives focusing on rural development and small/medium scale enterprises have an explicit emphasis on the poor:

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.

Zimbabwe's power sector has undergone a number of changes since independence. Generally speaking, four main drivers have been behind power sector reforms in Zimbabwe (Turkson, 2002) with one of the drivers explicitly focussed on the needs of the poor:

- 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.

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 Zimbabwe Electricity Supply Authority (ZESA) with the aim of streamlining the administration of the electricity sector, improving efficiency, standardizing 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 contracts of a new management team 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 was poor, probably because the Act still required independent producers planning to generate more than 100 kW, to seek approval from the Government and ZESA. In addition, the pricing, expenditure, capital budgets, procurement and staffing were to be regulated by the Government.

In 1996, the privatisation and expansion of the Hwange power station was proposed. For this project to be economically viable,it was recommended, the long-run marginal cost (LRMC) principle should be adopted. The 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. This was compounded by allegations of lack of transparency in negotiations. As a result, initiatives to privatise several power stations, including the Hwange project, were abandoned (Karekezi, *et al*, 2002).

In 1999, power sector reform programmes under consideration consisted of unbundling of the electricity sector, establishing a regulator, privatisation, and establishing a Rural Electrification Fund, based on a 1 per cent levy on all electricity bills. The Rural Electrification Fund 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 rural electrification under the fund has been slow, with only 14 of the targeted 54 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, by then, an excess of ZBD 460 million (Kayo, 2001).

In November 2001, the Zimbabwe cabinet approved a Rural Electrification Fund Bill that was to pave way for establishment of 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).

4. Impact of Electrification Programmes on the Poor

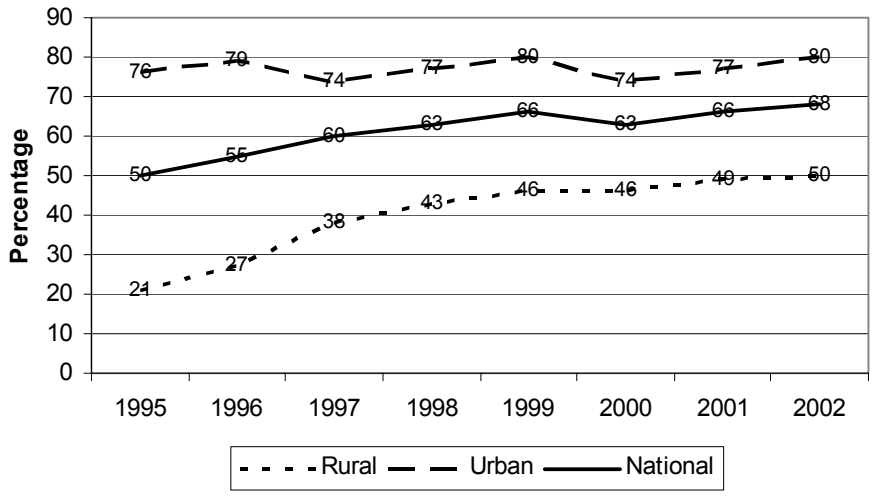
4.1 Impact of Electrification Programme on the Poor in South Africa

In 1993, only 36 per cent of the population had access to grid electricity, but since the introduction of the National Electrification Programme mentioned above, electrification rates have been increasing steadily as shown in fig. 3 below. Though the target was put at about 66 per cent by 2001, but it was exceeded, with 2.75 million connections achieved in Phase 1 (Borchers et al., 2001). At the end of 2001, the National Electrification Programme recorded more than 3.4 million new connections since 1994. According to Department of Minerals and Energy (DME), about 70 per cent of the households are currently electrified. The Government is continuing the programme with the intention to electrify 300,000 homes annually. An interesting feature to note is that the cost of connection was declining steadily during the programme. 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 (primarily composed of the poor) is yet to be electrified (20% urban and 50% rural). Fig.3 shows the trends of electrification in both rural and urban households. It shows that the programme essentially targeted the rural areas that housed mostly poor and dis-advantaged.

An off grid 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 was rated at 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 low-income 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.

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



Source: NER (2002b).

The Schools and Clinics Electrification Programme has provided off-grid 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.

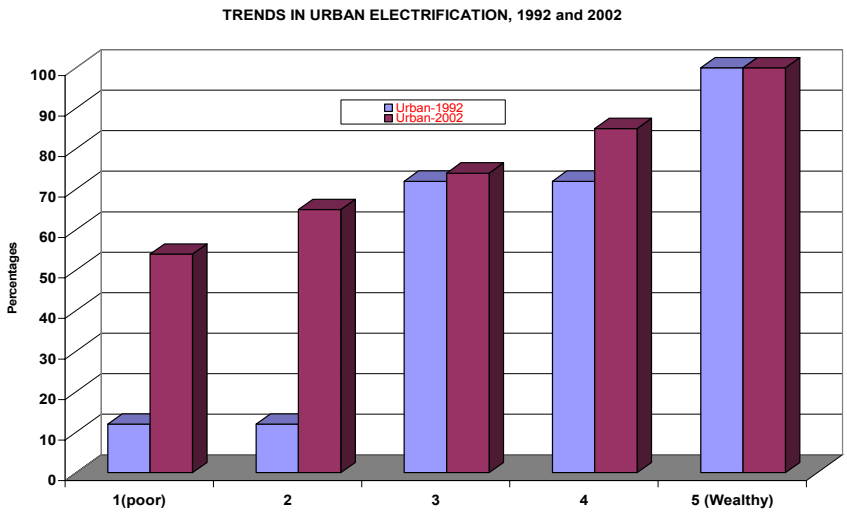
In the White Paper on Energy Policy, the Government recognised that household access to adequate energy services for cooking, heating, lighting and communication is a basic need. While these needs could be met by various fuel-appliance combinations, without access to electricity, human development potential will be constrained. The Government has committed itself to implementing legislative and other measures to progressively realise universal household access to electricity by 2010.

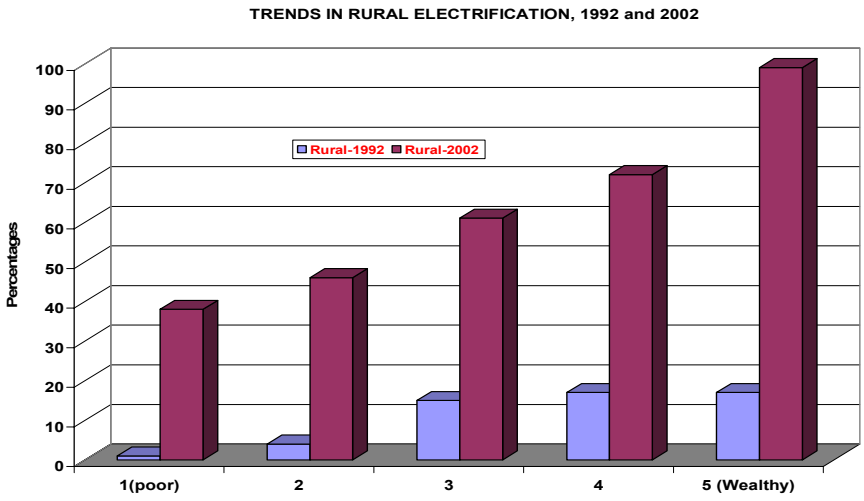
In general, the welfare of poor communities with access to electricity has improved significantly under both off-grid and grid programmes. However, the levels of improvement differ between off-grid and grid-connected users since the services to the former are limited to only lighting and media. The welfare 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 were these fuels are used extensively for cooking and heating. Electrification of clinics and schools has yielded significant benefits for 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.

Data restrictions do allow to show the trend in urban and rural electrification rates, but using empirical data for South Africa, this trend is shown in Figures 4 & 5 below.

Fig.4





4.2 Impact of the Rural Electrification Programme on the Poor in Zimbabwe

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 a widespread rural electrification drive (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.

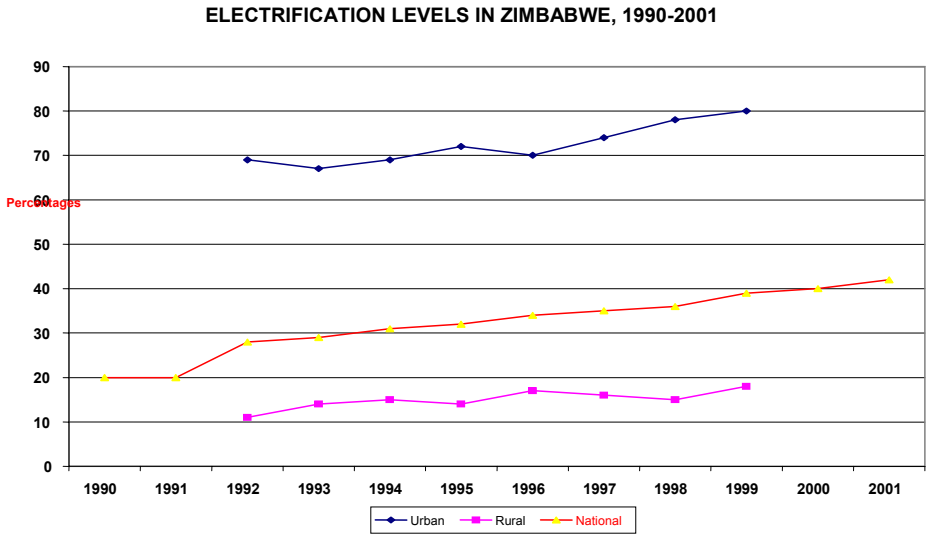
The long-term objectives of the initial EREP were stated as:

- Improving access to 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.
- Helping in reversing urban migration and energy-related environmental degradation.

Electrification levels

The Performance Improvement Programme (PIP) initiated by the Government in 1992 had, among others, the objective of 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). 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 every year (Dube, 2003). Fig. 4 shows the national urban and rural electrification levels from 1990 to 2001.

Fig.4



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. By 2003, about 100 rural centres were being electrified per month by this initiative (Dube, 2003).

Zimbabwe has an off-grid electrification programme that is mainly based on Solar Home Systems (SHS). 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.

Zimbabwe's experience with off-grid 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, the high cost of solar panels and the high failure rate of the systems have marred the progress.

In response to the high cost of solar panels, the Government 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 installed systems, Zimbabwe has recorded 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 was observed that donor-funded projects were more prone to failure than privately implemented projects.

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).

5. Electricity tariffs, subsidies and expenditure

5.1 Electricity tariffs in South Africa

Average electricity tariffs in South Africa is comparatively lower than many countries, but according to DME, this is due to coal which relatively cheap as the base energy source, early investments and declining debts of Eskom, the main utility. However, prices may be increased in the medium to long term, as is being advocated by Eskom to the Government. The need for replacement of generating facilities by 2007 has been given for the increase sought as existing surplus capacity will be utilised by then. In general, Eskom tariffs are classified according to many factors, but there are different charges and tariffs for rural and urban areas.

5.2 Electricity expenditure and consumption by poor households in South Africa

Data limitations have restricted the depth 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)[1]. 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 can 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). Although both communities we by South African standards relatively poor, there are major disparities in their electricity expenditure and consumption levels (as shown in Tables 7 & 8). 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. The difference is reflected in the amount of electricity consumed, but the poorer Antioch community spends a substantially higher proportion of their income on energy.

Table 9 below shows that in rural Antioch, 23 households (56%) electricity consumption was in the range of 0-50kWh, while in peri-urban Umgaga, only 2 households (4.5%) consumed electricity within this range. Also, the study further shows that households uses less than 25kWh per month is for lighting and radios..

[1] In 2000, the Government announced its intention to provide the poor with free basic water and electricity services (DME, 2003). It was recommended that 50kWh per month be provided to all poor households connected to the national electricity grid.

Table 7: 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
Energy expenditure as % of total household expenditure	17	12

* No formal regular income, occasional charity

Source: UCT (2002)

Table 8: Monthly Household Electricity Expenditure and Consumption: 2001

Attribute	Antioch	Umgaga
Average electricity expenditure (ZAR)	26	65
Minimum expenditure (ZAR)	3	15
Maximum expenditure (ZAR)	100	200
Average consumption of electricity units (derived from expenditure) (kWh)	68	170
Minimum consumed units (derived from expenditure) (kWh)	8	39
Maximum consumed units units (derived from expenditure) (kWh)	265	520
Average consumption (measured) (kWh)	61	-
Minimum consumption (measured) (kWh)	6	-
Maximum consumption (measured) (kWh)	242	-

Source: UCT (2002)

Table 9: 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.

5.3 Electricity subsidies for the poor in South Africa

The Government established 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. A total of 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-subsidies 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. The 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 water and electricity services (DME, 2003). It was recommended that 50kWh per month be provided to all poor households connected to the national electricity grid. The decision to use the threshold level of 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 that will alleviate the burden on the poorest sector of the population. Since the Government recognised there might be difficulties in applying this recommendation, the policy includes some flexibility over a range of 20-50kWh per month.

There are numerous tariffs 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 every year on this programme.

While the primary objectives of EBSST were to help alleviate poverty, some key issues need to be resolved. These include identifying the real target and analysing the benefits including improvement in living conditions of the poor. The EBSST can provide a good case study for assessing the effectiveness of subsidy schemes. It was designed to provide basic lighting and media access services plus very limited cooking service. 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 two studies that investigated the 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 10: Appliance Ownership by Electrified Households in Rural Areas of South Africa

% of all households	% of all households	% of households with per capita 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 10, a general framework of power requirements for a household owning some basic electric appliances is shown in Table 11. It has been assumed that use of an electrical stove would be minimal for such a household.

Table 11: 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	28
Television (black & white)	1	50	6	9
Radio (portable)	1	6	4	1
1 plate stove	1	1,000	1	31
Iron	1	1,000	¼	8
Kettle	1	1,000	¼	8
Total monthly units				85

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 11 indicates, 50kWh constitutes about 59 per cent of the electricity consumption of an average poor household per month for lighting, television, radio, ironing and an electric kettle. Using a one-plate stove would exceed the amount of the units given under the EBSST. 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 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 85kWh to about 33-40kWh per month. The LPG stove would replace the electric stove and efficient lighting (15W CFL) would consume 7kWh 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. The results are summarised in Table 12.

Table 12: 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. The reason 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 13.

Table 13: Use of Previously Unused Electrical Appliances 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).

Table 13 also shows that some 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 a broader array 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.

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 monthly saving on electricity expenditure was ZAR 7.50, a 5 per cent decrease in total household expenditure.

In general, the EBSST has started showing positive signs though it is at 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, about 30 per cent of the households have added lights in previously non-electrified rooms. Some households started using appliances they owned but were not able to use before the programme was implemented. Responses about the benefits 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;
- School children 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

5.4 Electricity tariffs and subsidies in Zimbabwe

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. These have significant impacts on electricity tariffs and subsidies. The Zimbabwe dollar depreciated by 500 per cent within a relatively short period from 1995 to 2001, with steep reductions occurring from 1998 onwards.

The Government has the final control in setting tariff levels, and there have been occasions when the Government has rejected tariffs recommended by external consultants. Nonetheless, Table 14 shows that tariffs have been changing every year.

Table 14: 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 300kWh 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 to be about 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 need to balance protection of the poor and limiting the cost on high-income groups.

Lifeline tariff subsidies in Zimbabwe entail preferential pricing to domestic consumers with lower consumption (as shown in Table 15). Connection fees are also subsidized for the poor as ZESA charges below the true connection cost. However, higher consumption groups also benefit from implicit subsidies. 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 the financial returns from system expansion. Total ZESA annual electricity subsidies are reported to be in the range of 53 per cent of the total revenue (Dube, 2003).

Table 15: 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)

5.5 Electricity consumption and expenditure in Zimbabwe

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 (as shown in Table 16). Based on electricity consumption patterns and the available subsidies to domestic consumers, Dube (2003) concluded 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 (as shown in Table 17).

Table 16: 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 17: 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).

6. Key findings

In both countries examined, primary data on the electrification of the poor are almost non-existent – and this forms a key limitation of this study. Although, for instance, the National Electricity Regulator in South Africa keeps track of rural electrification levels, the data are not categorised by poor and non-poor users. Therefore, this study has relied on secondary sources, being mainly studies undertaken by research institutions such as Energy Research Centre (ERC) 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 should not be regarded as fully conclusive. As far has been possible, the assessment of the impacts of power sector reforms on the poor has been carried out by using a set of five indicators. Whilst data has been available to make some use of these indicators, it has not been possible to check the robustness of the primary research, the consistency of definitions and the accuracy of the collected data.

The comparisons between South Africa and Zimbabwe indicate that the policy environment that will encourage and enable the provision of energy services for the porr needs to be designed for the specific needs of the country. Both South Africa and Zimbabwe have a history of apartheid and it is the respective Governments policies to redress the inequalities of past racial prejudice that form the basis of their reform programmes. The reforms undertaken to enhance access to electricity realized positive outcomes, particularly under the grid-based electrification programmes. In South Africa, national electrification levels 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. The Government-funded electrification programme in South Africa

took a shorter time and has reached a much larger proportion of the population than the programme in Zimbabwe.

In an attempt to reach the poor in remote locations, both countries have focused on the establishment of off-grid programmes which have been mostly centred on SHS powered by solar PV technology. However, evaluations of the PV-based off-grid programmes have raised some fundamental questions over both the performance and relevance of this option. The PV-based off-grid programmes in both countries have encountered serious technical problems and high failure rates.

Even if all the operational and financial problems are resolved, 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 for the poor (Davidson & Youba, 2002). Designing energy programmes for the poor must address household cooking and water heating needs as a priority over lighting, which would, for example, reduce dependence on fuelwood. Similar priority should be attached to the provision of electricity for motive power which would support small-scale rural industries for income-generating activities, and other serices such as water pumping.

In both countries, the reforms have attempted to make electricity affordable to the poor. 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 initiatives appear to have been instrumental in supporting electrification programmes and increased access to electricity access the poor.

The EBSST subsidy in South Africa, which supplies 20-50kWh of free electricity to the poor in selected areas, seems to have realized direct benefits for the poor. It had some positive impact on poverty alleviation as it reduced electricity expenditure. However, this is a very recent development and additional studies are required to assess the feasibility of the subsidy due to its high cost and potentially adverse impact on the Government's coffers.

The reforms in both countries have ensured the protection of funds for financing the electrification of the poor by requiring 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 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.

In order to meet the electrification challenge in rural areas, a diverse set of technical and institutional approaches will be needed – covering large-scale grid connected extensions and new developments, together with smaller-scale distributed energy systems using both conventional and renewable energy sources. This study has not undertaken a full review of the technologies for energy services for the poor in rural areas. Nevertheless, off-grid and small-scale conventional and renewable energy sources will have important roles to play in rural energy provision. In particular, measures which help to promote the up-take of sustainable energy services such as renewable energy through regulatory and legal structures are needed.

Strong institutions are the backbone of an efficient and effective energy sector. National policies that create the right enabling environment for investment and business-led market growth are going to be essential.

The paper recommends the following for further investigations:

- Income differentiated electrification current and trend data.
- More detailed understanding, through participatory approaches, of the associated social and economic characteristics of energy consumption patterns of the poor.
- Innovative technological approaches to reduce connection fees and distribution costs, to reduce the overall cost of increasing access to electricity by the poor.
- Further assessment and review of the use of renewable energy, especially SHS, as a poverty alleviation tool in off-grid electricity supply.
- Exploration of public-private management schemes that could benefit the poor. This should include an assessment of the role of independent power producers and energy service providers.

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