

**THE ELECTRIFICATION OF UNDERDEVELOPED AREAS:
A CASE STUDY IN CISKEI**

BY

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A dissertation submitted to the Faculty of Engineering at the University of Cape Town in **partial fulfillment** for the degree of Master of Science in Engineering.

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DECLARATION

I declare that this dissertation is my own, original work. It is being submitted in partial fulfillment of the requirements for the degree of Master of Science in Engineering at the University of Cape Town. It has not been submitted in this or in a similar form for a degree at any university.

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ABSTRACT

More than 20 million people in South Africa live without electricity in the household. Perhaps half of them live in underdeveloped rural areas in the 'homelands', which comprise about 14% of South Africa's land area. While considerable work has been done on methods of electrifying underdeveloped urban areas, little research has gone into the need for, and especially the cost of, electrifying the rural homeland areas. This dissertation documents an investigation into this question, using Ciskei as a sample area.

The study is based on research that was carried out between July 1987 and January 1989. This research included a literature review of rural electrification and development, two field trips to Ciskei to gather relevant information, two questionnaire surveys to assess people's perceptions of electricity, and the design and costing of distribution and reticulation networks for a rural sample area in Ciskei.

While underdeveloped communities in Ciskei could generally not afford the capital costs of electrification (particularly housewiring costs and the purchase of electrical appliances), it was found that the cost of using electricity is of the same order as unelectrified households' present expenditure on household fuels. The costing analysis indicated that the cost per household of rural electrification in Ciskei would not be much different to that of urban reticulation.

The benefits of the electrification of underdeveloped areas are manifest. However, it is not possible to assess whether these benefits outweigh the capital costs of such a development strategy. It is nevertheless believed that, although there exist certain practical obstacles to the immediate electrification of rural areas in Ciskei, access to electricity is a prerequisite for any long-term development above a subsistence level.

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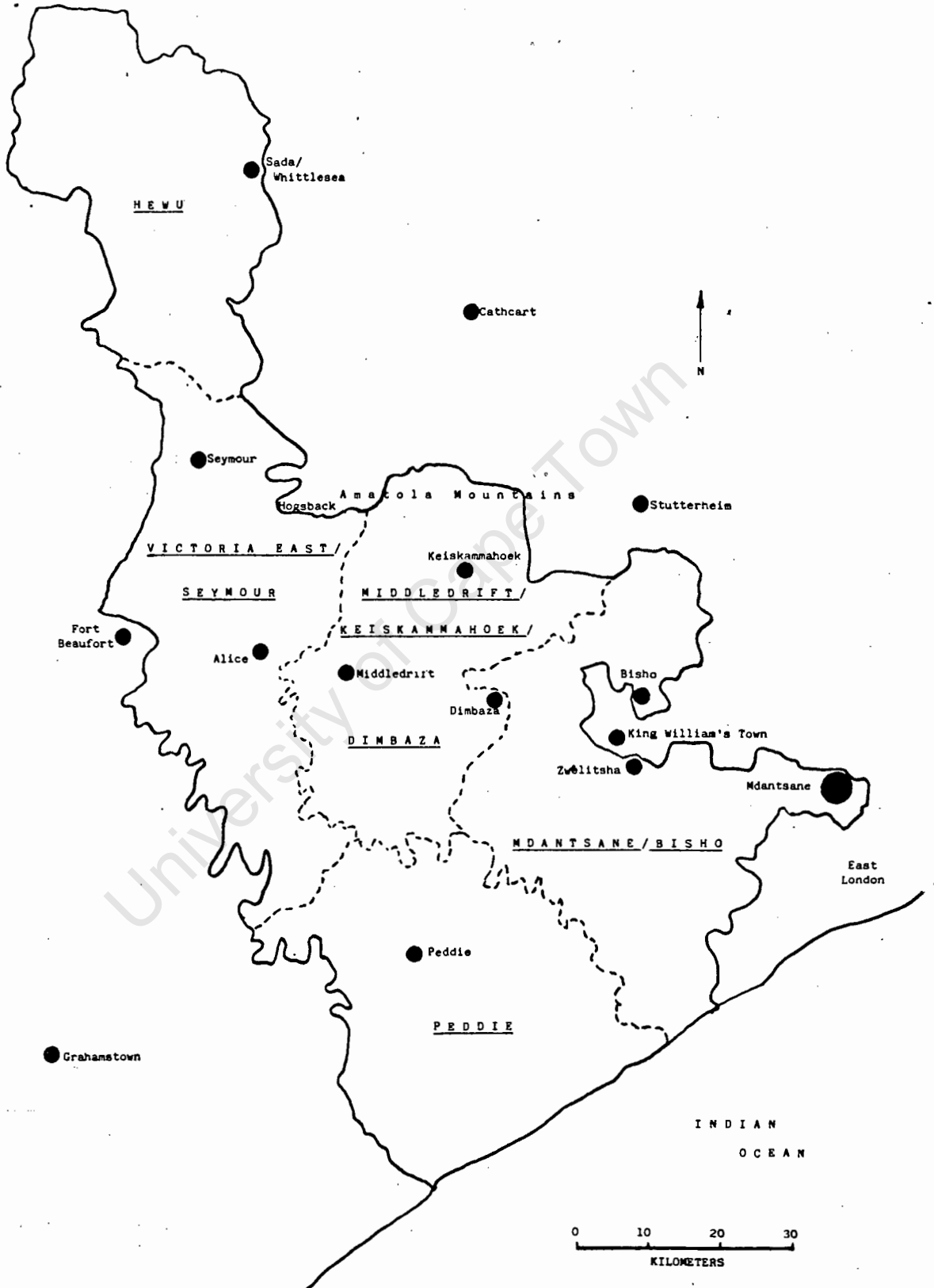


FIGURE 1: MAP OF CISKEI

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

Although South Africa consumes some 60% of the total amount of electricity generated in Africa as a whole, only 40% of the country's total population (including people living in the homelands) have access to electric power in their homes. The majority of people living in the underdeveloped areas of South Africa are without electricity. Conditions of underdevelopment can be found in the homelands, in the 'black' townships, in the informal shack areas on the outskirts of towns and cities and in some 'white' rural areas. There are also some four million farm workers and their dependents who live under often severe conditions of poverty on 'white' farms. These underdeveloped communities still depend to a large extent on traditional fuels, notably firewood, and on commercially available fuels such as paraffin and gas. All 'white' urban areas, most 'white' farms and certain designated 'black' urban areas (eg. Soweto) have been electrified, but the predominantly 'black' rural and peri-urban areas remain without electricity.

Electricity is probably the most versatile and convenient form of energy to use in the household. Its direct benefits include the easy and efficient application of electric power in a variety of household maintenance tasks like cooking and water heating, access to radio and TV information, and increased personal security as a result of electric lighting. Access to electricity, particularly in underdeveloped areas, would furthermore have far-reaching implications on the economy and the quality of life of the local people. While many energy-related problems in these areas could often more easily and cheaply be solved (at least in the short- to medium-term) by other methods like

improved wood-burning stoves or the planting of woodlots, electrification is a long-term solution with a variety of benefits for individual households as well as whole communities. The most important potential benefits of electrification are well summarised in a report by Hill Kaplan Scott Inc. (HKS, 1985: 13): "... the availability of electrical power to the people not only stimulates economic activity but is also a major contributor to the process of community development. ... Provision of electrical power to the rural areas will encourage the establishment of local industry and assist in stemming the drift of population away from the land. Electricity will also provide the means for an enlarged TV viewing community and will allow more people to be reached and communicated with by government, commerce and education. Electricity is a valuable tool in the process of improving education, income levels, social status, population behaviour and preservation of cultural heritage and language in a community." While these potential benefits make electrification an attractive development strategy it is very unlikely that it will achieve its full range of social and economic benefits, especially beyond the domestic context, without being integrated into wider infrastructural development programmes.

This dissertation is a study of the need for and cost of grid electrification for domestic purposes of underdeveloped areas in South Africa. Ciskei, a densely populated homeland which covers an area of some 8000 km² in the eastern Cape Province, was chosen as the study area. In December 1981 Ciskei became an 'independent state' within the South African political framework. The development philosophy of the Ciskei government (economic growth through centralised industrial expansion) makes provision for electrification, but this has so far been limited to industrial townships. Although a fairly extensive electricity distribution network spans the central and southern parts of Ciskei, providing industrial growth points, most proclaimed towns and some agricultural schemes with electric power, the rural village communities do not have access to electricity.

The study focuses on the supply of electric power to the unelectrified areas of Ciskei, with the main objectives of establishing

1. the need for household electricity as perceived by householders themselves, and
2. the cost of providing all unelectrified households in Ciskei with a reliable supply of electricity.

The following specific questions are addressed:

- * Would the people that live in unelectrified areas of Ciskei prefer electricity to their presently used household fuels?
- * Do they regard electrification as a development priority?
- * What would it cost to bring grid electricity to rural settlements in Ciskei?
- * Could unelectrified households afford electricity?
- * Do suitable institutional structures to promote the electrification of underdeveloped areas exist in Ciskei?

Although this study is confined to Ciskei it is complementary to similar research being carried out by others in other underdeveloped areas of South Africa.

1.2 METHODOLOGY

The research for this dissertation was carried out between July 1987 and January 1989. The need for household electricity in unelectrified areas of Ciskei, as perceived by householders themselves, was addressed by examining people's perceptions of electricity: two questionnaire surveys were conducted, the one among unelectrified households (to establish whether people want electricity, whether they can afford it and whether they regard electrification as a development priority) and the other among electrified households (to establish how access to electricity has influenced the financial situation of households and whether it has had an impact on the quality of life of these people). Both surveys were planned, conducted (with the aid of an experienced translator), analysed and evaluated by the author himself.

The research can be divided into four phases. Phase One consisted of a literature review of rural development, and particularly rural electrification, to obtain an understanding of the issues relevant to, and the problems generally experienced with, this kind of development strategy. Some detailed background reading on the history of Ciskei was necessary to understand the political and social dynamics of the study area.

Phase Two was marked by a two-week trip to Ciskei which took place during September 1987. The objective of the trip was three-fold: firstly, the author intended to familiarise himself with conditions in Ciskei; secondly, discussions were to be held with representatives from various Ciskei government departments and a number of development organisations that operate in the area, with the primary aim of obtaining an insight into Ciskei development matters, but also to collect information on plans and possibilities for the electrification of underdeveloped areas in Ciskei; thirdly, the survey among unelectrified households was to be conducted.

Basic information on general development strategies in Ciskei were obtained from the Directorate of Planning in the National Assembly in Bisho, while Eskom's regional office in East London and the electrical branch of the Department of Public Works in Bisho were approached on electrification matters. Township development was discussed with town planning consultants in East London. During the second week of the visit, the survey was conducted on a random sample of 200 unelectrified households in 15 randomly selected rural and urban areas.

A second two-week trip to Ciskei (Phase Three) was undertaken during April 1988. The objectives this time were to obtain more detailed information on the electricity supply industry in Ciskei and to conduct the survey among electrified households. The Chief Electrical Engineer in the Department of Public Works provided information on electricity supply and demand in Ciskei and on possible extensions of the network to rural areas. Information on Ciskei's existing electrical infrastructure was obtained from Eskom in East London and from the consulting firm Hill Kaplan Scott Inc. in Bisho. Ciskei's power generation potential was discussed with the Deputy Chancellor on Physical Development (Directorate of Planning). The Ciskei People's Development Bank and the representative of the Development Bank of Southern Africa in the Directorate of Planning were approached on the financing of a major development programme, like the electrification of underdeveloped areas in Ciskei. Problems with the supply of power to township households were discussed with the town manager of Mdantsane, while information on the use of electricity in rural development and agriculture was obtained from the Ciskei Agricultural Corporation (ULIMOCOR) and from the Dean of the Faculty of Agriculture at the University of Fort Hare in Alice. The survey was conducted on a random sample of 80 electrified households in seven randomly selected towns and townships. Complaints of consumers about high electricity bills and frequent power outages were followed up with the supply authority in an attempt to trace their origins.

Phase Four consisted of the design and subsequent costing of the distribution and reticulation systems that would be required to supply all unelectrified households in Ciskei with grid electricity. Ciskei can purchase its bulk electricity requirements from Eskom at their normal rates. Eskom's internal needs for expansion are accordingly not considered part of this study. In any case, the full electrification of Ciskei would only add approximately 0.3% to Eskom's present annual electricity sales.

Various consultants and suppliers in Cape Town were approached on the issue of designing appropriate reticulation networks and a reasonable hypothetical design strategy was adopted.

The approach adopted in the costing analysis was to estimate an upper bound, rather than an average value, of the likely cost of electrification, i.e. a figure that planners can work to with a high degree of confidence. The northern Hewu district of Ciskei was chosen as the study area. This region, which is virtually unelectrified except for its only two urban areas, is considered reasonably typical of unelectrified rural areas in Ciskei. Its population density is lower than that of the rest of unelectrified rural Ciskei, which means that the cost estimate is unlikely to be an underestimate. The fact that the Hewu district lacks the electrical infrastructure that exists in the central and southern regions of Ciskei also implies that the estimate, if anything, is on the high side.

1.3 A GUIDE TO THE THESIS

Chapter 2 presents the reader with an overview of Ciskei, giving a brief insight into the territory's geography and climate, its population, its history, its constitutional development, its institutional framework, its economy and its physical infrastructure.

Chapter 3 looks in some detail at the electricity supply industry in Ciskei. The existing electrical infrastructure is described, with reference to both the power generation potential of Ciskei and electricity supply in rural and urban areas. The territory's growth in demand for electric power and the cost of electricity for domestic consumers are then discussed. Furthermore, the present organisational structure of this industry is described and the scope and objectives of a proposed independent energy authority for Ciskei are briefly outlined.

Chapter 4 summarises and discusses the results of the two questionnaire surveys that were conducted among unelectrified and electrified households in Ciskei. The survey procedure is described in detail. The results of each survey are then presented and discussed before analysing the most important trends in people's perceptions of electricity. The questionnaires are attached as Appendix A. Detailed results of the two surveys, in the form of tables, are presented in Appendix B and Appendix C respectively.

An upper bound cost estimate for the electrification of unelectrified rural areas in Ciskei is presented in Chapter 5. The costing analysis is based on a possible design of medium voltage distribution and low voltage reticulation networks for the largely rural Hewu district.

Chapter 6 presents a critical analysis of the affordability and priority of electrification in Ciskei. Means of making electricity more attractive to people in underdeveloped areas are briefly dealt with. Finally, some general conclusions regarding the electrification of underdeveloped areas are drawn.

CHAPTER 2

CISKEI: AN OVERVIEW

Ciskei as a country was created by the South African government in pursuance of its policy of 'separate development' for the different ethnic groups living in South Africa. In early history the land between the Great Kei and the Great Fish rivers was known as "the Ciskei". Later, parts of that land became one of South Africa's homelands. In December 1981 the borders of this homeland became political borders within South Africa and the country called itself the "Republic of Ciskei", simply referred to as "Ciskei" in this report.

2.1 GEOGRAPHY AND CLIMATE

The country consists of a single geographical unit situated on the south-eastern coast of Southern Africa, between latitudes 31°55' and 33°30' south and longitudes 26°20' and 27°50' east. The territory, which today covers a total land area of about 8000 km², is bounded by the Great Fish and Kat rivers in the west, the Swart Kei and Klipplaat rivers in the north and north-east, and the Indian Ocean in the south-east. When land consolidation has been completed Ciskei is to cover an area of 8300 km² (Black et al, 1986: 3).

The five main geographical regions are the coastal plain, the coastal plateau, the coastal highlands, the Amatola Mountains and the inland plateau. The altitude varies from sea-level to over 1200 meters on the inland plateau.

Ciskei lies within the summer rainfall region of Southern Africa with more than 70% of the annual precipitation occurring in the six months from October to March; in the

coastal regions rainfall is more evenly distributed throughout the year (DBSA, 1985: 2-2). The mean annual rainfall varies from about 500mm in the Middledrift district to 1000mm in the Keiskammahoek district, the highest occurring in the vicinity of the escarpment. In spite of the relatively high rainfall for Southern Africa the area is subject to periodic droughts. Much of the arable land is overworked and badly eroded. Few regions have a potential for intensive agricultural development unless supported by irrigation. The region is used mainly for small stock and cattle farming, and small-scale crop production. Pineapples may be grown in coastal areas, and fruit and vegetable production is possible under irrigation (Charton, 1980: 9).

Mean daily temperatures in Ciskei vary between about 10°C and 25°C. The highest temperatures - these can be as high as 42°C - are recorded during the late summer months (December to March), while July is the coldest month throughout Ciskei, with temperatures as low as -2°C. While the coastal regions are frost-free, the inland regions experience regular periods of frost during the winter months.

Ciskei presently comprises the following eight magisterial districts: Zwelitsha, Mdantsane, Keiskammahoek, Victoria East, Seymour, Peddie, Middledrift and Hewu. However, for planning purposes, the country has been divided into five planning regions (see Figure 1), namely:

1. **Mdantsane/Bisho**, covering the magisterial districts of Mdantsane and Zwelitsha;
2. **Middledrift/Keiskammahoek/Dimbaza**, which includes the magisterial districts of Middledrift and Keiskammahoek as well as Dimbaza (mainly the town and industrial area) which is in fact part of Zwelitsha magisterial district;
3. **Hewu**, which covers the magisterial district of Hewu;
4. **Peddie**, covering the Peddie magisterial district;
5. **Victoria East/Seymour**, which includes the magisterial districts of Victoria East and Seymour.

The latest official figures (these were obtained during the 1984 survey of population settlement in Ciskei - see DBSA, 1985: 4-1) indicate that there are 17 proclaimed towns and 429 villages and informal settlements in Ciskei.

2.2 POPULATION

Anthropologists use the term *Cape Nguni* to designate the Xhosa-speaking peoples living in Ciskei and Transkei. Ciskei's population consists mainly of Xhosa, one of the Cape Nguni tribes.

In 1985 the total estimated population of Ciskei numbered about 910 000. Of these, 380 000 lived in urban area and 530 000 lived in rural areas (DBSA, 1985: 3-1). While these figures included Ciskeians not living in Ciskei, the total 1985 de facto population, i.e. all persons physically present in the country at the time of the census, was estimated to be 750 000 (these are the latest official figures). The 1987 population density in Ciskei was 96.6 people/km² (DBSA, 1987) which is high compared to the corresponding figure for South Africa (excluding the 'independent' and 'self-governing' states) of about 25 people/km² and that for Transkei of about 67 people/km². At an estimated average annual population growth rate of 2.8% (DBSA, 1985: 6-4) the total de facto population of Ciskei is projected to increase to 1.4 million by the turn of the century.

The largest concentration of people occurs in Planning Region 1 (Mdantsane/Bisho) where the most densely populated rural areas and the two largest proclaimed towns, Mdantsane and Zwelitsha with respective populations of 250 000 and 30 000 (1984 estimates), are situated. This concentration of people in the south-eastern parts of Ciskei is directly linked to the region's close proximity to East London and King William's Town. The rapid economic and

industrial development in these 'white' border areas during the 1970s, relative to Ciskei, has created many new job opportunities and stimulated the growth of 'black' towns. People who found employment in these border industries "could opt to become commuter labourers rather than migrant labourers" (Charton, 1980: 9) to more distant South African towns and cities.

2.3 A BRIEF HISTORY OF CISKEI

Oral tradition and observations made by mariners shipwrecked along the coast indicate that by the beginning of the 17th century parts of what today is Transkei were already occupied by Nguni tribes, particularly Xhosa and Thembu, while parts of what today is Ciskei were occupied by Khoi (Saunders and Derricourt, 1974: 51). The first significant westward migration of the Xhosa tribe across the Kei river took place in 1702. White colonists were encountered for the first time and a trading relationship developed. In 1778 the colonial government declared the Fish river the boundary between the Nguni and the Cape colony. However, continued violation of this boundary by both the colonists and the Nguni led up to the first frontier war in 1779. Eight more frontier wars were to follow over the next century. During this period colonial expansion gradually proceeded eastward, forcing the Xhosa off their land. While many were driven back over the Kei river into the Transkei, others were resettled in so-called 'reserves' or 'locations'.

In the 1820s western influences, in particular the activities of missionaries and a booming trade between the Xhosa and the colonists, began to disrupt traditional society. Through education the colonial government aimed to undermine the power of chiefs and encourage African peasant agriculture. With the discovery of diamonds and gold in the second half of the 19th century Africans were sucked into the developing economy.

In 1835 the colonists proclaimed the land between the Keiskamma and the Great Kei rivers the Province of Queen Adelaide. A year later the name was changed to British Kaffraria and the Buffalo Mission (what is now King William's Town) was declared the capital and military headquarters of the territory. On 17 April 1866 the Ciskei was annexed by the British government and incorporated into the Cape Colony. As the Ciskei was colonised and Africans lost the ownership of their land, the economy was taken over by 'white' farmers, merchants and industrialists. The Transkeian Territories, on the other hand, were only annexed to the Cape colony between 1879 and 1894. However, instead of being fully incorporated into the colony's political, legal and administrative systems, the Transkei was administered as a separate entity, the basic reason being that the great majority of the Transkeian population were Africans who lived on their own land and not on 'white' farms. Although this strategy was in the interests of 'white' control ("giving the Transkei a separate status would make it easier to turn it into a labour pool" - Saunders and Derricourt, 1974: 194), the colonists, being concerned about the addition of the Transkei's large 'black' population to the colony, argued that it was "in the interests of the Transkeians that the area be a reserve, protecting the African population from the inroads of white farmers and exposure to the disruptive effects of the ordinary Cape law." (ibid). This history of employing in the Transkei a system of administration different to that in the Ciskei partly accounts for the present distribution of the Xhosa-speaking people between two separate territories.

With the colonisation of the Ciskei and the Transkei the Cape Nguni were subjected to western forms of government. The powers of traditional chiefs were deliberately suppressed by introducing a system of appointed headmen accountable to the magistrate in charge of a district or region. The 'locations' became the basic administrative areas. Only with the establishment of tribal authorities in 1951 was the tribal identity restored (Jackson, 1975: 1).

The Cape of Good Hope Constitution of 1853 granted Africans franchise rights based on a R50 voting qualification. However, the passing of the Franchise and Ballot Act of 1892, which not only increased the voting qualification to R150 but also included as a prerequisite for the right to vote the ability to write, excluded thousands of Ciskeians who would have qualified to vote under the old requirements (Ciskei Commission, 1980: 142).

The 'reserves' which were created for the exclusive occupation by Africans served the two principal functions of ensuring, firstly, separation between 'black' and 'white' and, secondly, a labour pool for South Africa's growing capitalist economy. Thousands of 'black' South Africans were expelled from 'white' areas and settled in the 'reserves'. In pursuing its policy of 'separate development' the South African government gradually deprived Africans of their citizenship rights within the political framework of the Republic while at the same time providing limited political and administrative structures in the homelands.

In the early 1970s Ciskei obtained 'self-governing' status with the consequence of loss of (political rights of) South African citizenship for thousands of Ciskeians living outside the homeland. In 1978 the Ciskei Commission under the chairmanship of Professor Quail was appointed to investigate, among other things, the feasibility of independence for Ciskei. In view of the conditions for independence as understood at the time, the commission recommended that independence was not a favourable option. However, following a dubious referendum, conducted by the Ciskeian authorities, indicating that the majority of Ciskeians were in favour of independence (Black et al (1986: 3) state that a survey by the Ciskei Commission indicated the opposite!), Ciskei became an 'independent' state within South Africa on 4 December 1981.

Between 1968 and 1978 six political parties were established in Ciskei. But since shortly after the general elections of 1978, in which Chief Sebe's Ciskei National Independence Party won a landslide victory, Ciskei has been a de facto one-party state.

In terms of its constitution Ciskei at 'independence' declared itself to be "a sovereign, democratic and independent Republic in a confederation of Southern African states." (Ciskei, 1982b). Decisionmakers in Ciskei envisaged that a confederal relationship, in which the constituent states delegate limited powers to a central government but retain their various 'sovereignties', would be entered into with the Republic of South Africa.

2.4 THE CONSTITUTIONAL DEVELOPMENT OF CISKEI

This section has been compiled from information in the following references: BENSO, 1981; Black et al, 1986; Ciskei, 1981a; Ciskei, 1981b; Ciskei, 1982b; Ciskei Commission, 1980; Jackson, 1975.

Glen Grey Act of 1894 - Experience of western forms of government began for the Cape Nguni with the introduction of this act which provided for the establishment of 'location boards' for the control of individual administrative areas, and a district council for the administration of local affairs in the Glen Grey District as a whole. The traditional administrative system of the Cape Nguni was not taken into account in the functioning of these bodies.

Natives Land Act of 1913 - In accordance with this act some 7% of the total area of South Africa was set aside for the exclusive occupation by Africans. These people were now no longer allowed to purchase land in 'white' areas or share it with 'whites' for agricultural purposes. Many Ciskeians

were removed from 'white'-owned farms to the 'reserves' where the pressure on land was already heavy.

The act was intended to minimise competition between 'white' farmers and 'black' farmers. "Certainly the evolution of black-run states was never envisaged, although the reserves were regarded as places wherein 'the native way of life', including limited application of indigenous law and governance, could be continued. The primary object of the act was to segregate. The secondary object was to limit the number of black families permitted to reside on white-run farms, particularly in the Transvaal." (Ciskei Commission, 1980: 145).

Bantu Affairs Act of 1920 - The council system in Ciskei, which was to facilitate the administration of the affairs of Ciskeians, developed by virtue of this act. Local councils, which were much like the district council of Glen Grey, were established for eight districts in Ciskei. The Ciskei General Council was established in 1934 and had jurisdiction over the eight local councils and the district council of Glen Grey. In addition to the administration of local affairs, the General Council could deliberate on any matters involving the economic and social welfare of the peoples of Ciskei, and pass resolutions on them or on any legislation proposed for the territory.

The council system was dominated by 'white' officers. The Ciskeian General Council, which comprised men elected from among the ranks of Ciskeians, "did not prove very successful, however, because the local chiefs were paramount and their powers superseded those of the General Council." (Ciskei, 1981a: 40). It was dissolved in 1956.

Natives Trust and Land Act of 1936 - This act provided for the incorporation of additional land into the 'black' areas with the aim of consolidating the homelands. The process of transfer, however, has been slow and by the time Ciskei obtained 'self-governing' status in 1972 the area was still fragmented.

Natives Representation Act of 1936 - In terms of this act Africans were finally denied the right to vote. All African voters were removed from the common voters roll and instead provision was made for the election on a separate roll of three 'whites' to represent them in the House of Assembly, and four members of the Senate to represent the interests of Africans throughout South Africa.

Bantu Authorities Act of 1951 - With this act the South African government laid the foundation for its policy of 'multinational development' providing for 'self-government' and eventually 'independence' of the homelands. By virtue of this act, tribal or community authorities were established for most of the tribes in Ciskei between 1957 and 1959. A tribal authority consists of a tribal chief and his councillors and deals with local tribal matters by virtue of the chief's powers. A community authority is designed for a community that lacks a chief or where two or more small communities are combined. Eight regional authorities were established between 1958 and 1961, and the ninth in 1965. They superseded the old local councils and the Glen Grey district council, and had much the same powers and functions. The Ciskeian Territorial Authority was established in 1961 and replaced the Ciskeian General Council. This new system differed from the old in two important respects: traditional tribal government was now utilised at the tribal level, and 'white' officers were excluded.

Promotion of Bantu Self-government Act of 1959 - This act identified the different ethnic groups within the borders of South Africa and provided the machinery for their political development to 'self-government' and 'independence'. In 1960 a Commissioner-General was appointed for Ciskei and Transkei. His functions were "to advise and to serve as a link between their governments and that of the Republic of South Africa." (Jackson, 1975: 3). In 1968 the Ciskeian Territorial Authority was given wider executive powers. A Ciskeian government service with six departments was established, and the Executive Committee was superseded by

an Executive Council. Various functions, duties and powers which had been in the hands of the nine regional authorities, were centralised by being transferred to the new body.

Bantu Homelands Citizenship Act of 1970 - By virtue of this act all 'black' South Africans are no longer South African citizens, but citizens of one of the homelands. This act, in conjunction with the South African Citizenship Act of 1949, thus deprived Ciskeians of their political rights of citizenship in the central South African political framework while allowing them to exercise these rights within the political framework of Ciskei.

Bantu Homelands Constitution Act of 1971 - By the provisions of this act the Ciskeian Territorial Authority was replaced by a Legislative Assembly comprising of traditional leaders and elected members. The Legislative Assembly was vested with both legislative and executive powers in respect of all matters of immediate concern to the people of Ciskei.

Ciskei Constitution Proclamation of 1972 - In terms of this proclamation Ciskei was declared a 'self-governing' territory within the Republic of South Africa, with effect from August 1, 1972. The area of the 'self-governing' Ciskei was restricted to those areas delimited by the Natives Trust and Land Act of 1936, but further land consolidation was proposed.

The constitution provided for a Legislative Assembly consisting of the Paramount Chief, 29 chiefs, and 20 elected members, 50 in all. A Cabinet, consisting of a Chief Minister and five other Ministers, was also provided for. Xhosa was recognised as an official language in addition to English and Afrikaans. The Bantu Homelands Constitution Act of 1971 determined the legislative powers, and provided for an own flag, and a national anthem. Ciskeian citizenship exists by virtue of the Bantu Homelands Citizenship Act of 1970.

Republic of Ciskei Constitution Act of 1981 - This act provides for a constitution for Ciskei as "a sovereign democratic, independent republic in a confederation of Southern African states." (Ciskei, 1981b: 1). The constitution makes provision for

- an economy based on private, communal and tribal ownership and free enterprise;
- the precedence of public international law over the laws of Ciskei;
- an official Seal, a national flag, a Coat of Arms, a National Anthem, and Xhosa and English as the official languages;
- a Declaration of Fundamental Rights;
- a President, elected by the National Assembly, as the Head of State and Commander-in-Chief of the armed forces; the President will hold that office for a period of seven years;
- a Vice-President, appointed by the President from the members of the National Assembly;
- an Executive Council, consisting of the President, the Vice-President and the Ministers of State;
- a National Assembly, with a term of office of five years, consisting of the President, the Paramount Chief, chiefs appointed or recognised by the President, twenty-two members elected by registered Ciskeian voters, a maximum of five special advisers nominated by the President, and a Paramount Chief's representative nominated by the Paramount Chief and approved by the President; bills passed by the National Assembly and assented to by the President will become law;
- a Supreme Court, consisting of the Chief Justice, appointed by the President, and such number of other judges as may be determined by the President from time to time; the Supreme Court has jurisdiction over all persons within the Republic of Ciskei and acts as appeal court for all lower courts; indigenous law and tribal customs are recognised and can be applied at the discretion of the Supreme Court

The following laws, referred to above, were repealed at 'independence':

- Bantu Authorities Act of 1951,
- Promotion of Bantu Self-Government Act of 1959
- Bantu Homelands Citizenship Act of 1970
- Bantu Homelands Constitution Act of 1971
- Ciskei Constitution Proclamation of 1972

2.5 INSTITUTIONAL FRAMEWORK

This section was adapted from the development information file on Ciskei published by the Development Bank of Southern Africa in conjunction with the Ciskei government (DBSA, 1985).

Since December 1981 Ciskei is an 'independent' republic. Central government is headed by the Executive President who is appointed by the National Assembly which in 1984 consisted of 69 members of which 42 were chiefs (these are ex-officio members), 22 were elected by the voting public and 5 were nominated by the Executive President. The Executive Council comprised of the President and 16 ministers appointed by him, one being without a portfolio. The 15 government departments are:

- Office of the Presidency
- Auditor General
- Foreign Affairs and Information
- Justice, Police and Prisons
- Health
- Education
- Internal Affairs and Land Tenure
- Finance and Economic Development
- Agriculture and Forestry
- Manpower Utilisation
- Transport

- Public Works
- Posts and Telecommunication
- Social Welfare, Pensions and Sport
- Defence

Judicial power is vested in the Supreme Court and the lower courts of Ciskei. The Supreme Court acts as Court of Appeal for the Magistrate's Courts which in turn act as Courts of Appeal for the chief's courts. Appeals from the Supreme Court are heard by the Appellate Division of the South African Supreme Court in Bloemfontein.

Local government in the rural areas is in the hands of Tribal Authorities that traditionally administer the villages. Their functions, which are much like those of municipalities, include the general administration of the affairs of the tribe in conjunction with the chief. They also advise the Government in relation to the well-being of the inhabitants. In 1984 there were 42 Tribal Authorities represented in seven regional authorities. Smaller towns are controlled by the Department of Internal Affairs and Land Tenure, while some bigger towns like Mdantsane and Zwelitsha have Town Councils.

2.5.1 Planning structure

The planning structure which coordinates and facilitates development planning in Ciskei (divided into five planning regions for this purpose - see Section 2.1 above) is composed of the following bodies:

- (a) **The Executive Council** is responsible for the final adoption of development programmes and policies.
- (b) **The National Planning Committee** consists of the directors-general of all government departments, specialist advisers to the Presidency and representatives of all development institutions. (The

most important development institutions are the Ciskei Peoples Development Bank, the Ciskei Agricultural Corporation, the Ciskei Agricultural Bank and the Ciskeian Small Business Corporation.) The Committee meets under the chairmanship of the controlling minister.

- (c) **The Urban Planning Board** meets on an ad hoc basis to consider draft town planning schemes and guide plans for individual towns or metropolitan areas.
- (d) **The Directorate of Planning** consists of a director and technical and professional staff. In addition to its planning function the Directorate also serves as the secretariat of the National Planning Committee and the Urban Planning Board. To cover the entire spectrum of planning there are three technical planning sectors, viz. one for regional planning, one for economic planning and one for urban planning.
- (e) The local planning unit is the tribal area and its villages. To ensure planning from the grass roots level **Tribal Authorities** are engaged in the process.

2.6 SOME ASPECTS OF THE CISKEIAN ECONOMY

The Ciskeian economy, which is founded on the principles of free enterprise, showed a steady growth over the years on the country's path to 'independence' and beyond.

The gross domestic product (GDP - a measurement of the total output of a country's economy, i.e. all goods produced and services rendered within its territory by residents and non-residents without regard to its allocation among domestic and foreign claims, over a period of one year) of Ciskei increased at an average annual rate of 25.0% (current prices) between 1980 and 1985 to a total of

R397 million in 1985 with the market sector contributing 92% and the non-market sector only 8%. During the same period the total gross national product (GNP - GDP plus factor incomes accruing to residents from abroad, less the income earned in the domestic economy accruing to persons abroad) increased at an average annual rate of 22.1% (current prices) to R825 million; in per capita terms this means an average annual increase in GNP of 19.9% (current prices) to R1019. Government revenue (loans excluded) between 1980/81 and 1986/87 increased at an average annual rate of 27.9% to a budget of R493 million for 1986/87, while Government expenditure increased at an average rate of 30.5% per annum during that period to a budget of R616 million (DBSA, 1987: 5).

During the 1970s the Ciskeian economy has to a large extent been dependent on the export of unskilled labour to South Africa. The increase in per capita income from R146.2 (constant prices) in 1970 to R222.2 (constant prices) in 1980 has been ascribed mainly to the contribution of income from commuters and migrants to the GNP (DBSA, 1985: 6-2). In 1980 commuter income and migrant income jointly still contributed 56.5% towards the GNP, but since Ciskei has over the last decade begun to establish its own economic base, most importantly demonstrated by its recent industrial developments, this contribution can be expected to have become less significant.

2.6.1 Tax incentives to attract investment

In the belief that low taxation can in general produce a greater growth in revenue than can tax increases, the Ciskeian government reformed the income tax structure by abolishing company tax and introducing a flat rate of 15% on personal tax. Since these new tax laws came into effect in March 1985, Ciskei has been undergoing a period of considerable industrial growth, creating many new employment opportunities. Sixty-one new manufacturing concerns were

established between March 1985 and March 1987, bringing the total to 141. Private sector investment in new industry began to exceed public sector investment for the first time. However, whereas the attraction of industry on the tax free basis has been reasonably successful, concern has been voiced about the fact that the type of new industry has tended to be less labour intensive, resulting in an increased need for skilled labour. However, the new tax incentives have created a suitable climate for the promotion and development of small business which plays an important role in providing employment opportunities for the ever increasing number of job seekers.

2.6.2 Labour and employment

The potentially economically active population of Ciskei (those persons between the ages of 15 and 64 years) is estimated at approximately 50% of Ciskei's de facto population (the figures for 1980 and 1985 were 50.7% and 50.6% respectively). Ciskei's 1985 total labour force, however, was only estimated to be approximately 210 000 of which 17.5% were unemployed (DBSA, 1987: 136)

While only 64 000 people found employment within Ciskei in 1985, the close proximity of Ciskei to industrial development points in South Africa provides the surplus labour supply with the opportunity to seek employment as commuters. There are also job opportunities in the major industrial centres of South Africa for migrants from Ciskei. The Development Bank of Southern Africa estimated that approximately 48 000 transfrontier commuters from Ciskei (people who live in Ciskei and who cross the border daily to go to their places of employment in South Africa and return to their homes every day after work) and approximately 60 000 migrant workers from Ciskei were employed in rural and urban areas of South Africa in 1985 (DBSA, 1987: 136). Today, due to rapid industrial development in Ciskei, more and more Ciskeians can be expected to find employment closer to home.

2.7 PHYSICAL INFRASTRUCTURE

Due to its position in Development Region D (see Figure 2) between the cities of Port Elizabeth and East London, Ciskei has inherited a reasonably good infrastructure with 'independence'. However, services in rural areas are often non-existent, a major problem being the lack of both purified piped water and sewerage. There are virtually no electricity services and only a few telephone connections outside the proclaimed towns.

The approximately 125km of railway line within Ciskei form part of the larger railway network administered by the South African Transport Services. Rail facilities are available at the two industrial growth points (Dimbaza and Fort Jackson) and at eight stations, three sidings and numerous stopping places and halts. Railway points in the South African region adjacent to Ciskei render similar services to the country. Between Mdantsane and East London the railway operates a commuter transport service (DBSA, 1985: 9-2).

In 1985 the Ciskeian road network extended for 3004km of which 553km were primary roads (73% paved), 455km secondary roads (9% paved) and 1996km tertiary roads (0.2% paved) (DBSA, 1987: 156). More than 1000 taxis offer an efficient road transport service within Ciskei and to adjacent South Africa while several bus transport undertakings provide regular and scheduled bus services and organised party services. A number of long distance bus services connect Ciskei with Cape Town, Port Elizabeth, the OFS goldfields and Transkei (DBSA, 1985: 9-3).

An international airport capable of handling modern commercial aircraft has recently been constructed at Bulembu near King Williams Town. Landing strips exist at Keiskammahoek, Sada/ Whittlesea, Wesley, Alice and Seymour.

By 1987, 33 post offices and 71 telephone exchanges had been established in Ciskei. The total number of telephone connections in 1986 amounted to 11 300, with approximately

8000 single line residential connections, 2500 other single line connections (eg. for businesses), 170 public telephones and 650 party-line services (DBSA, 1987: 155). However, a great backlog for telephone connections exists, particularly in the rural areas. Of the approximately 7000 telephone connections in 1984, about 6000 were in proclaimed towns (DBSA, 1985: 9-4).

The Ciskeian electricity network is described in detail in Chapter 3. With very few exceptions electricity is readily available in proclaimed towns, while only a few clinics, hospitals, irrigation schemes, schools and farms in rural areas are served.

In 1984 the domestic and agricultural water network included 19 dams in and adjacent to Ciskei, 13 purification plants and canals and pipelines for water distribution. In rural areas a poor supply of purified water exists with boreholes, wells, streams, rivers and springs being the main sources (DBSA, 1985: 9-1).

The 1984 housing figures are divided into 110 000 residential structures in the proclaimed towns and 170 000 in the rural villages and informal settlements. With a population of 750 000 this means an average of 2.8 people per residential structure (DBSA, 1985: 4).

Health and welfare services in Ciskei in 1984 comprised of six hospitals with 2589 beds, 89 clinics, three child and family care institutions, one institution for the care of the aged and four institutions for the care of the handicapped (DBSA, 1985: 10-2).

In 1985 there were 710 educational institutions (including three teacher training colleges and one university) in Ciskei providing pre-primary, primary, secondary and tertiary education to approximately 254 000 Ciskeian pupils and students. The average pupil-to-teacher ratio in primary schools was 43:1, while that in secondary schools was 30:1 (DBSA, 1987: 151).

CHAPTER 3

THE ELECTRICITY SUPPLY INDUSTRY IN CISKEI

Ciskei is situated within South Africa's Development Region D which comprises the whole Eastern Cape (including Ciskei) and southern Transkei (refer to Figure 2). An extensive electricity supply network spans central Ciskei and, although the coastal regions and the northern district of Hewu on the inland plateau are not yet provided with the necessary infrastructure, electricity can be supplied to any point within Ciskei, the only requirement being that there are enough would-be consumers who can afford electricity to make it a feasible venture (DBSA, 1985: 9.1).

This chapter provides an insight into the existing electrical infrastructure in Ciskei as part of Development Region D, the country's electricity demand, the cost of electricity, and the organisational structure of the electricity supply industry. In addition, the proposed structure of an independent energy authority for Ciskei is described in brief.

3.1 ELECTRICAL INFRASTRUCTURE

A 220kV transmission line from Eskom's Poseidon King substation supplies Pembroke substation near the town of Ilitha. From Pembroke substation power is distributed to East London, Transkei, Queenstown, Grahamstown and to various substations in southern and central Ciskei. Sada/Whittlesea in the Hewu district is supplied from Komani substation near Queenstown. Mdantsane and the industrial area at Fort Jackson are at present still receiving their power from the Municipality of East London, but will soon be supplied entirely from Potsdam substation near Fort Jackson.

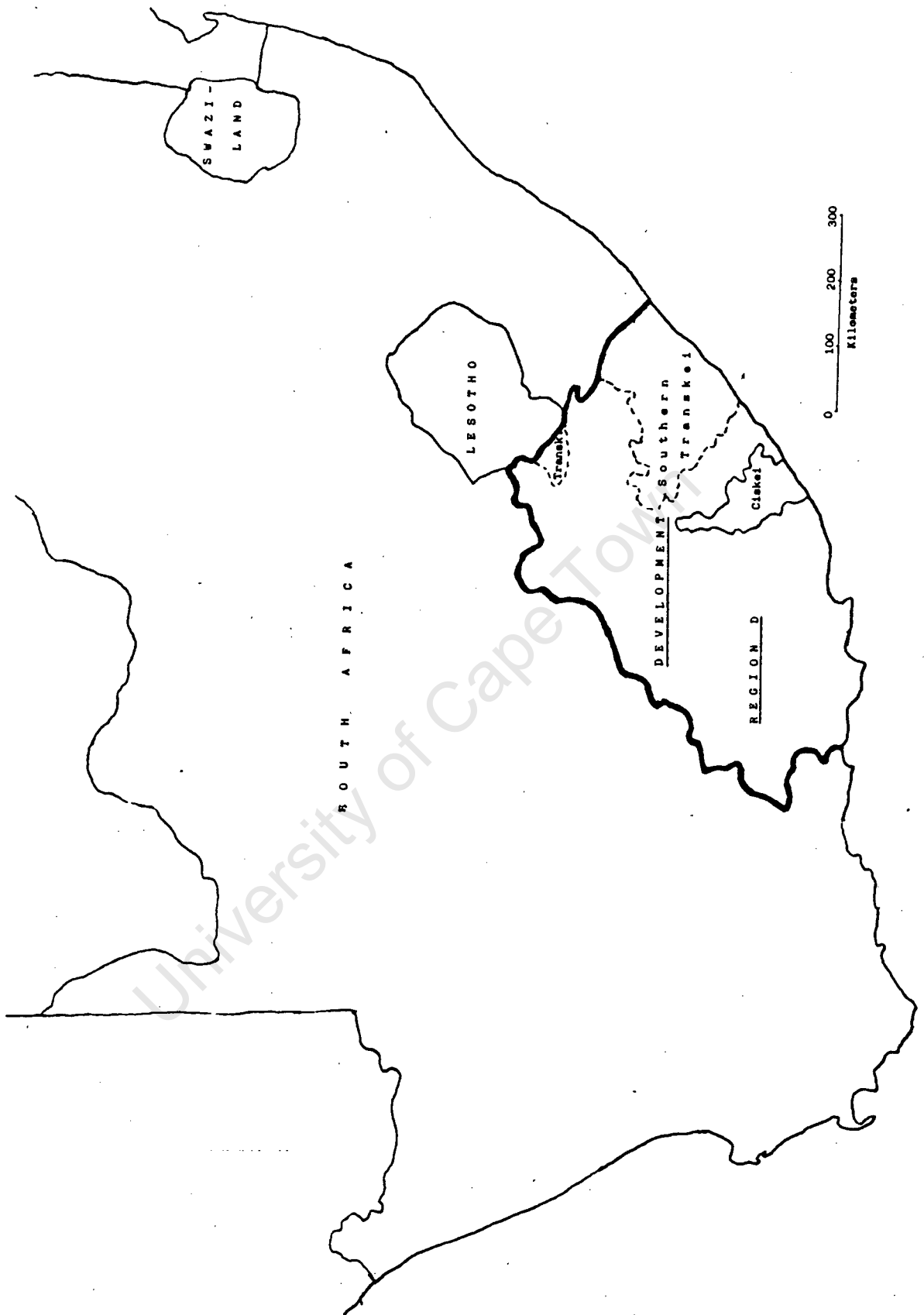


FIGURE 2: CISKEI WITHIN SOUTH AFRICA'S DEVELOPMENT REGION D

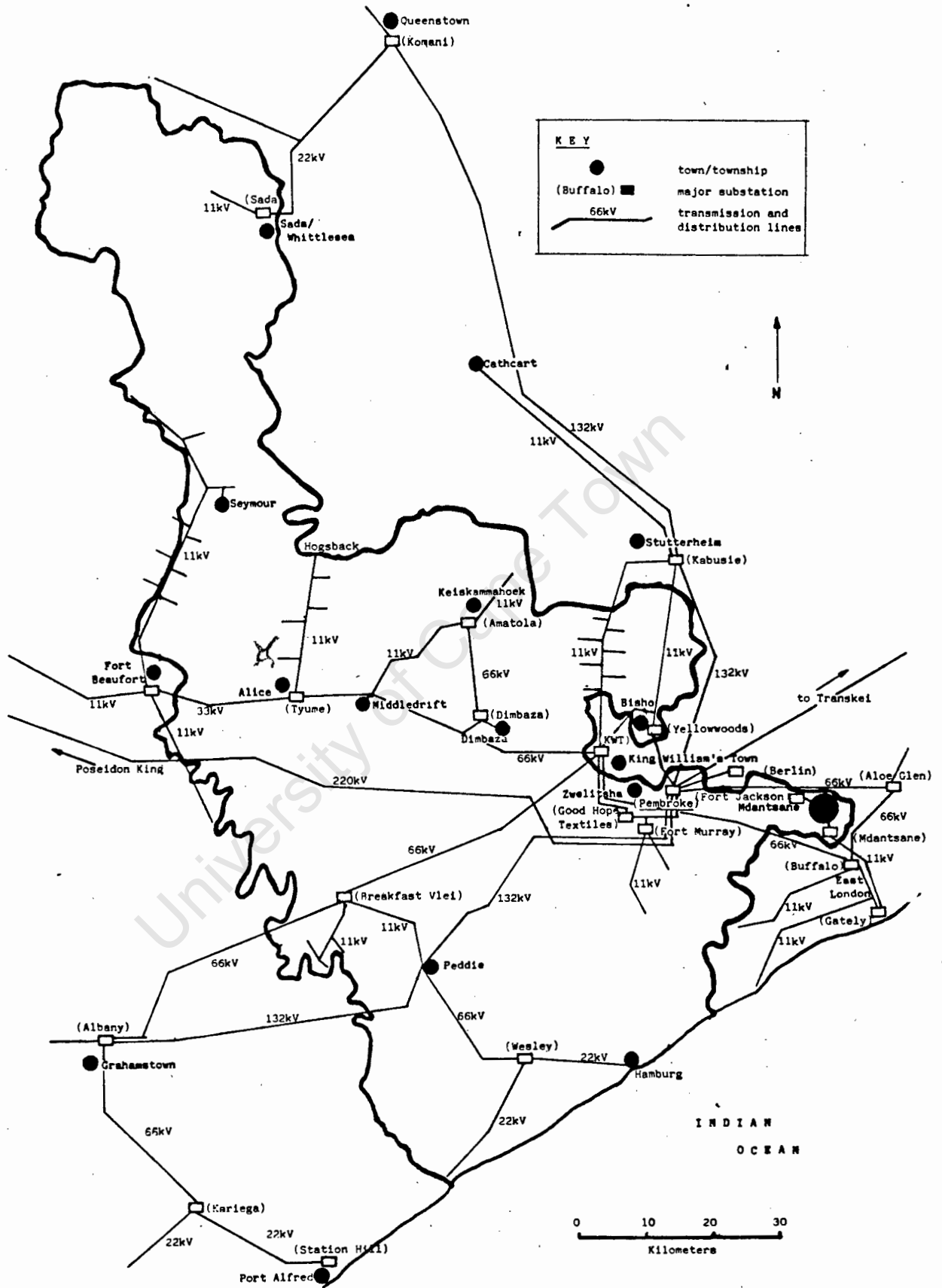


FIGURE 3: THE EXISTING ELECTRICITY SUPPLY NETWORK IN AND AROUND CISKEI

On 1 April 1987 the Ciskei Department of Public Works took over responsibility from Eskom for approximately 285km of 66kV line, 85km of 11kV line, 71km of 11kV spur line and nine 66/11kV substations (Wesley, Good Hope Textiles, Fort Murray, Yellowwoods, Dimbaza, Bulembu, Amatola, Breakfast Vlei and Tyume). These networks involved the takeover by Ciskei of 610 small power customers and 33 large power customers. Two further networks were taken over from Eskom on 1 April 1988, these being Dunbar Lake (approximately 55km of 22kV line, 11km of 11kV line, 120m of 400V line and the 22/11kV Dunbar Lake substation) and Kat Valley (approximately 103km of 11kV line and 1.6km urban reticulation in Seymour), involving the takeover by Ciskei of 130 small power customers and 10 large power customers. The existing Ciskeian medium voltage distribution network is shown in Figure 3.

Excluded from the Ciskeian electricity network are all those transmission lines traversing the country that do not have any tap-off points within Ciskei (i.e. the 220kV line supplying Pembroke substation, the 132kV line from Pembroke substation to Albany substation near Grahamstown and the two 66kV lines from Pembroke substation to King William's Town and to Buffalo substation), Pembroke substation and Hogsback village. Also excluded are Mdantsane and Sada since the supplies to these townships are not interconnected with the main system in Ciskei.

3.1.1 Electricity generation within Region D

In 1985 there existed a total generating capacity of 567 MVA within Region D as a whole of which 65 MVA was hydroplant (Transkei), 332 MVA was coal-fired steam-raising plant (South Africa) and 170 MVA was gas turbine plant (South Africa) (Eskom, 1985: 3.2). Theoretically, it would be possible to meet the region's electricity requirements from its own generating capacity but in practice only the Transkei hydropower is economically viable. However, this

suffers from a water storage limitation which prevents Transkei from even meeting its own annual consumption needs (about 200 GWh in 1985). The coal-fired and gas turbine generating plant is old and is coming to the end of its useful life. It can therefore not be considered for base load generation and is presently being used to reduce peak demands on the Eskom system and for emergency reasons. As the demand for electricity in the region increases year by year and the regional generating plant is phased out it becomes necessary to invest either in new regional plant, or in new plant in the Eastern Transvaal and additional transmission lines to the region. In order to partly fill the gap that is anticipated to open up between the region's electricity supply and demand over the next decade, Eskom in 1985 have initiated construction of an additional 400kV feeder to the region (Eskom, 1985: 4.1).

3.1.2 Electricity generation in Ciskei

Apart from a number of small diesel driven generating sets for emergency electricity supply or for selected remote sites (like government buildings, clinics or police stations), there is as yet no generating capacity of notable size installed in Ciskei. During a visit to Ciskei the author noted small photovoltaic systems at several clinics and community centres in remote rural areas. According to the Department of Public Works these systems were installed to supply power for radio communication.

Unfortunately, Ciskei's electricity generating potential is poor due to a lack of natural resources, but limited possibilities of generating electricity from wind and water do exist. The Amatola mountain range offers considerable scope for wind generated electricity and in the Hog's Back area it would be possible to build a pumped storage scheme. Both options would be highly capital intensive initially, but a wind plant has the advantage of utilising a renewable source of energy while a pumped storage scheme uses

electricity only during off-peak periods. To date, only the pumped storage option has been examined as this appeared more promising. Feasibility studies on this scheme revealed that it would be viable in the size range 1000 MVA to 1500 MVA (Eskom, 1985: 4).

Another option that still needs to be considered is small-scale hydro-electric generation. Many sites exist in Ciskei that could provide the necessary water power. Existing legislation regarding the diversion of natural watercourses might have to be reviewed before this option is to be exploited.

3.1.3 Electricity supply in the urban areas of Ciskei

With the exception of Frankfort, Hamburg and Kwa Kyaletu all proclaimed towns are fully reticulated. A 22kV distribution line to Hamburg is presently under construction. The streetlighting network in all electrified towns is complete and businesses, community buildings (like schools, churches, hospitals and clinics) and industries generally consume mains electricity. However, although electricity is readily available, many private homes are not yet connected to the grid. In Mdantsane, which is 100% reticulated, only 30% of households have accepted supply (Eskom, 1988a). Many households cannot afford to have their houses wired (at the present costs and standards) and pay the connection fee of approximately R300, nor can they afford to purchase electrical appliances to be able to make full use of electricity. The low consumer density in this township,

however, is also partly due to people's negative perceptions of electricity: a survey by the author among electrified households in Mdantsane (refer to Chapter 4) revealed that people perceive electricity as an expensive source of energy to use in the household, despite the unit cost of 7.5c/kWh. This is an indication of the lack of consumer information on the real cost of electricity.

3.1.4 Electricity supply in the rural areas of Ciskei

Despite the extensive electricity supply network in central Ciskei only a few selected rural places (some schools, clinics, farms, irrigation schemes, etc.), but no rural villages and informal settlements, are as yet electrified. Limited power requirements are usually met by diesel generating sets, and in some instances even by small photovoltaic systems. This lack of electricity services in the rural areas of Ciskei is mainly due to Ciskei's economic policy which gives top priority to the reticulation of industrial townships. However, it is anticipated that greater attention than in the past will be devoted to rural electrification to stimulate economic development.

In their proposal for an independent Ciskei Energy Authority (see Section 3.5) Hill Kaplan Scott Incorporated stressed that rural electrification would be one of the most urgent priorities of the Authority. Such a programme would aim to bring electricity to as many people as possible, raising their standard of living and improving their quality of life. However, "detailed studies are needed to pinpoint the most viable areas of the country for electrification and to ascertain costs and tariffs that are affordable by the people. It is not economic sense to expand randomly and these studies must provide the data for decisions on priorities for the competing areas based on sound economic argument and on the ability of the Authority to meet the requirement." (HKS, 1985: 73)

3.2 THE DEMAND FOR ELECTRICITY

As there is as yet no generating capacity installed in Ciskei, its bulk electrical power requirements are imported from Eskom and the Municipality of East London.

The number of electricity consumers in Ciskei has risen by 14% in the period 1983 to 1985 (Eskom, 1985: 2.1.5). This rapid growth was expected to be sustained by population growth, industrial expansion and rural electrification. Table 3.1 gives an indication of economic growth in Ciskei, while Ciskei's annual electricity requirements between 1980 and 1984 are summarised in Table 3.2. In early 1985 Ciskei's electricity consumption for that year was estimated at 175 GWh (about 230 kWh per capita) with a ceiling demand (before diversity) of 42 MVA. The corresponding figures for Transkei were estimated at about 200 GWh and 50 MVA, and those for Region D as a whole at 2830 GWh and 465 MVA.

Table 3.1 Electricity demand in five major growth centres in Ciskei, 1976 and 1988 (Piva, 1988)

year	Bisho	Mdantsane	Dimbaza	Zwelitsha	Sada
1976	0.0 MVA	4.3 MVA	0.6 MVA	0.8 MVA	0.2 MVA
1988	5.5 MVA	25.0 MVA	14.0 MVA	3.5 MVA	1.4 MVA

Table 3.2 Increases in ceiling demand and electricity consumption in Ciskei, 1980 to 1984 (adapted from Eskom, 1985: 2.1)

year	ceiling demand	annual growth rate	electricity consumption	annual growth rate
1980	18.85 MVA		59.55 GWh	
1981	20.96 MVA	11.2 %	87.77 GWh	47.4 %
1982	26.36 MVA	25.8 %	103.00 GWh	17.4 %
1983	31.84 MVA	20.8 %	124.00 GWh	20.4 %
1984	37.16 MVA	16.7 %	158.00 GWh	27.4 %

Eskom in 1985 estimated Ciskei's long term annual growth rate in ceiling demand at 10% and that in electricity consumption at 11% (Eskom, 1985: 2.1). The projected annual electricity requirements of Ciskei between 1985 and the year 2000 are given in Table 3.3. The long term growth rates of both ceiling demand and consumption for Region D overall were estimated at 8% per annum, and those for Transkei at 10% per annum. At these growth rates the ceiling demand of Ciskei will approach 175 MVA by the year 2000, with Region D as a whole requiring 1475 MVA and Transkei 207 MVA; annual electricity consumption will rise to approximately 837 GWh in Ciskei, to 8900 GWh in the region as a whole and to 867 GWh in Transkei. The picture for Region D thus shows a rapidly increasing demand for electricity with the highest growth rates in Ciskei and Transkei, but with only very limited local generating capacity available or actively planned. It is estimated that a very large gap between supply and demand will open up in the remaining years until the year 2000.

Table 3.3 Estimated ceiling demand and electricity consumption in Ciskei at respective annual growth rates of 10% and 11%, 1985 to 2000 (adapted from Eskom, 1985)

year	ceiling demand	electricity consumption	year	ceiling demand	electricity consumption
1985	42 MVA	175 GWh	1993	90 MVA	403 GWh
1986	46 MVA	195 GWh	1994	99 MVA	448 GWh
1987	51 MVA	216 GWh	1995	109 MVA	497 GWh
1988	56 MVA	239 GWh	1996	120 MVA	552 GWh
1989	61 MVA	266 GWh	1997	132 MVA	612 GWh
1990	68 MVA	295 GWh	1998	145 MVA	680 GWh
1991	74 MVA	327 GWh	1999	160 MVA	754 GWh
1992	82 MVA	363 GWh	2000	175 MVA	837 GWh

3.3 THE COST OF ELECTRICITY FOR DOMESTIC CONSUMERS

Conventional housewiring by a registered electrical contractor will cost an average township household, occupying a three-roomed house, around R700 (refer to Chapters 4 and 5). In more remote settlements this cost can be expected to be higher as the necessary supporting

- infrastructure and expertise does not exist there. Once connected to the grid - a single phase underground service cable connection costs R310 - domestic consumers (less than 25kVA) pay a monthly service charge of R3 and a unit charge of 7.5c per kWh (Ciskei, 1986a: 3; Ciskei, 1988). In more remote areas it is possible that a monthly capital charge will be imposed in addition to the standard tariff to cover the cost of the distribution network. The irony of such a system would be that the poorest people (usually those living in remote areas) will have to pay more for their electricity than people who are more affluent (usually those living in the already reticulated towns and townships).

According to the Office of the Manager in Mdantsane this township's average cost of domestic electricity consumption is R33/month per electrified household (Ciskei, 1988). Average monthly electricity bills, however, were found to be much higher: R68/month among electrified town households and R43/month among electrified township households (refer to Chapter 4). There are two major reasons for this discrepancy: firstly, most households only pay part of their electricity bill so that the outstanding amount is carried over to next month's bill (this is often the result of unclear billing) and, secondly, the manual meter-reading system is not very reliable. During the survey among electrified households many complaints were received regarding unacceptably high bills even in the absence of consumption. It can be concluded that consumption levels are often estimated rather than actually read off the meter.

Interestingly, unelectrified households' average expenditure on fuel (R35/month in urban areas and R39/month in rural areas) is of the same order as Mdantsane's average cost of electricity consumption above. This indicates that the use of electricity, once a household is connected to the grid and owns some electrical appliances, will in all probability not cost more than the present fuel usage.

The cost of electrical appliances will mean an additional financial burden on households that become consumers. A study by Eskom indicated that the relative cost of electrical appliances could be as high as 50% of the overall cost of electrification (Brooking, 1987: 17). While it is expected that many households will want to keep their paraffin and/or gas appliances because they have a suspicion that the use of electricity is expensive, it might not be easy for those who want to get rid of these appliances to sell them. Also, most households will financially not be in a position to purchase electrical appliances immediately after the expenses incurred for housewiring and connection to the grid.

Another electricity related cost for a consumer is the repair or replacement of faulty or damaged appliances. In remote areas this cost could be prohibitively high if no supporting infrastructure is established.

3.4 ORGANISATIONAL STRUCTURE OF CISKEI'S ELECTRICITY SUPPLY INDUSTRY

Before Ciskei became independent in December 1981 the Electricity Supply Commission of South Africa (Eskom) was responsible for most of the electricity supply and distribution in this homeland; the Municipality of East London supplied electricity in and around Mdantsane. Shortly after independence the Ciskei Government took over some responsibilities regarding the supply of electricity to Ciskei. The Ciskei Department of Public Works began to purchase electricity from Eskom and, in the case of Mdantsane and the Fort Jackson industrial area, from the Municipality of East London, for distribution to public and private consumers within Ciskei; this department also took over from Eskom the operation and maintenance of electricity supply installations in several urban areas.

In an agreement between the governments of the Republic of South Africa and Ciskei, the Government of Ciskei undertook to recognise the Electricity Control Board (of South Africa) and its control over electricity supply within Ciskei. In terms of this agreement, and of a mandate agreement between Eskom and the Government of Ciskei, Eskom continued to own, use and have access to its assets (mainly transmission and distribution lines, substations and operating depots) within Ciskei. Furthermore, these agreements require Eskom to supply electricity either at an agreed point on the border of Ciskei or to consumers in Ciskei under the provision of the Electricity Act.

Since 1987 the Ciskei Department of Works has taken over responsibility from Eskom for several networks within Ciskei, involving ten substations and over 600 kilometers of high and medium voltage line (see to Section 3.1). With this transfer of assets the Department of Public Works became responsible for the construction, operation and maintenance of electricity supply installations that form part of the Ciskei electricity network. However, this department is not yet solely responsible for electricity supply in Ciskei. For practical reasons some consumers within Ciskei are supplied directly from the Eskom distribution network and in some hospitals electrical installations are operated and maintained by staff of the Department of Health. The Department of Public Works also operates and maintains a number of diesel generator sets at various government buildings that are remote from existing power lines.

The electro-technical staff of the Department of Public Works is responsible for the maintenance of the Ciskeian network and construction of small extensions to the system. In 1985 this staff consisted of the four professional registered electrical engineers, four chief artisan foremen, nine principal artisan foremen, ten senior artisan foremen, eleven artisan foremen, 54 artisans, 18 apprentices, 368 technicians, eleven clerks and two assistant clerks, a total of 491 (HKS, 1985: 79). During the design stage for the

extension of the electricity network a consulting engineer is appointed. If a determined policy of network extension is adopted then there will be a need for more construction teams and maintenance artisans. Hill Kaplan Scott Incorporated envisaged a total initial staff complement of 523 for their proposed Ciskei Energy Authority (HKS, 1985: 94).

Housewiring is done by registered private electrical contractors. Some 60 to 70 electrical contractors are presently registered with the Department of Public Works.

Metering of electricity sales, billing of consumers and collection of revenue from electricity sales in all proclaimed towns, except Bisho, is in the hands of the Department of Internal Affairs and Land Tenure; in Bisho the Municipality of Bisho is responsible. In smaller towns the Department of Public Works is responsible.

Plans have been formulated to establish a Ciskei Electricity Supply Authority (Section 3.5) with the aim of combining the various electricity related activities, presently shared by different government departments as outlined above, in one organisation. The prime purpose of this Authority would be to market electricity in Ciskei and generate revenue to finance further expansion of electricity services. The formal proposal to set up the authority was submitted for Government approval in late 1985. Some of the organisational features of the proposed Authority have already been incorporated in the Department of Public Works.

3.5 PROPOSAL FOR AN INDEPENDENT ENERGY AUTHORITY IN CISKEI

This section has been adapted from the following three reports by the consulting firm Hill Kaplan Scott Inc.: HKS, 1982a; HKS, 1982b; and HKS, 1985.

In 1982 HKS proposed that a statutory energy corporation be established to operate, maintain, develop and commercially manage electrical and alternative energy supply and distribution within Ciskei. As an interim stage before the formation of such a corporation, to take advantage of the existing administrative facilities, they recommended that an authority, provisionally named the Ciskei Energy Authority, be established as a separate unit within the Department of Public Works but with scope for future development into an independent statutory authority or corporation. This authority would take over the electricity supply activities of Eskom, the Department of Public Works and the Department of Internal Affairs and Land Tenure. Advantages arising from taking control of electricity supply include the implementation of electrical system development and operation to support other development activities, the adoption of tariffs suited to Ciskeian consumers, the creation of training and employment opportunities and the retention in Ciskei of profits generated from operation of the Ciskeian electrical system. As the Authority expands and assumes all responsibilities and functions of an energy supplier it should be constituted as an autonomous organisation.

The main objective of the proposed Authority would be the operation of the Ciskeian electrical system and the expansion of electricity services to support national development activities in Ciskei. In this regard it would be advantageous to centralise energy expertise in one organisation because administrative overheads (duplication of staff and facilities) could be reduced and greater flexibility in the deployment of technically trained staff could be provided for. The Ciskei Energy Authority would develop technical expertise, physical facilities and

administrative and financial capabilities. These strengths in the field of energy supply and utilisation would then be used to develop alternative energy resources.

It was proposed that the management structure of the new Authority should be along the lines of the two-tier board system, comprising a Board of Control and a Management Board, as recommended by the Commission of Inquiry into the Supply of Electricity in the RSA. The proposed Authority should assume the role of bulk supplier of electricity to a number of municipalities and city corporations and responsibility for revenue collection in the large urban areas should be delegated to these municipal bodies. Large power users and rural consumers would be supplied directly by the Authority.

HKS's most important recommendations regarding the scope of the proposed energy authority are summarised below:

- * The electricity supply activities of the Electrical Branch of the Department of Public Works should be taken over immediately by the Ciskei Energy Authority.
- * The Ciskei Energy Authority should acquire from Eskom those assets supplying electricity within Ciskei. (This step was partly taken on 1 April 1987 and 1 April 1988 when the Department of Public Works took over most of the transferable Eskom assets (as detailed in Section 3.1).)
- * Instead of purchasing electricity from East London Municipality consideration should be given to taking all supply from Eskom only.
- * The Ciskeian network should be supplied from a minimum number of intake points. Alternatively, summated maximum demand metering of Eskom imports could be established so as to take the greatest advantage of diversity of demand. (At present, Ciskei imports electricity at three major intake points, the most important one being Pembroke

substation near the town of Ilitha. The other intake points are Potsdam substation supplying both Mdantsane and the industrial area at Fort Jackson, and a substation at Sada supplying electricity to the northern Hewu district.)

* Responsibility for metering, billing and collection of revenue from sales of electricity should be transferred from the Department of Internal Affairs and Land Tenure to the Ciskei Energy Authority.

* The Ciskei Energy Authority should participate in the distribution of coal and similar fuels and in the construction of systems to exploit hydro, solar and wind energy in Ciskei. However, as the distribution of petroleum fuels (petrol, diesel, paraffin and gas) is already well organised, with existing facilities established by private enterprise, advantages and disadvantages of extending the Authority's activities in this direction must be carefully considered.

* The Ciskei Energy Authority should investigate establishing manufacturing, marketing, distribution and installation activities related to energy appliances where they do not exist already. Furthermore, the Authority should assess possibilities of providing consumer services such as housewiring, inspection of contractors' installations, advice to consumers on suitable appliances, safety and economy as this would enhance its image and serve to promote the sales of electricity.

* Building maintenance and electrical and mechanical services for government buildings should not remain split between government departments as at present. Rather, energy expertise should be centralised in one organisation. Such energy-related activities would best suit the proposed Ciskei Energy Authority.

CHAPTER 4

ELECTRICITY FOR DOMESTIC USE: PEOPLE'S VIEWS

An important step in ensuring that the real needs and aspirations of developing communities are met is consultation with and involvement of these communities. Many development projects have failed to live up to the expectations of the planners and developers involved because they "have neglected to ascertain the constraints on, and the needs of the people they sought to uplift" (Rose et al, 1986: 2). In an attempt to assess whether there exists the need for an electricity supply in underdeveloped areas of Ciskei, two questionnaire surveys were conducted, the one among unelectrified households and the other among electrified households. While both surveys addressed general and specific issues related to electrification it was also aimed to place electrification into the context of perceived development priorities. The two surveys complement each other in that the one among unelectrified households identified people's expectations of electricity, while the one among electrified households tested whether such expectations have been met. By interviewing both unelectrified and electrified households it was attempted to provide a historical perspective which might give an indication of how the situation has changed with the introduction of electricity to previously unelectrified households.

The main issues addressed in the survey among unelectrified households were:

- * whether people living in unelectrified areas would prefer electricity (for domestic consumption) to other fuels;
- * whether these people could afford electricity; and
- * what priority electrification enjoys among these communities' goals and aspirations.

In the survey among electrified households it was sought to determine

- * how the availability of electricity has affected people's ways of life; and
- * how the financial situation of these households has changed due to their use of electricity.

4.1 SURVEY METHODOLOGY

Surveys are a means of converting data and other information about a particular situation or event into a real and objective understanding of that situation or event. Rural energy surveys, which attempt to explain and quantify rural energy systems, are fairly new, because the seriousness of the energy crisis in underdeveloped rural areas has only been recognised by researchers and scientists in the recent past. As yet, however, there is little understanding of these systems, because their structure and dynamics are different from those of conventional energy systems which are based on modern technology. In Third World rural energy systems technology is of little importance and usually only serves to support the community's attempt to meet its basic needs. Energy consumption for domestic purposes is by far the most dominating aspect of the rural energy crisis; this is exactly what makes it different from any energy crisis in developed countries which would be, and has been, dominated by industrial and transport energy consumption.

The lack of understanding of rural energy systems in underdeveloped areas are in most cases a result of the way in which surveys are being conducted. In this regard, Barnett et al (1982) identify four particular methodological issues:

1. Surveys usually only cover short periods of time so that the dynamic nature of rural energy systems is often not

accounted for. Without providing a historical perspective and acknowledging how the situation has changed in the past, however, it will hardly be possible to foresee how it might be expected to change in the future. Furthermore, surveys tend to ignore the dynamic interactions between elements within the rural energy situation, thereby isolating energy problems from their social context. Rural people, for example, may not separate energy problems from their other problems, thereby making it difficult for the researcher to fully understand the extent of the crisis without firstly having gained a deeper insight into rural life. .

2. In collecting quantitative data many surveys rely on the estimates and memory of the local people without ever cross-checking their answers by physical measurement. In cases where this has been done it was often found that the actual quantity deviated considerably from people's perception thereof. Physical measurement of quantitative data must therefore be taken as an essential part of any assessment of the rural energy crisis.

3. Most surveys are conducted by way of questionnaires, because this is the most economical method. Being able to use a standard questionnaire and employing trained enumerators to conduct the survey it becomes possible to cover a larger, and therefore more representative, sample. However, although being more representative than an in-depth study (which can only be performed on a small sample), questionnaire surveys might considerably limit the understanding of a situation, depending on how open-ended the questionnaire is. A highly-structured questionnaire might miss important elements that would be essential for an objective understanding of the situation. The more open-ended 'anthropological' approach, on the other hand, "seeks to suspend preconceived notions of how a particular system functions" (Barnett et al, 1982: 13) by way of close and prolonged observation of the situation, offering a larger scope of interview and also being more sensitive to qualitative issues. The ideal approach appears to be a compromise between the two extremes of "the more

representative sample that may miss the point" (ibid) and the in-depth study of a small part of the system that "may or may not be typical" (ibid).

4. Although surveys are usually administered by outsiders whose knowledge and experience necessitate their participation in the process, it must be kept in mind that the rural people themselves contribute considerably to the understanding of the situation: they are the ones who are directly affected by the rural energy situation, only they can provide the detailed information on local conditions and on their specific needs. It must be acknowledged, therefore, that "no one group has a monopoly on truth: the views of rural people may not reflect more general national interests, the views of technologists are often biased in favour of one particular gadget (...), the views of social scientists are often based on a false understanding of the technical options and so on" (Barnett et al, 1982: 16).

4.1.1 The survey procedure

Taking account of the above methodological issues as well as practical considerations (limited funds and time) it was decided to conduct the surveys by way of questionnaire, as opposed to in-depth participant observation. Every effort was made to minimise the drawbacks of this type of survey method (narrow scope of interview; insensitivity to qualitative issues; overlooking important elements that would be essential for an objective understanding of the situation, because of a too highly structured questionnaire), while at the same time fully exploiting its advantages (most economical survey method; standard questionnaire; large, and therefore more representative, sample). The two questionnaires were designed in consultation with a sociologist who was familiar with rural energy issues, and with researchers who have had some experience in the field of questionnaire surveys. In addition, the questionnaires that had been used in two

previous rural energy studies in southern Africa (see Eberhard, 1986a; Eberhard and Dickson, 1987) served as a guide to understanding the rationale behind this survey method while at the same time being relevant in content.

With the limitations of questionnaire surveys in mind both questionnaires were designed with much scope for interviewees to express their views and problems: all questions addressing qualitative issues were left open-ended and interviewees were encouraged to talk freely. Furthermore, instead of making use of enumerators, the author conducted both surveys himself with the aid of an experienced translator, thereby avoiding the limitations imposed upon surveys by enumerators (no thorough understanding of the purposes of the survey; low motivation). This procedure proved to be very valuable because of the flexibility that it offered: additional questions could be accommodated in the questionnaires as other issues, that were not thought of before, emerged. Also, when it became apparent that a question was misinterpreted, it was possible to adapt it to the interviewees' perception and so obtain a reliable answer. (Both these shortcomings might have been avoided by testing the questionnaires on a pilot sample and then modifying them before the actual survey.)

In order not to have to interview every single household in Ciskei statistical methods that allow one to make inferences, concerning the whole population, from only a small sample were employed. The size of the sample depends on the required accuracy of the inferences. "In general the larger the sample the more accurate the inferences will be; that is as the size of the sample increases the values calculated from the sample will be nearer to the true population values. However, there is a cost associated with each unit included in the sample and therefore, the accuracy required should be justified by its associated cost." (Pouris, 1988: 9). In determining the sample size for a chosen confidence level and confidence limit, the variability of the characteristic of interest (as it is

expressed by the standard deviation) has to be established. For the survey among unelectrified households, where the main questions to be answered were whether people would prefer electricity above other fuels and whether they could afford this service, the variability of the answer to both questions is 50% (either "yes" or "no"). For the survey among electrified households, where the characteristics of interest are the amount of money spent on electricity (more, less, or the same as without electricity) and the quality of life (better, worse, or the same as without electricity) the variability of the answer, in both cases, is 33%. Once the variability is known the confidence limit and the confidence level are set according to the required accuracy of the inferences. The sample size is then given by the formula (adapted from Pouris, 1987: 9)

$$n = \left[\frac{Z * S}{C} \right]^2$$

where n is the sample size

Z is the standard error unit measure for the desired confidence level, which gives the probability of finding the real population value (commonly used confidence levels are 95% and 99%, with Z-values of 1.96 and 2.58 respectively)

S is the standard deviation of the characteristic of interest in the sample

C is the confidence limit, which gives the distance from the sample mean (in either direction) within which the population value can be expected to be found.

For the survey among unelectrified households, with a variability of the characteristic of interest of 50% ($S = 0.5$) and a chosen confidence limit of 7% ($C = 0.07$) at 95% confidence level ($Z = 1.96$), the sample size was fixed at 200 which appeared to be manageable in terms of time and funds available. For the survey among electrified

households, which had less importance for the study, the sample size was fixed at 90 (with $S = 33\%$, $Z = 1.96$ and $C = 0.07$).

Random sampling was used to draw the samples from their respective frames (the set of all unelectrified households and the set of all electrified households within the borders of Ciskei, respectively): a unique identifying number is allocated to each element in a sampling frame and those elements whose identifying number appears in a previously selected part of a random number table are included in the sample.

4.2 THE SURVEY AMONG UNELECTRIFIED HOUSEHOLDS

In this section the results of the survey among unelectrified households are presented. The aim of this survey, which was conducted during September 1987, was to assess people's attitudes towards electrification, with the focus on the following three questions:

1. Would they prefer electricity (for domestic consumption) above other fuels?
2. Could they afford electricity?
3. How important is the electrification of underdeveloped areas, from their point of view, compared to other development needs?

The frame from which the survey sample (of size 200) was drawn comprised of all unelectrified households within Ciskei. However, since it was not possible to identify individual elements in this set beforehand, subframes, in the form of settlements, were randomly selected from the complete set of settlements within Ciskei. This approach had the advantage of giving a fairly even spread of sample across Ciskei (Figure 4). It was decided to differentiate between rural villages and towns/townships to see if and how

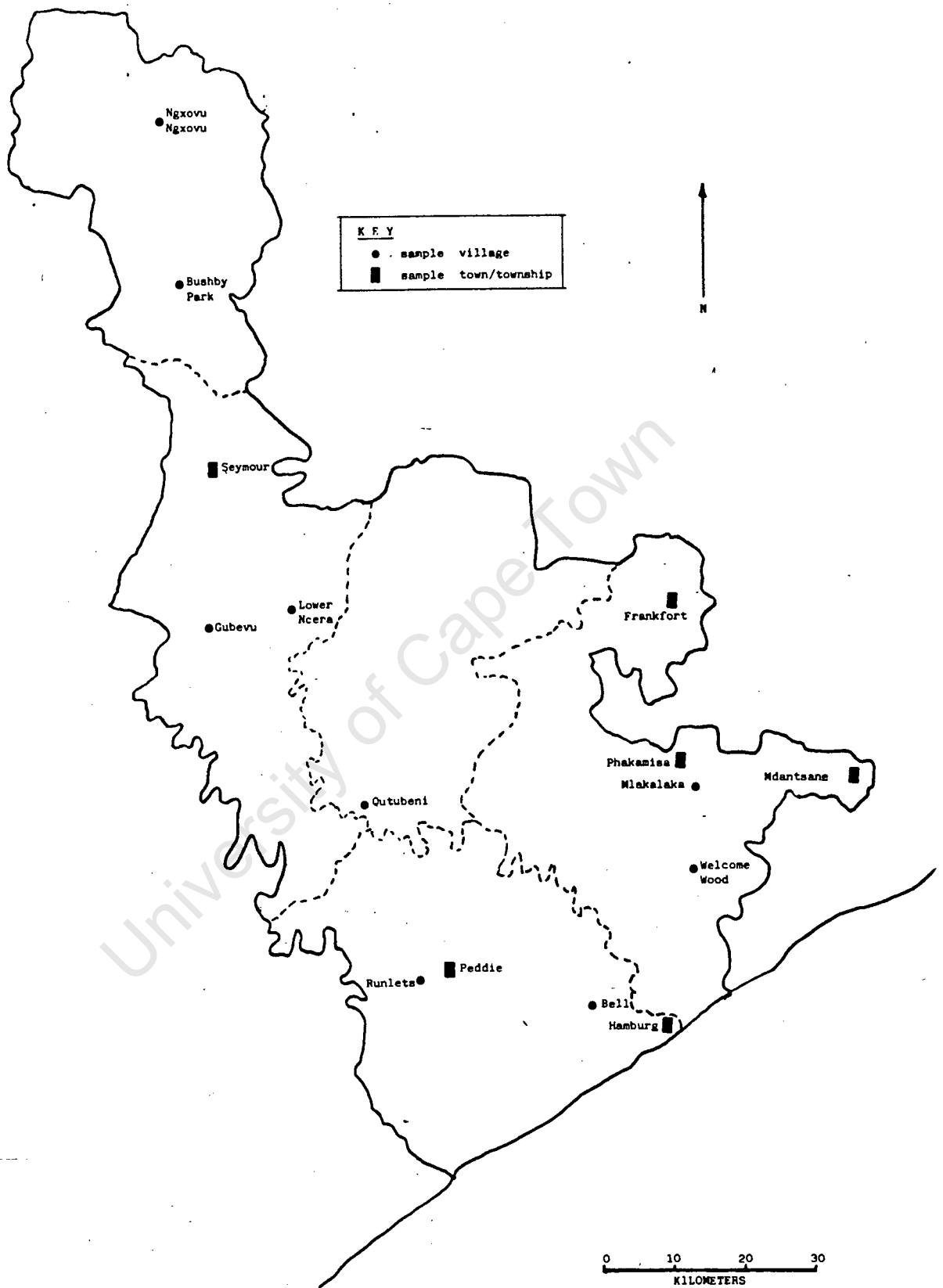


FIGURE 4: THE SAMPLE VILLAGES AND TOWNS/TOWNSHIPS SELECTED FOR THE SURVEY AMONG UNELECTRIFIED HOUSEHOLDS

the responses differ between these two categories. With an equal number of interviews (100) to be conducted in each of the categories, samples of nine villages (out of a total of 469) and six towns/townships (out of a total of 17) were drawn. The sample households to be interviewed in each of these 15 subframes were randomly selected on site: ten households per sample village and twenty unelectrified households per sample town/township (with the exception of Frankfort where there were only about ten unelectrified households).

4.2.1 The questionnaire

The questionnaire (see Appendix A) is divided into four sections. Section 1 deals with household occupancy and employment, and Section 2 deals with household income. Section 3 is subdivided into four parts, respectively dealing with the fuels currently being used by the household, the major problems experienced with these fuels, whether these fuels are considered to be expensive or not, and the household's monthly expenditure on these fuels. Section 4, consisting of ten questions, deals with the issue of electrification:

- a) What percentage of the population living in unelectrified houses has already had some experience with electricity? The answer to this question can be used to assess the need for an educational program about electricity usage.
- b) Would people want to have their houses connected to the grid if electricity was introduced to the village or area? The aim of this question is to find out how people feel about electricity, and whether they regard electricity as an improvement on their current situation.

c) What are the reasons for not wanting electricity (for those who said they would not want their houses to be connected to the grid)? This question is useful in that it might give an indication of what people know about electricity and its use.

d) Would people be prepared to pay the high cost for housewiring and connection to the grid? It might be argued that people who answer this question with "yes" believe that the benefits of electricity offset this initial high cost.

e) Would people use electricity for basic domestic purposes (lighting, cooking, heating)?

f) What else would they like to use electricity for? The answer to this question might give an indication of how aware people are of the versatility of electricity.

g) Do people think that they can afford to purchase the necessary electrical appliances? The answer to this question might also show how aware people are of the cost of appliances.

h) What do people regard as the major benefits of electricity? Only after the first few questionnaires had been completed it was found necessary to split this question into two, the one asking about the major benefits that electricity would have for the household itself, and the other being concerned with the benefits of electrification for the whole community.

i) What do people regard as the disadvantages of electrification and electricity, if any? This question allows those people who said that they did not want electricity to elaborate on their reasons.

j) What, to the people, are more important issues than electrification? The answer to this question gives planners an indication of what people's priorities are as regards development.

4.2.2 Data analysis

Detailed summaries of the survey results for both the rural villages and the towns/townships are attached as Appendix B.

Occupancy, employment, income:

Rural households comprise of more members than urban households (on average 7.3 and 6.9 respectively). The average number of children per rural household is about the same as the number of adults (3.6 and 3.7 respectively), while in urban areas adults slightly outnumber children (on average 3.6 and 3.2 respectively).

In the rural villages the average number of people that are employed is 1.7 per household of which 47% are employed locally and 53% are migrants, while in the towns an average of two people per household are employed of which 60% work locally and 40% are migrants. The average total monthly income per household in the rural areas was found to be R399 (R67 per person) while the corresponding figure for the towns was R452 (R89 per person). The highest contribution towards household income, both in the rural villages (63%) and in the towns (75%), comes from people who are employed locally. The money sent home by migrants contributes, on average, only 19% to the rural household income and 15% to the urban household income while pensions contribute, on average, 16% and 7% respectively. In terms of actual amounts the respective contribution towards average household income from these three income groups, in rural villages and towns respectively, are R410/month and R444/month, R141/month and R163/month, and R119/month and R95/month (these figures are average values for only those households that have the specific source of income). The average contribution from the sale of crops and livestock and other sources (like casual work, sewing, etc.) is negligible in both cases (0.1% and 1.5% respectively for rural villages, 0.2% and 3.8% respectively for towns), but

to some individual households these are the only sources of income.

It should be noted that the average household income in villages close to urban areas is generally higher than that in remote rural areas. This can be attributed to the fact that many people living in the not so remote villages are employed in the towns and commute to their places of work every day. Also, in the more industrialised towns the average household income is higher than in small urban areas.

Currently used fuels:

The most commonly used fuel, both among rural and urban households, is paraffin. This fuel is used by 99% of rural households and 98% of urban households, while firewood is used by 86% and 63% respectively. With the use of firewood still being prominent in rural areas, rural people experience the fuelwood scarcity as a considerable problem (31% of rural firewood users voiced this complaint). The long distances that they have to travel to collect wood does not rank so high as a problem (only 22% mentioned this), probably because it has become part of rural life. Urban firewood users, on the other hand, list this as their major complaint (20%), and since firewood is not freely available in close proximity to the urban areas most users have to resort to buying wood or change to other commercially available, but more expensive, fuels like paraffin and gas. The fact that they have to buy wood is listed as a problem by 11% of urban firewood users and 8% of rural firewood users. Around some urban areas (eg. Peddie) it is prohibited to collect firewood: this is a problem for 8% of urban firewood users. The problem that firewood is often green, as was mentioned by a few people, is an indication of the severe firewood scarcity in some areas. The major problem that was experienced with the use of firewood is smoke (mentioned by 5% of rural users and 7% of urban users).

For urban paraffin consumers the major problems are that it is smoky (30%), smelly (3%), dirty or messy (7%), and that the fumes burn the eyes (5%). For rural consumers a major problem is that paraffin is not always readily available at the nearest shop (8%).

Other fuels that are being used for cooking and heating are listed in the table below:

fuel	% of households	
	rural	urban
gas	10	20
coal	3	1
dung	52	19
crop residues	14	4

Gas and coal are not always readily available, even in the towns, while dung is scarce in the rural areas because it is used as building material and in the urban areas because of a lack of livestock. Crop residues are only available after harvesting. Candles are widely used in both rural villages and towns (on average by approximately 65% of households in both categories). 88% of rural households and 84% of urban households make use of batteries other than car batteries to power lamps, radios and HiFis. Television sets, and in some cases also HiFis, are usually powered by car batteries which have to be recharged every now and then. The proportion of households that use car batteries for these purposes (10% and 14% respectively for rural and urban households) might give an indication of how many households own a television set. Petrol and diesel generators are only used in some rare cases, on average by 4% and 1% of rural households respectively, and by 2% and 1% of urban households respectively.

It is interesting to note that a considerable number of households complain that they have to buy their fuel. Some years ago it was natural for these people to obtain

virtually all their energy supplies free of charge in the form of firewood which they were able to collect in the immediate surroundings of their homesteads. But with the population increase and the confinement of the majority of black South Africans to small homeland areas, the traditional gathering of firewood has resulted in the rapid denudation of natural woodland, and has forced people into the money economy. It is therefore small wonder that 93% of rural households and 89% of urban households consider the fuels they currently use as being expensive. A rural household spends, on average, R39/month on fuel while the corresponding figure for an urban household was R35/month. Expressed as a percentage of monthly household income, the mean value of the average fuel expenditures for the individual villages is 18% while that for towns is 12%. In both cases the expenditure on paraffin, which is being used for cooking, water heating and lighting, makes up for almost half (on average R14/month and R15/month respectively) of the total fuel expenditure. Rural households spend more money on firewood than urban households (on average R12/month and R9/month respectively). Both urban and rural households spend about R8 per month on batteries (excluding car batteries). Gas, petrol and diesel (the latter two being used as generator fuels) are the most expensive fuels, and households that use these fuels generally have a much higher fuel bill than households that use only cheaper fuels like paraffin and wood. In the rural areas generators are more common than in the towns, which partly accounts for the higher average fuel expenditure in the villages.

Electricity:

The survey results show that the majority of people in Ciskei are in favour of electrification: 79% of unelectrified rural households and 91% of unelectrified urban households said that they would like to use electricity. It was noted, however, that in only 60% and 71% of these households respectively, at least one person claimed to know how to use electricity. It might be

concluded that those other 20% who said they want electricity but do not know how to use it have got some idea of its benefits. 64% of the rural households and 77% of the urban households that are in favour of electrification are prepared to pay at least R500 for housewiring and connection to the grid (the figure of R500 was chosen to examine whether people would be prepared to pay a significant amount towards the initial cost of electrification).

Those interviewees who said that they do not want electricity gave a number of reasons, the main one, in both rural and urban areas, being that the expenses associated with electricity (installation costs, costs of appliances, repairs to damaged appliances, and electricity bills) would be too high. About three times as many rural interviewees as urban interviewees said they did not want electricity because they have never used it before, and because they are afraid of it ("electricity is dangerous"). This indicates that people in rural areas are not as familiar with electricity as urban people. Some rural people, but no urban people, gave as their reason that they are too old, while a considerable number of urban people, but no rural people, were against electricity because they have no proper house.

In both the rural villages and the towns the overwhelming majority said that they would like to use electricity for lighting, cooking and baking, water heating, and space heating in winter. Other popular electrical appliances are an iron, a radio/HiFi, a television set, and a refrigerator. Some people also said that they would like to use electrical workshop appliances (mainly welders).

Most interviewees seemed to be aware of the relatively high costs of electrical appliances, but despite this the majority (60% of rural households and 68% of urban households that are in favour of electrification) said that they would purchase the wanted appliances. However, people usually stressed that they could not afford to buy all appliances at once, but that these would be purchased one

after the other as the financial situation of the household allowed.

For rural people the most important benefit of electricity is that it is quick (listed by 49% of rural interviewees who are in favour of electrification): you just have to flick a switch and it can boil a cup of tea in no time at all compared to a woodstove. 35% like electricity because it is easy to use, while only 24% think that electricity is a more economical source of energy than the fuels that are currently being used. In the urban areas, on the other hand, many more people (37% of urban electricity enthusiasts) believe that electricity is a cheaper source of energy, but that it is quick and that it is easy to use also ranked highest (43% and 39% respectively). To a considerable number of interviewees, both rural and urban, the benefits of electricity furthermore include that

- * electricity is clean and does not smoke;
- * an electrified house appears neater than a house where paraffin and firewood are the main energy sources;
- * electricity is versatile in its application;
- * electric lights are brighter than candles and paraffin lamps; and
- * with electricity all energy problems will be solved.

The greatest benefit that people think electricity would have for the whole community is a reduced crime rate as a result of lighting (streetlights in particular) at night. Lights are also important because they give the village or suburb a facelift at night.

Electricity is believed to make rural and urban life easier and even to improve the living standard of the many people who are still without it. Another major benefit for the whole community would be that all energy problems would be resolved by introducing electricity. In the rural areas people furthermore argued that electricity would make evening schools possible, and that it would create much-

needed job opportunities. In one particular village, where recently two people were struck by lightning, the electricity lines are regarded as beneficial to the village because these could serve as lightning conductors.

The greatest disadvantage that rural people see in electricity is the possibility of children being electrocuted while handling electrical cables and appliances. In the urban areas this is also listed as a disadvantage, but urban people are much more concerned about the maintenance costs (eg. for the repair of appliances) that electricity brings with it.

Almost every interviewee (91% of urban interviewees and 94% of rural interviewees) thought that there are at present other issues that need more urgent attention than electrification. In the rural areas the most pressing need is for a decent water supply, i.e. every household being supplied with piped water, but the general response also revealed a need for other basic services like better education, healthcare facilities, sanitation, public transport, agricultural development, and churches. In urban areas, on the other hand, people think that better education, more and better equipped schools, more employment opportunities, and higher salaries and pensions are most important. Other popular issues in urban areas include better housing, healthcare facilities, and sanitation.

4.2.3 Conclusions

Five main conclusions can be drawn.

1. From the survey results it is evident that the overwhelming majority of the people living in unelectrified rural and urban areas in Ciskei would prefer electricity as a source of energy above other currently used fuels.

2. The current expenditure on fuel in both rural and urban areas (about R35 per month) is comparable to the cost of electricity for the same purposes.

3. The majority of households said that they would be prepared to pay the relatively high costs (of about R500) for housewiring and connection to the grid, which indicates a strong belief in the benefits of electricity. It is, however, likely that for many households the payment of this amount would have to be spread over several months.

4. Most households indicated that they would make full use of electricity (this should be taken into account when making ADMD estimates), but that the purchase of the necessary appliances would have to be spread over time.

5. Electrification does not enjoy top priority among the majority of households. Rural people emphasised an urgent need for more basic services, mainly a decent water supply, while in the towns people are more concerned about the low standard of education, the lack of employment opportunities, low salaries and pensions, and the poor quality of housing.

4.3 THE SURVEY AMONG ELECTRIFIED HOUSEHOLDS

The results of the survey among electrified households are presented in this section. This survey was conducted during April 1988, with the aim of studying the effects of electrification on developing communities in Ciskei. The results complement those of the survey among unelectrified households in Ciskei (Section 4.2) to form an overall picture of people's views on, and perceptions of, electricity.

The two key questions that were addressed by the survey were:

1. How has electricity affected people's lives?
2. How has electricity affected the financial situation of households?

With the aim of capturing changes in the household energy situation which have occurred as a result of electrification, the frame for the survey was to comprise of all those electrified households in Ciskei, which have obtained electricity only recently (within the last three years or so), either by connecting up to the grid or by moving into a previously electrified house from an unelectrified environment. However, as such households could not easily be identified beforehand, the survey sample had to be drawn from all electrified households in Ciskei, irrespective of how long electricity has been available to them. Answers that depend on the memory of the people, like the expenditure on fuel before electricity was available, will therefore have to be treated with caution in cases where a household has had access to the grid for a long time.

A similar approach as for the previous survey was adopted in that eight of the 14 towns/townships that were reticulated at the time were randomly selected as subframes from which the sample households were to be drawn (see Figure 5 for the sample towns/townships). Ten randomly selected households in each of the sample towns/townships were to be interviewed, except for Mdantsane where 20 interviews were to be conducted. In Mdantsane, however, interviewees were found to be very suspicious of the survey and wary to answer questions about their household. In the light of the tense atmosphere it was decided to discontinue the survey in this township; instead, some useful electricity consumption data was obtained from the town manager. Ten more interviews were then conducted in Zwelitsha. In the data analysis it was decided to differentiate between towns and townships to see if and how the responses differ between these two categories.

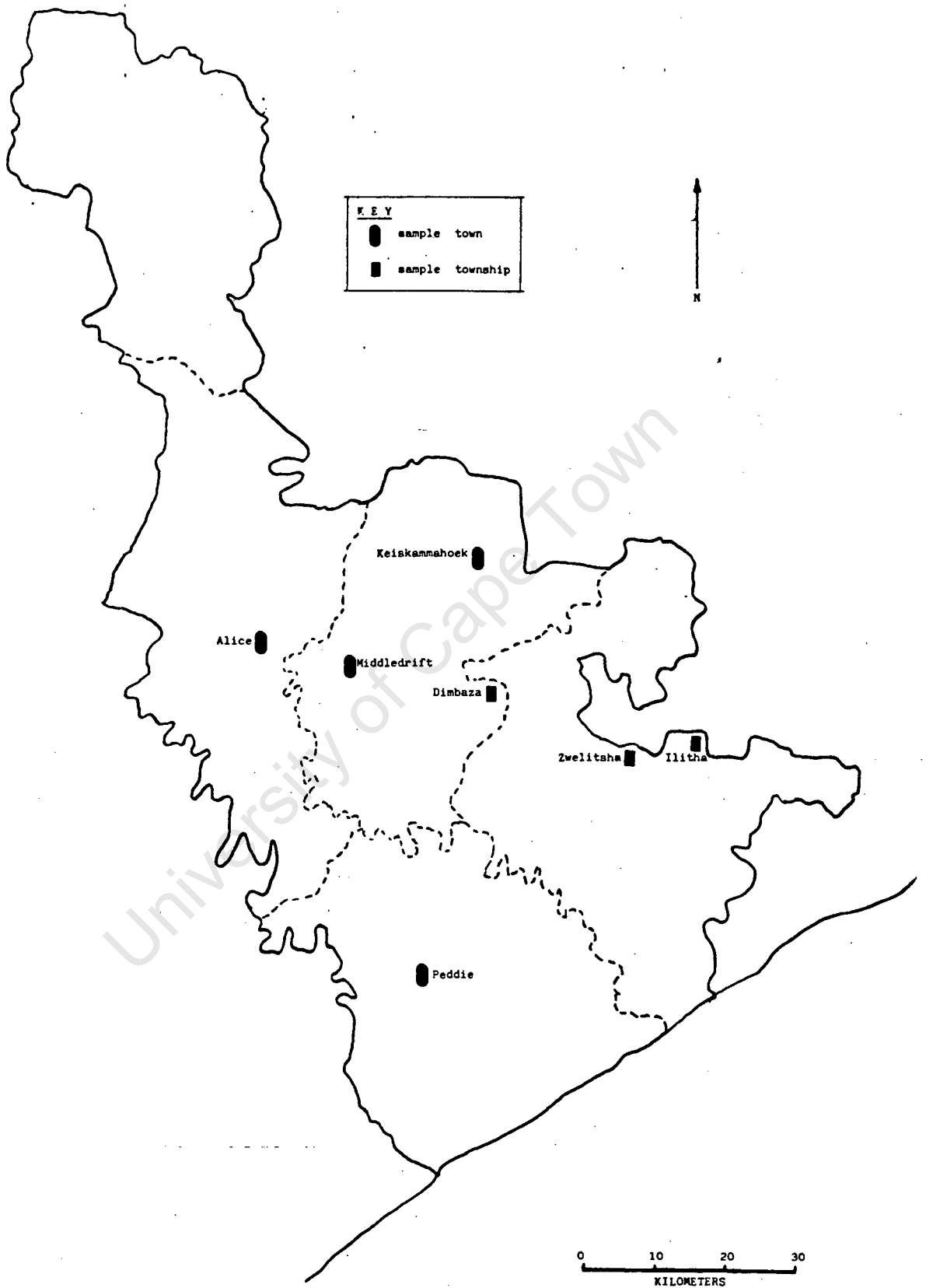


FIGURE 5: THE SAMPLE TOWNS/TOWNSHIPS SELECTED FOR THE SURVEY AMONG ELECTRIFIED HOUSEHOLDS

4.3.1 The questionnaire

The questionnaire (see Appendix A) is divided into three sections. Section 1 deals with household occupancy and employment, and Section 2 deals with household income. Section 3 consists of thirteen questions about the use of electricity in the household:

- a) How long has electricity been available?
- b) Which other fuels are used in addition to electricity? As people usually mentioned what these fuels are used for, the answer to this question gives an indication of the extent to which electricity is used.
- c) What is the monthly household expenditure on electricity and on the other fuels being used?
- d) Before electricity was available, was the total monthly fuel expenditure more, less or approximately the same as now?
- e) Does the household use any of the following electrical appliances: an electric hotplate, an electric stove (with oven), a hotwater cylinder (geyser)? The extent to which these appliances, which consume a considerable amount of electricity, are being used must be taken into account when making ADMD estimates for future electrification projects.
- f) What other electrical appliances are being used?
- g) What other electrical appliances does the household intend to acquire in the future? This question was intended mainly for households which at present make only very limited use of electricity.
- h) At what times of the day does the household use electricity for cooking? And for other electrical appliances? For how many hours per day does the

household use lights? The answers to these questions are important in determining the load factor of an electrical system.

- i) Has electricity benefited the household?
- j) What do people regard as the major advantages of electricity?
- k) What do people regard as the disadvantages of electricity?
- l) What effect did electrification have on people's lifestyle? Here people are asked to compare their present lifestyle with that before electricity was available.
- m) Are traditional practices negatively affected by the household use of electricity?

4.3.2 Data analysis

Detailed summaries of the survey results for both the towns and the townships are attached as Appendix C. In the data analysis reference will often be made to the results of the survey among unelectrified households (Section 4.2).

The results for the individual survey towns showed that there is a marked difference in the constitution of electrified households between the formerly 'white' South African towns (Alice, Peddie, Keiskammahoek and Middledrift - in this report referred to as "towns") and the so-called townships, meaning mass dormitory suburbs on the periphery of cities or towns (Zwelitsha, Ilitha and Dimbaza - in this report referred to as "townships"). This difference is most apparent in the household income figures (average total monthly incomes of R2508 and R1122 respectively), but also in adult to child ratios, employment figures and the use of

electrical appliances (only 48% of the interviewed households in the towns use a stove with oven, while 70% of those in the townships use one). In Alice, a small university town and former capital of Ciskei, virtually all electrified houses are occupied by either academics from the university, business people, or government officials. The majority of houses were already electrified before Ciskei became 'independent' and have merely been taken over from the former 'white' occupants. In Keiskammahoek the situation is similar.

In Peddie and Middeldrift it was found that many electrified houses are merely used for accommodating government officials (policemen, agricultural officers, etc.) while on duty; off duty these people live with their families in the villages. It was also found that some of the larger electrified houses are occupied by a number of locally employed single people who share the house but not domestic tasks like cooking. Each tenant has his/her own electrical appliances and the electricity bill is thus accordingly high. In some cases landlords charge lodgers a fixed amount for electricity consumption. This charge is usually significantly higher than the actual consumption would cost, as lodgers in most cases only use lights and maybe a few minor electrical appliances like an iron, a kettle or a television set. People who live in these types of household do not regard them as their homes, but rather as a temporary means of accommodation. The use of electrical appliances is therefore limited.

The data analysis focuses on households in the townships, for two reasons. Firstly, most of these households are regarded as homes, with energy consumption patterns similar to those observed among unelectrified households. Secondly, the average number of years that electricity has been available to them is only 4.4 as opposed to 6.6 in the towns; township people's perceptions of changes which have occurred as a result of electrification might therefore be more trustworthy.

Occupancy, employment and income:

The argument that many electrified houses in the towns are accommodating mainly employed people rather than whole families is based on the following findings. While the average number of people per electrified household in these towns is about the same as in the townships (6.8 and 6.9 respectively), the proportion of children in the latter category far outweighs that in the former (on average 4.0 and 2.4 children per household respectively). In the townships an average of only 1.8 people per household are employed, while in the towns this figure is 3.1. It was furthermore found that the average income earned by locally employed people in the towns is almost twice as high as in the townships (R1043/month and R617/month respectively). However, although in both cases locally employed people are the main contributors to overall household income, the average total household income is more than twice as high in the towns as in the townships (R2508/month and R1122/month respectively), this being attributable to the difference in employment figures. Average per capita income is R407/month in the towns and R212/month in the townships.

When comparing the above employment and income figures with corresponding figures from the survey among unelectrified households, it is interesting to note that they differ considerably. The average proportion of migrant workers from unelectrified households is substantial (53% of employed persons from rural villages, and 42% from towns/townships), while among electrified households this figure amounts to only about 4%.

(It should be noted that it is not clear how accurate the migrant labour figures are. Although interviewees were specifically asked to give the number of migrant workers who are members of the household, the answers have to be treated with care as it is a matter of definition of what a migrant worker is and whether he/she is regarded as a member of the household. For the purposes of this analysis migrants are only of interest in so far as the overall household income -

to which migrant labourers usually contribute through remittances - is concerned. Although the huge difference between electrified and unelectrified households is striking, the actual number of migrants per household is not particularly important since these people hardly have any effect on the electricity consumption of a household.)

The finding that the overwhelming majority of employed people from electrified households (about 96%) is employed locally might indicate that these households are more firmly settled than unelectrified households and therefore have an interest in electricity as a means of making life easier and upgrading their standard of living. This argument is supported by the fact that many of these people are business people, shopowners, civil servants, policemen, etc., i.e. people with a secure job.

From the household income figures it appears that people who live in electrified houses are financially far better off than people who do not have access to electricity (average total household incomes of only R452/month for unelectrified urban households and R399/month for unelectrified rural households; respective per capita income values are R89/month and R67/month). Within this context it might be understood why the proportion of migrant labourers per unelectrified household is on average more than ten times higher than per electrified household: because of the high unemployment rate in Ciskei and the low wages, many people - often the main bread winners of families - are forced to seek employment in distant South African towns and cities (eg. on the goldmines of Johannesburg). Ironically, however, the remittances sent home by migrant workers do not significantly improve the financial situation of a household.

Locally employed people from unelectrified households earn much less than those from electrified households (on average about R285/month and over R600/month respectively). This discrepancy is primarily due to the finding that most locally employed people from unelectrified households are

blue collar employees (unskilled and semi-skilled labourers, artisans, truckdrivers, etc.), while many of those from electrified households are white collar employees (being in the government's employ as civil servants, police and agricultural officers, nurses, etc., or running a business).

Fuels used in addition to electricity:

A considerable number of people who live in electrified houses still use other fuels in addition to electricity, paraffin and gas being the most prominent (50% of interviewed households in the towns and 20% of those in the townships use paraffin, while gas is used by 47% and 17% respectively). These fuels are mainly used for cooking, firstly, because many households cannot afford an electric stove and, secondly, as many people put it, "to reduce electricity consumption". Many households also use paraffin for space heating in winter. As power outages seem to occur frequently (a disadvantage that was mentioned by 62% of township households and 38% of town households) many electrified households stock paraffin, candles and gas as a backup fuel; one household even had a petrol generator to supply power during such times.

Fuel expenditure:

The survey figures indicate that electrified households spend on average more than R30/month more on fuel than unelectrified households (respective average fuel expenditure figures are about R72/month and R37/month). In the townships electrified households spend on average R51/month (9% of average monthly household income) on fuel, while electrified households in the towns claim that their average fuel expenditure is as high as R94/month (6% of average monthly household income). The bulk of this expenditure, in both cases, was found to be for electricity consumption: R43/month in the townships and R68/month in

the towns. These are surprisingly high figures when compared to the average electricity expenditure for Mdantsane of R33/month per electrified household (this figure, which is based on the average electricity consumption per household, was obtained from the township's manager). By examining old bills at the township manager's office in Mdantsane, it was found that many households pay only part of the total amount due; the balance is brought forward to the following month's bill. (In Mdantsane electricity consumption, water consumption, service fee, maintenance and rent all appear on the same bill, while in other townships and towns consumers are billed separately for the different services.) Consumers, however, did not seem to be aware of this, suggesting that the bills are not explicit enough. If it is assumed that the situation is similar among the interviewed households, then the unexpectedly high expenditure on electricity might be explained.

On average, 72% of electrified households in the towns and 65% of those in the townships claimed that their fuel expenditure before they had electricity was less (on average R63/month and R39/month respectively, the latter figure being very similar to average fuel expenditure figures among unelectrified households) than it is now.

Electrical appliances:

The most commonly used electrical appliances in the townships are a television set, a HiFi or radio, an iron and an electric stove (with oven). Electric refrigerators, hotplates and heaters are also widely used. In the towns hotplates were found to be more common than electric stoves, the major reason being the different composition of these households as discussed above. Refrigerators and stoves topped the priority list for new electrical appliances to be acquired by township households.

The overwhelming majority of electrified households who use an electric stove or a hotplate cook in the late afternoon or early evening. Other electrical appliances (like an iron, a washing machine, a vacuum cleaner, a heater or a TV) are used as much during the day as in the evening. The demand peak is therefore expected to occur towards evening. Electricity consumers estimate that, on average, they use lights between 3 and 4 hours per day.

Perceptions of electricity:

Every single interviewee thought that electricity benefited the household. Of major importance to the majority of interviewed consumers is the fact that electricity is a quick and clean source of energy. Other important advantages of electricity that were mentioned include that it is easy and convenient to use, that it solves the energy crisis in the underdeveloped areas, and that it gives a brighter light than candles or paraffin lamps. Power outages and that electricity consumption is expensive were the most frequently mentioned disadvantages of electricity. Some people felt that a major drawback of electricity is that "the bill cannot be predicted" and that it is therefore difficult to budget for electricity consumption. Many households, especially in the townships, complained that their electricity bills were fluctuating considerably from one month to the next, although, they claimed, their consumption was relatively constant. Others complained that, although their house was not occupied for some months and therefore no electricity was consumed, their electricity bill was still high.

On average, over 90% of electrified households thought that electricity had made life more comfortable, while about a quarter felt that it had increased their standard of living. Some households even mentioned that they wouldn't like to live without electricity, now that they have access to it. Only a tiny proportion of the interviewed households believed that electricity had a negative effect on the Xhosa

tradition; the majority held the view that electricity did not interfere with their traditional practices.

4.3.3 Conclusions

The results of this survey indicate that households feel that they have greatly benefited from electrification. There exists a firm belief among electrified households that electricity has positively influenced township life in that it has eliminated the hardships associated with the consumption of other fuels.

As expected, the cost of electricity is approximately the same as the monthly fuel expenditure of unelectrified households (about R35/month). However, since electricity bills are generally much higher than the actual cost of consumption (this is mainly due to arrears payments), the majority of electrified households believe that electricity is more expensive than other fuels.

Although many electrified households still use paraffin or gas for cooking and heating, they indicated that they would make full use of electricity if the circumstances allowed them to. The majority of those households that were using major electrical appliances, like a stove (with oven), a hotwater cylinder and/or a washing machine, use these in the late afternoon or early evening hours. The electricity demand peak is therefore expected to occur towards evening. In view of the alleged frequent power outages it appears that substations supplying the townships were designed for a much lower demand.

4.4 SUMMARISING DISCUSSION

The finding that the overwhelming majority of unelectrified households in Ciskei would rather use electricity in the household than any other fuel, if they had the option, must be seen in the context of perceived development priorities: it is important to note that a solution to energy problems is not considered an immediate priority. Most unelectrified households were found to be poor and in need of more basic services. If an electrification programme is to be implemented under these circumstances it should be established whether the perceived priorities are addressed by the adopted development strategy. If not, the electrification programme will most probably not achieve the desired results; also, unelectrified households might be impoverished even more by having to pay for a service they cannot afford. This should be kept in mind in the following discussion.

In this section the energy consumption patterns of both unelectrified and electrified households in Ciskei are broadly summarised and compared. Major trends in people's perceptions of the use of electricity in the household are then discussed.

4.4.1 Domestic energy consumption in Ciskei

Table 4.1 summarises the extent to which the different fuels/sources of energy are used in both unelectrified and electrified areas in Ciskei.

The most widely used fuel among unelectrified households is paraffin. Its popularity can be ascribed to its versatility as a form of energy in the household: it can be used for lighting, cooking and heating. Household appliances using paraffin are readily available at relatively low cost. Even among electrified households it was found that paraffin is widely used by people who do not want to, or who cannot

afford to, buy the necessary electrical appliances. Many electrified households also keep paraffin and candles as back-up fuels for times when the electricity supply is cut off.

**Table 4.1 Fuel usage among unelectrified and electrified house holds in Ciskei
(% of households using each fuel)**

fuel/source of energy	unelectrified		electrified	
	rural	urban	townships	towns
electricity	-	-	100%	100%
firewood	86%	63%	-	18%
paraffin	99%	98%	20%	50%
gas	10%	20%	17%	47%
coal	3%	1%	-	5%
candles	66%	64%	-	4%
car battery	10%	14%	-	-
other batteries	88%	84%	-	-
dung	52%	19%	-	-
crop residues	14%	4%	-	-
petrol } for	4%	2%	-	3%
diesel } genset	1%	1%	-	-

Rural households still largely depend on firewood for heating and cooking. The use of wood by rapidly increasing numbers of people, however, has reduced the natural woodland so dramatically that in many areas firewood is not freely available anymore and has become a commercial fuel. Having been forced into the money economy, many households in such areas have opted for the more efficient paraffin. Firewood is an important fuel in traditional cooking. During traditional festivities even electrified households make use of this fuel.

The most widely used fuels among electrified households, besides electricity, are paraffin and gas. These fuels are mainly used for cooking and water heating. Other fuels like firewood, candles and batteries are rarely used. Among unelectrified households candles are a popular means of lighting and batteries are widely used to power torches, radios, HiFis and television sets. While poor rural households frequently use dung and crop residues as energy sources, many wealthier households use gas for cooking and water heating and some people even own and use petrol or diesel generators to supply electricity on special

occasions. Very few households use coal as it is not available in most areas.

All electrified households use electricity for lighting and most own and use a number of small power electrical appliances like an iron, a radio/HiFi and a television set. The use of electric stoves is more widespread than might have been expected, particularly in the townships. People are generally aware that electric stoves and geysers consume a lot of electricity and many households, in an attempt to reduce their electricity bills, have abandoned these appliances to (once again) use paraffin or gas, which they believe is cheaper than electricity, for cooking and water heating. This step backwards is a very important issue that should be addressed by the protagonists of electrification. However, the fact that a number of households already make full use of electricity, together with the intention of others to increase their use of electricity (by acquiring more electrical appliances when their financial situation allows them to), gives a strong indication that electricity consumption levels in these areas will, in a few years' time, not differ much from those in more affluent areas. Unelectrified households also expressed the desire to make full use of electricity once it is made available, but an increase in demand for domestic electricity in underdeveloped areas can be expected to be a very gradual process as most households could not afford the necessary appliances all at once. The demand peak for domestic electricity in Ciskei can be expected to occur in the late afternoon/early evening hours when people return from work and meals are cooked and water is heated.

4.4.2 Major trends in people's perceptions of the use of electricity in the household

In the unelectrified areas of Ciskei there appears to be a strong belief in the advantages of electricity over other household fuels. Even among electrified households, where electricity is generally regarded as an expensive source of

energy to use in the household, its benefits, particularly in terms of convenience and neatness/cleanliness, are greatly appreciated. People's willingness (in unelectrified areas) to make a relatively high payment towards the initial cost of housewiring and connection to the grid demonstrates their commitment to the ideal of having access to electricity. Few households, however, would immediately enjoy the full benefits of this source of energy as the majority could not afford the necessary electrical appliances. Among electrified households it was found that many still only use very few electrical appliances.

The surveys showed that electrified households spend much more money on fuel than unelectrified households; even their expenditure on electricity alone is higher than unelectrified households' total fuel expenditure. It was established, however, that the cost of domestic electricity consumption can be expected to be of the same order as the current average fuel expenditure by unelectrified households (about R35/month). According to the town manager of Mdantsane electricity bills do not necessarily reflect the actual monthly cost of consumption as arrears payments might appear on the bill. Another widespread problem that might partly account for the high bills is that of unreliable meterreaders who estimate the consumption instead of reading the meters. Consumers don't know this. They associate the high bills with a high unit cost of electricity and are thus bound to perceive electricity as an expensive source of energy. While the fault partly lies with the authorities (eg. unreliable meterreaders and unclear billing), this negative perception among electrified households is to a great extent the result of a lack of consumer information and education. People need to be made aware of how best to take full advantage of electricity. This could be achieved, as the National Rural Electric Cooperative Association recommends (NRECA, 1988: 26), by "outreach programs using agents who are broadly knowledgeable in the technical, economic and financial aspects of electricity use" in underdeveloped areas, as part of a rural extension service for example.

A major concern among electrified households is the difficulty of budgeting for electricity consumption: a household has to pay for the amount of electricity that it consumed without knowing how much it is consuming at the time. Prepayment meters might be a way of circumventing this problem; this will also make it possible for people to understand what electricity consumption really costs. Apart from allowing consumers to budget for their consumption, prepayment meters have the additional advantage of making meterreading and billing of consumers redundant.

Comparing unelectrified and electrified households' perceptions of the benefits of electricity (summarised in Table 4.2), it is interesting to note that the trends are very similar. Of major importance to both is the fact that electricity is a quick and clean source of energy that is easy and convenient to use.

Table 4.2 Major benefits of electricity as perceived by unelectrified and electrified households respectively

benefit	unelectrified		electrified	
	rural	urban	townships	towns
economical	24%	37%	35%	17%
cheaper appliances	1%	3%	-	-
clean/no smoke	19%	36%	70%	43%
neat	7%	11%	60%	43%
quick	49%	43%	85%	70%
safe/healthy	1%	2%	7%	14%
versatile	15%	8%	27%	29%
easy to use/convenient	35%	39%	37%	55%
bright light	23%	22%	25%	39%
no energy problems	23%	19%	30%	41%
safety (less crime)	42%	27%	-	8%

Perceptions of the disadvantages of electricity, however, differ between the two (see Table 4.3). Unelectrified households only seem to be aware of the obvious danger aspect of electricity, while electrified households are more concerned about use-related aspects of electricity. The most common complaint of electrified households, especially in the townships, is that of frequent power outages. This

is a shortcoming of the electrical system, however, and not an inherent disadvantage of electricity like the other complaints. The Department of Public Works in Bisho commented on this problem by saying that the demand for electricity is increasing at such a rate that it already exceeds the supply capacity; during peak hours parts of an affected township are therefore blacked out on a rotating basis.

Table 4.3 Disadvantages of electricity as perceived by unelectrified and electrified households respectively

disadvantage	unelectrified		electrified	
	rural	urban	townships	towns
electrocution	8%	3%	3%	36%
child hazard	10%	7%	3%	19%
expensive energy	-	-	27%	28%
expenses/repairs	-	8%	10%	12%
power cuts	-	-	62%	38%
budgeting difficult	-	-	2%	5%
none	82%	82%	15%	26%

Nearly all electrified households said that they live a more comfortable life, now that they have access to electricity. Some households also believed that access to electricity has increased their standard of living, while only very few thought that electricity interferes with traditional practices. Interestingly, unelectrified households seldom thought in terms of such abstract concepts as quality of life.

Electrification does not rank very high among the priorities for a better life of people living in unelectrified areas. Almost all unelectrified households believed that other issues - most importantly a clean water supply in rural areas and better schools and a better education in urban areas - require more urgent attention in the development of these areas (refer to Table 4.4).

Table 4.4 Perceived development priorities in unelectrified areas of Ciskei

service	unelectrified	
	rural	urban
clean water supply	64%	40%
better education and schools	61%	55%
employment opportunities	38%	39%
higher salaries and pensions	17%	24%
healthcare facilities	17%	3%
agricultural development	16%	2%
transport/better roads	9%	3%
better housing	2%	8%
churches/cemeteries	11%	1%
toilets/sanitation	4%	7%

CHAPTER 5

THE COST OF ELECTRIFICATION IN CISKEI

This chapter provides an indication of the capital costs involved in an electrification programme (domestic load only) covering the unelectrified rural areas of Ciskei. The aim is to present a realistic cost estimate, approaching an upper bound rather than an average value, for a suitable distribution system, i.e. a figure that planners and developers can work to with a high degree of confidence. If it is found that electrification is viable at this upper bound then a strong case exists for the implementation of such a programme. Economic viability alone, however, does not justify a development strategy. It is therefore necessary to place electrification in the context of regional development priorities in order to determine its contribution to general infrastructural development.

In this cost estimate only the costs of electricity distribution and reticulation are considered. It is expected that the bulk supply authority (Eskom) would be prepared to make bulk electricity available to Ciskei on the same terms as for all other bulk customers. This means that electricity generation and transmission costs, including the costs of high voltage lines and major substations, would have to be met by the bulk supply authority. This study thus focuses on the extent of additional medium voltage (22kV) distribution and low voltage (380V) reticulation network required to make electricity available to every single household in Ciskei. The material and construction costs of this complete distribution system are independent of the number of households that would subsequently decide to become consumers (ignoring the expansion of settlements). (The general term "settlement" refers to all three types of settlement otherwise denoted as village, informal settlement or urban area).

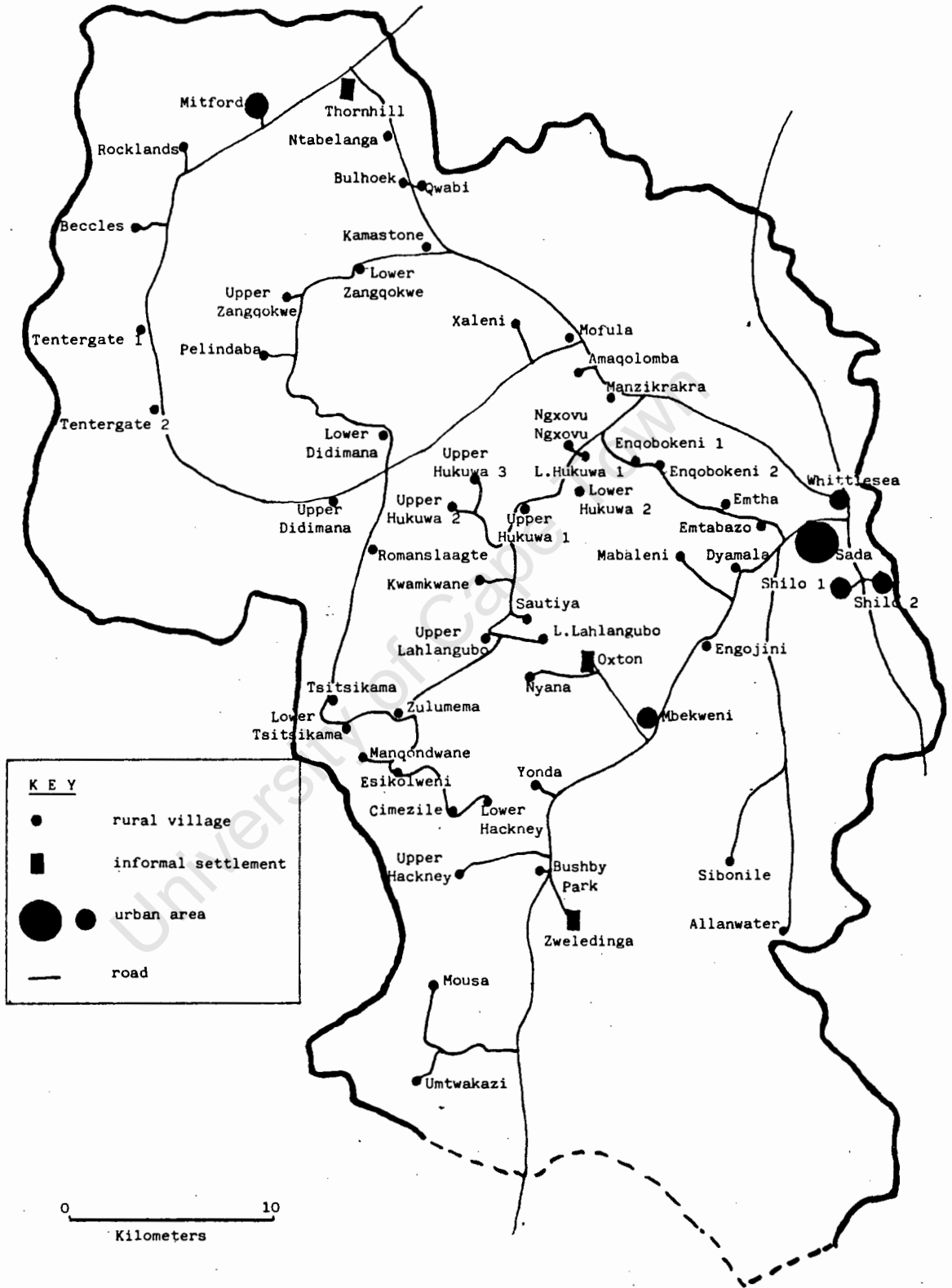


FIGURE 6: HEWU DISTRICT SHOWING ALL 59 SETTLEMENTS

The process of estimating the costs of the distribution system involves two stages. In the design stage the individual networks that make up the system are designed and their physical requirements are determined; in the costing stage a cost is put to those physical requirements. There are many ways of designing electrical distribution and reticulation networks. However, since it would be difficult to investigate the various strategies in detail from a hypothetical position and since optimisation is not the purpose of this study, only one design strategy has been presented here. The choice of strategy, which was ultimately limited by the information available, is the result of discussions held with a number of electrical consultants about electrification methods.

The overall costs of an electrical system are difficult to fix, because prices of materials vary from supplier to supplier and contractors' costs of construction fluctuate depending on supply and demand. In order to accommodate such economic factors an upper bound cost is estimated. All assumptions have been stated and the design method has been detailed so that the overall costs can easily be recalculated if it is found that material prices and construction costs differ considerably from the ones presented here.

The Hewu district in northern Ciskei was chosen as the study area for the cost estimate (see Figure 6). This area is of particular relevance because it is almost unelectrified. Of the district's 59 settlements (six urban areas, three informal settlements and fifty rural villages) only Sada and Whittlesea have so far been provided with an electrical infrastructure. These two urban areas have been assumed fully reticulated and were thus excluded from the cost estimate. According to the official 1984 population and housing figures approximately 53 000 people live in 22 000 unelectrified residential structures in the Hewu district (Table 5.1). Settlement patterns observed by the author in rural areas of Ciskei indicated that village households, in general, occupy more than one residential structure.

Informal settlements and urban areas, on the other hand, are dominated by single structure housing units.

Assuming an average of two residential structures per village household, but only one residential structure per household in informal settlements and urban areas, the number of households (erven) to be electrified is 15 401. The electricity distribution system for the Hewu district has been designed for 15 688 erven (because of the method of design). With an assumed design ADMD (after diversity maximum demand) of 2kVA per household the major substation at Sada/Whittlesea should have a supply capacity of approximately 31MVA for the district's domestic load alone. (ADMD is a measure of the maximum demand of an individual consumer as part of a group of consumers, taking into account the fact that the individual maximum demands will not occur all at the same time. It is defined as the consumer's maximum demand divided by a diversity factor which is the ratio of the sum of individual consumer maximum demands to the total maximum demand of the group of consumers at a specific moment. Typical diversity factors and ADMDs are given in the Department of Community Development's "guidelines" (1983: G5)).

The cost of electrification, in terms of capital costs per household, in other unelectrified areas of Ciskei can be expected to be lower than in the Hewu district, firstly, because of existing electrical infrastructure, particularly medium voltage distribution line, in the eastern and central regions of Ciskei (refer to Chapter 3) and, secondly, because of a higher population density in southern and central Ciskei. In the Hewu district the population density is 45 people/km² (Sada and Whittlesea excluded), while that in the rest of unelectrified (rural) Ciskei is approximately 72 people/km² (DBSA, 1985: 3).

Table 5.1 a) Number of erven to be electrified in the Hewu district (based on the 1984 [1] population and housing distribution)

urban areas [*], informal settlements [#], and rural villages	derived population	number of structures [2]	number of erven to be electrified
Thornhill [#]	12 482	3 516	3 516
Oxton [#]	5 020	1 414	1 414
Mitford [*][3]	3 995	2 200	2 200
Mbekweni [*]	1 478	621	621
Zweledinga [#]	1 023	430	430
Shilo 1 [*]	469	177	177
Shilo 2 [*]	888	335	335
Tentergate 1	5 125	2 153	1 077
Lower Didimana	1 129	570	285
Sibonile	704	296	148
Upper Hackney	1 195	297	149
Pelindaba	1 683	930	465
Rocklands	1 915	805	403
Cimezile	563	311	156
Tentergate 2	1 305	548	274
Yonda	691	310	155
Kamastone	1 028	420	210
Mousa	673	372	186
Bulhoek	304	168	84
Upper Lahlangubo	333	184	92
Tsitsikama	836	462	231
Umtwakazi	436	241	121
Mofula	594	300	150
Romanslaagte	539	298	149
Zulumema	244	135	68
Upper Didimana	600	303	152
Engojini	509	214	107
Beccles	710	358	179
Upper Zangqokwe	445	246	123
Nyana	402	222	111
Lower Lahlangubo	360	182	141
Engobokeni 2	291	161	81
Lower Hackney	310	171	86
Lower Tsitsikama	398	220	110
Ntabelanga	219	121	61
Mabaleni	295	163	82
Engobokeni 1	139	77	39
Dyamala	402	222	111
Allanwater	369	104	52
Ngxovu Ngxovu	141	78	39
Xaleni	362	200	100
Emtha	246	136	68
Esikolweni	226	125	63
Mangondwane	208	115	58
Sautiya	186	103	52
Lower Zangqokwe	203	112	56
Upper Hukuwa 1	165	91	46
Emtabazo	91	50	25
Manzikrakra	159	88	44
Upper Hukuwa 2	92	51	26
Upper Hukuwa 3	43	24	12
Lower Hukuwa 2	65	36	18
Lower Hukuwa 1	34	19	10
Amaqolomba	40	20	10
Qwabi [4]	360	200	100
Kwamkwane [4]	450	250	125
Bushby Park [4]	60	35	18
TOTAL	53 232	21 990	15 401

Notes on Table 5.1:

- [1] latest official figures (DBSA, 1985: 4-12).
 - [2] In the case of most settlements the figures in this column refer to the number of structures used for residential purposes (DBSA, 1985: 4-16).
 - [3] The figures for Mitford are adapted from the unofficial 1986 population figures calculated by the Directorate of Planning (Ciskei, 1986b) to take into account the considerable growth of this urban area since 1984. In 1984 the official population of Mitford was only 262 with 110 structures (DBSA, 1985: 4-13).
 - [4] The villages Qwabi, Kwankwane and Bushby Park are not listed in DBSA, 1985. The figures for these villages are estimates by the author based on unofficial 1986 population figures (Ciskei, 1986b).
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5.1 MEDIUM VOLTAGE (22kV) DISTRIBUTION

The proposed medium voltage distribution network consists of several 22kV main feeders spreading out radially from the substation near Sada/Whittlesea with individual settlements being supplied by 22kV spur lines that branch off these radial lines. The network was designed with bare overhead line and it was assumed that all lines are to be built along existing roads. The design is based on the road network and on the distribution of settlements as shown on the 1:50 000 Regional Development Plan of the Hewu planning region (O'Connell et al, 1985). Since the dimensions of the individual settlements are depicted on this map, the extent of medium voltage reticulation within each settlement could also be determined. The layout of 22kV reticulation was designed such that no part of a settlement would be more than 400m (this is the assumed maximum reach of the low voltage feeders - see Section 5.2) away from the nearest medium voltage line.

A load flow program was used to determine the number of radial distribution lines that would be required to cover all 15 688 households in the district's 57 settlements. The reach of a line is dependent on the conductor size, the maximum ADMD load demand on that line and the load

distribution along the line. In this design it was decided to use only hare conductor (105 mm² conductor area) and mink conductor (63 mm² conductor area). With the assumed design ADMD of 2kVA per household the maximum domestic load demand of the individual settlements could be determined. It was thus found that nine radial lines would be required in the Hewu district. Spur lines (mink conductor only) connect the individual low voltage reticulation networks with the radial lines. The proposed medium voltage distribution network is shown in Figure 7.

It should be noted that the above network is designed to cater only for the maximum domestic load that could be expected if every single household in the Hewu district became a consumer. It does not cater for a possible public, commercial or industrial load. However, not all households will become consumers immediately so that the spare capacity on the system could in the meantime supply non-domestic consumers like shops, schools, clinics, etc.

The figures used in estimating the costs of the medium voltage distribution network are based on cost estimates by organisations involved in electrification. These estimates are not broken down into the individual component costs but are quoted in terms of a total cost per kilometer of line which includes material, transport, engineering and labour expenses. In order to accommodate different estimates by the various organisations a conservative rather than optimistic estimate was adopted in this costing analysis: R20 000 per kilometer of line using hare conductor and R15 000 per kilometer of line using mink conductor. Table 5.2 summarises the required line lengths, the number of erven covered by each radial line, the total medium voltage line cost and the line costs per erf. According to this design the average cost per household for the Hewu medium voltage distribution network as a whole is approximately R590 while average costs per household for the individual lines range between R182 and R1036 with a mean of approximately R640. It should be noted that these are the total costs, including transport and construction costs.

Table 5.2 Summary of line lengths (radial and spur lines) and costs of a medium voltage distribution network for the Hewu district

radial line	no. of erven covered	bare conductor		mink conductor		total MV line costs (R)	MV line cost per erf (R)
		length (km)	cost (R) @ R20000/km	length (km)	cost (R) @ R15000/km		
Line 1	1 688	47.3	946 000	26.6	399 000	1 345 000	797
Line 2	1 650	41.5	830 000	5.0	75 000	905 000	548
Line 3	1 760	35.0	700 000	8.0	120 000	820 000	466
Line 4	1 760	35.0	700 000	8.0	120 000	820 000	466
Line 5	1 728	43.2	864 000	32.0	480 000	1 344 000	778
Line 6	1 080	-	-	49.0	735 000	735 000	681
Line 7	1 570	-	-	82.5	1 237 500	1 237 500	788
Line 8	1 460	30.8	616 000	59.8	897 000	1 513 000	1 036
Line 9	2 992	-	-	36.3	544 500	544 500	182
TOTAL	15 688	232.8	4 656 000	307.2	4 608 000	9 264 000	-
AVERAGE	1 743	38.8	776 000	34.1	512 000	1 029 333	638 591

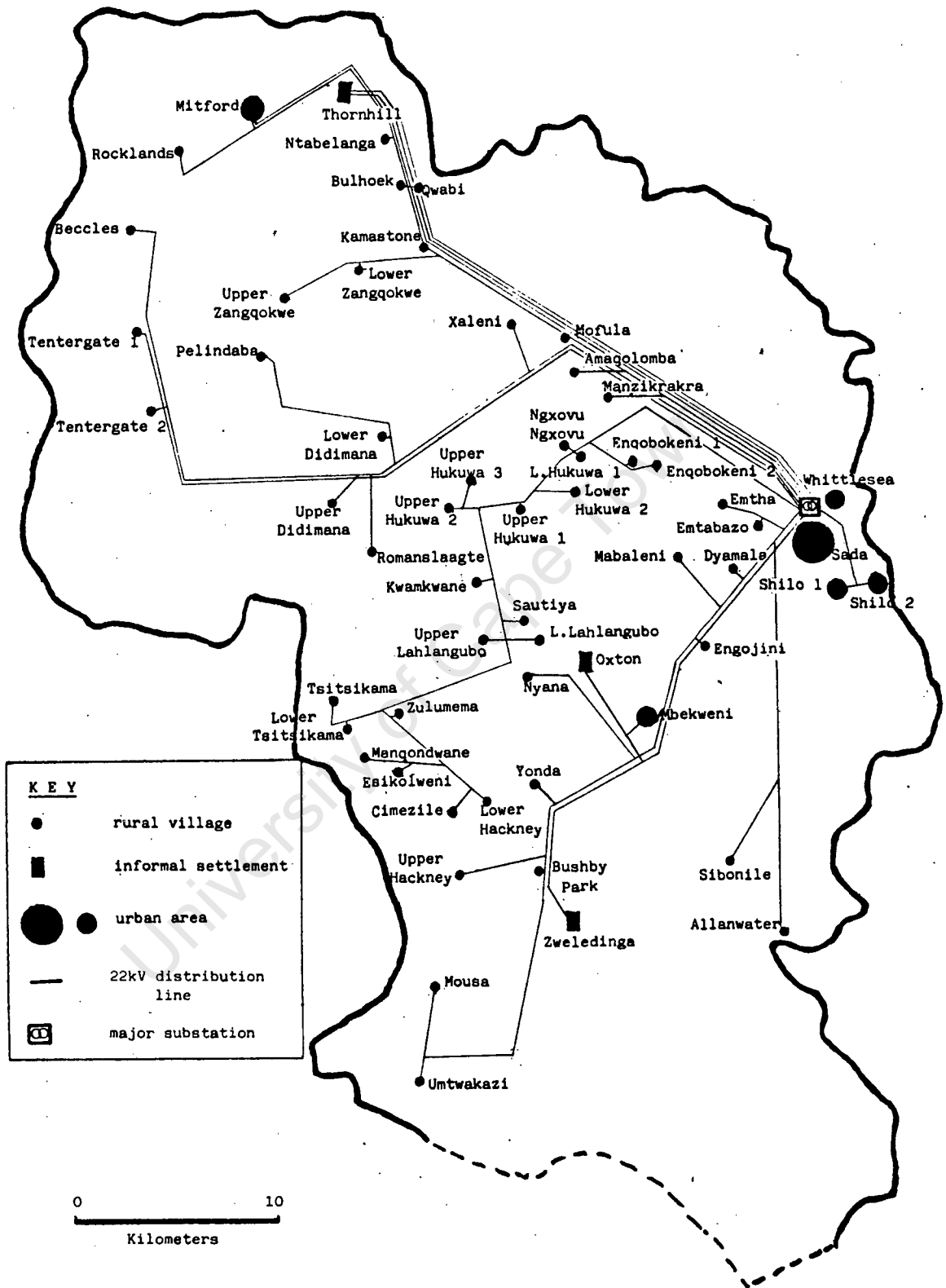


FIGURE 7: THE MEDIUM VOLTAGE (22kV) DISTRIBUTION NETWORK FOR THE HEWU DISTRICT

5.2 LOW VOLTAGE (380V) RETICULATION

This section presents the design of economical reticulation systems for all 57 settlements in the Hewu district. These might not be the most cost-effective systems but this estimate gives a fair indication of the cost involved in reticulating settlements in underdeveloped areas in Ciskei. The design strategy is the same for all settlements.

The selection of the type of design depends to a large extent on the geographical features of individual settlements, the settlement layout (settlement dimensions, housing distribution and housing density) and the type of consumer. However, no maps, plans or aerial photographs of the individual settlements were available, only the above-mentioned 1:50 000 Regional Development Plan of the Hewu planning region (O'Connell et al, 1985), indicating the dimensions of settlements. An approach which assumes that houses in a settlement are distributed evenly over the settlement area was thus adopted. While the housing distribution is simplified, the housing density is not altered. In reality rural villages are often composed of a number of housing clusters and the cost of reticulation can therefore be expected to be lower than in township-type settlements with a regular housing layout. This means that the adopted design strategy will most probably yield an upper bound cost.

Households in underdeveloped areas generally have very low incomes (see Chapter 4 for average household incomes in unelectrified areas of Ciskei) so that it can be expected that the use of electrical appliances will initially be limited to mainly lights. The Development Bank of Southern Africa suggests that an ADMD of 2kVA per household should be used for sub-economical housing where households use electricity for lighting only (DBSA, 1985: 9-8), while typical design ADMDs for low income housing in the Department of Community Development's "guidelines" (1983: G5) range between 1.5kVA and 2.5kVA per household (100 or more consumers in a

group). With the expected limited use of electricity in underdeveloped areas of Ciskei actual initial ADMDs will be much lower than these suggested values, but in order to accommodate load growth the design ADMD was set at 2kVA per household. It has also been suggested that lowering the design ADMD, i.e. making less electrical power available to individual consumers, will not reduce reticulation costs dramatically. The consulting firm C A du Toit & Partners, for example, found that lowering the design ADMD from 1.9kVA to 1.28kVA (a reduction of 34%) will only reduce reticulation costs by 3.7% (Jordaan and du Toit, 1987). It must be considered whether such a relatively small cost saving is warranted when this precludes the use of certain popular electric appliances like an electric stove.

The design of the 57 low voltage reticulation networks is based on a three phase overhead system with insulated aerial bundle conductors (ABC). According to a cost comparison between underground, open overhead and insulated overhead reticulation methods, the method with the lowest capital and maintenance cost (not taking into account the possibility of vandalism) is insulated overhead reticulation with overhead service connections (Jordaan and du Toit, 1987). Such a system offers an economical alternative to overhead reticulation with open conductors because the maintenance cost due to natural faults for the former is much lower and in fact comparable to that of an underground system. Also, although aerial bundle conductors are more expensive than open conductors, the total line cost using ABC is lower than the cost of conventional open lines (Seymore, 1987: 6).

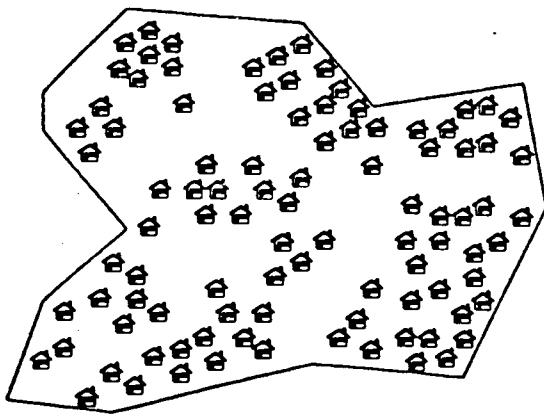
Pole-mounted 22kV/400V miniature substations and transformers are used in the design. Their features are described in some detail in Appendix D. The miniature substations are used in all the larger settlements where at least two low voltage feeders would be required to reach all households, while transformers are only used in the smallest rural villages where all households could be reached with only one or two low voltage feeders. The advantage of a minisub over a normal transformer are its protection and

multiple low voltage feeder facilities. The costing analysis (see below) revealed that a reticulation system with pole-mounted minisubs is more economical than one using more sophisticated ground-mounted minisubs. A similar conclusion was reached in a cost comparison of several alternative installations including pole-mounted transformers and ground-mounted minisubs (Seymore, 1987: 9).

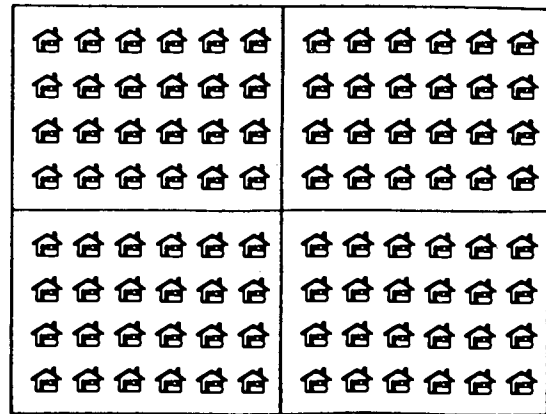
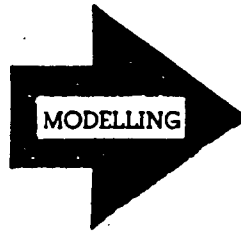
The design, which excludes housewiring, assumes the following standards:

- * transformer ratings of 50kVA and 100kVA;
- * minisub ratings of 50kVA, 100kVA, 160kVA, 200kVA and 315kVA;
- * a maximum of two low voltage feeders per transformer;
- * a maximum of four low voltage feeders per minisub;
- * a maximum reach of a low voltage feeder of 400m;
- * a maximum distance between poles of 70m;
- * a uniform length of the overhead single phase service connection cable of 50m;
- * 80W mercury vapour streetlights, one per pole.

A separate reticulation network was designed for each unelectrified settlement in the Hewu district. The average erf area was calculated by measuring the settlement's area (on the above-mentioned 1:50 000 Regional Development Plan) and dividing this by its number of erven. It was assumed that a settlement consists of residential erven only and that all erven are squares of equal size that are laid out along straight roads with 90° turns. Knowing the maximum reach of a low voltage feeder, it was thus possible to determine the number of erven that could be supplied from one minisub/transformer (such a group of erven is called a "zone" in the following discussion) and also the number of minisubs/transformers required to supply all erven in that settlement. The modelling of a settlement in this rectangular layout, subdivided into uniform zones with one minisub/transformer each, is illustrated in Figure 8.

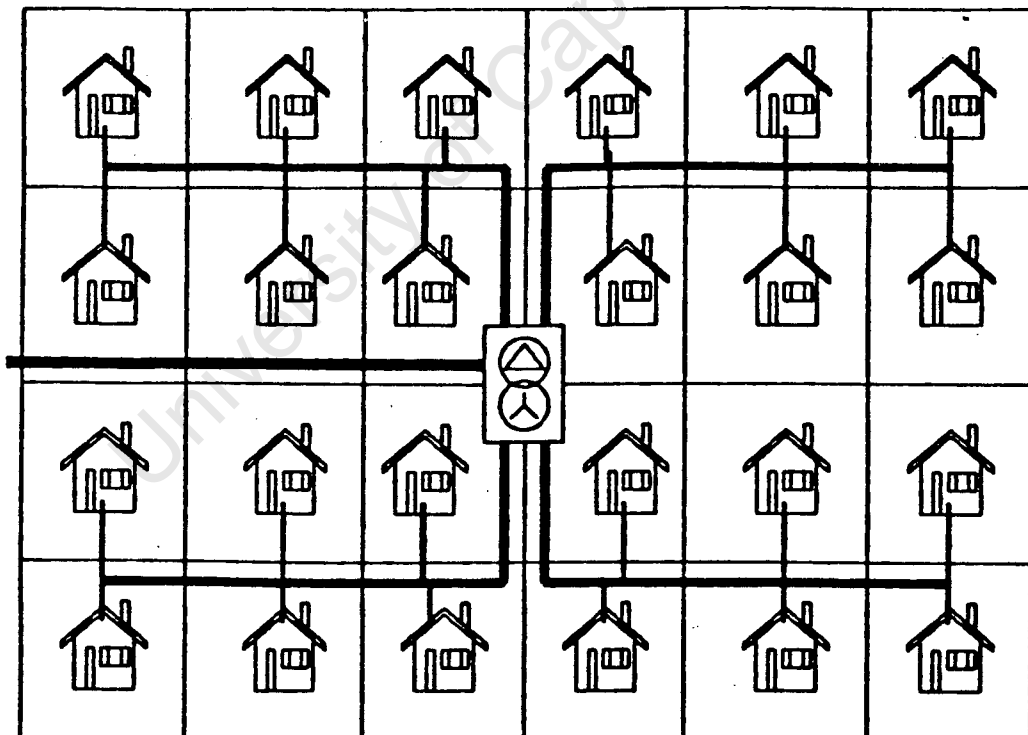


RURAL VILLAGE AS DEPICTED ON THE 1 : 50000 DEVELOPMENT PLAN



RURAL VILLAGE MODELLED IN RECTANGULAR FASHION AND SUBDIVIDED INTO ZONES SERVED BY ONE MINIBUS EACH

RETICULATION WITHIN A ZONE



- MEDIUM VOLTAGE (22 kV) FEEDER
- LOW VOLTAGE (380 V) FEEDER
- SERVICE CONNECTION CABLE

FIGURE 8: MODELLING A SETTLEMENT FOR THE PURPOSES OF DESIGNING A LOW VOLTAGE RETICULATION NETWORK

The required minisub/transformer rating to meet the after diversity maximum domestic load demand in a zone is calculated with the following formula:

$$\text{kVA rating} = (\text{ADMD}_D * N_Z) + L_{SL}$$

where ADMD_D is the design ADMD per household (= 2kVA)
 N_Z is the number of erven in the zone
 L_{SL} is the zone's streetlighting load
 (= 80W * the number of poles in the zone)

The size of the low voltage ABC feeder to be used (refer to Table 5.3) is determined by its current rating. This is calculated with the following formula:

$$\text{current rating} = \frac{(\text{ADMD}_D * N_{Ph}) * DF}{V_{Ph}}$$

where ADMD_D is the design ADMD per household (= 2kVA)
 N_{Ph} is the number of erven supplied by one phase of a feeder (= number of erven supplied by one feeder ÷ 3)
 DF is a diversity factor, which is the ratio of the sum of the individual consumer maximum demands within a zone to the maximum demand of the zone. DF was set at 2.5 which, according to the Department of Community Development's Guidelines (1983: G5), corresponds to approximately 40 consumers per zone.
 V_{Ph} is the phase voltage (= 220V).

Table 5.3 Current rating and size of aerial bundle conductor (figures quoted by Bernard Dudley)

current rating	cross-sectional area
130 A	35 mm ²
165 A	50 mm ²
205 A	70 mm ²
250 A	95 mm ²
290 A	120 mm ²

The required number of poles was calculated in accordance with the assumed relationship between average erf frontage and the distance between poles, as set out in Table 5.4. Four poles were added for each minisub/transformer. A stay and a strain clamp is required at each end of a straight line, while suspension clamps are required at all intermediate poles. The required total length of low voltage feeder within a zone is dependent on the distance between poles, or rather the average erf frontages. It must be remembered that there are, at most, four feeders per minisub and two per transformer. The number of connectors and service connections is equal to the number of households to be electrified. Each service connection cable is assumed to be 50m long.

Table 5.4 Distance between poles as a function of average erf frontage

average erf frontage	distance between poles
frontage < 35m	2 * frontage
35m < frontage < 70m	frontage
70m < frontage < 140m	frontage/2
140m < frontage < 210m	frontage/3

The material requirements for the 57 low voltage reticulation networks, according to the adopted design strategy, are summarised in Table 5.5.

The total cost of low voltage reticulation for all unelectrified settlements in the Hewu district is obtained by summing the costs of the individual system components which were calculated using the prices given in Appendix D. These prices were obtained from only a small range of suppliers in Cape Town and might therefore not be the lowest. A breakdown of the material costs of the 57 low voltage reticulation networks is presented in Table 5.6.

The average cost per household for the Hewu district as a whole is approximately R875, while average costs per household for the individual settlements range between R633 and R1843 with a mean of approximately R1080. These, however, are only material costs. It is estimated that transport, labour and engineering will, on average, cost an additional 30% of the material cost giving a total average cost of approximately R1140.

A study conducted by Eskom indicated that the average cost of reticulation, using an overhead system, is just over R700 per household, excluding housewiring (Brooking, 1987: 17). Considering the fact that the estimated average reticulation cost of R875 is an upper bound based on less densely populated settlements - Eskom's study was conducted in a township comprising 4000 households - this figure compares well with the estimated figure.

Table 5.5 Summary of the material requirements of the low voltage reticulation networks for the Hewu district

NAME OF SETTLEMENT	NO. OF ERVEN TO BE ELECTRIIFIED	22KV/400V POLE-MOUNTED MINISUBS (TR = TRANSFORMER ONLY)			POLES		STAYS REQUIRED NUMBER	STREET LIGHTS REQUIRED NUMBER	380V FEEDER		SUSPENSION CLAMPS REQUIRED NUMBER	STRAIN CLAMPS REQUIRED NUMBER	SERVICE CABLE REQUIRED LENGTH (M)	CONNECTORS REQUIRED NUMBER
		STANDARD MINISUB SIZE (KVA)	REQUIRED NUMBER	NO. OF ERVEN PER MINISUB	DISTANCE BETWEEN POLES (M)	REQUIRED NUMBER			REQUIRED LENGTH (M)	CROSS-SECTIONAL AREA (MM ²)				
THORNHILL	3 520	200	44	80	38	1 048	704	1 672	66 880	50	1 320	528	176 000	3 520
OKTON	1 360	315	10	136	46	360	160	340	15 640	95	260	120	68 000	1 360
TENTERGATE 1	1 080	160	15	72	43	570	240	510	23 220	35	390	180	54 000	1 080
MITFORD	2 184	315	21	104	60	630	336	546	32 760	70	378	252	109 200	2 184
LOWER DIDIMANA	256	100	8	32	50	256	128	224	12 800	35	176	96	12 800	256
BECKWENI	640	200	8	80	39	336	128	304	12 480	50	240	96	32 000	640
SIBONILE	160	100	4	40	70	88	64	72	5 600	35	40	48	8 000	160
UPPER HACKNEY	160	50	8	20	70	192	128	160	11 200	35	96	96	8 000	160
PELINDABA	480	200	6	80	40	252	96	228	9 600	50	180	72	24 000	480
ZWELEDINGA	480	200	6	80	40	252	96	228	9 600	50	180	72	24 000	480
ROCKLANDS	432	100	9	48	63	234	144	198	13 608	35	126	108	21 600	432
CINEZILE	160	100	5	32	47	160	80	140	7 520	35	110	60	8 000	160
TENTERGATE 2	256	160	4	64	49	136	64	120	6 272	35	88	48	12 800	256
SHILO 1	192	160	3	64	45	102	48	90	4 320	35	66	36	9 600	192
YONDA	160	100	4	40	67	88	64	72	5 360	35	46	48	8 000	160
KAMASTONE	192	100	4	40	59	104	64	88	5 664	35	56	48	9 600	192
MOLISA	168	160	3	56	56	90	48	78	4 704	35	54	36	8 400	168
BULHOEK	96	100	2	48	58	52	32	44	2 784	35	28	24	4 800	96
SHILO 2	320	200	4	80	39	168	64	152	6 240	35	120	48	16 000	320
UPPER LAHLANGUBO	96	100	3	32	44	108	48	96	4 750	35	78	36	4 800	96
TSITSIKAMA	240	100	5	48	62	130	80	110	7 440	35	70	60	12 000	240
UNTWAKAZI	144	160	2	72	41	76	32	2	2 952	35	24	24	7 200	144
HOPLA	144	100	3	48	59	78	48	4	2 248	35	36	36	7 200	144
ROMANGLAASTE	160	100	4	40	36	176	64	160	6 192	35	136	48	8 000	160
ZULUMPA	96	100	2	48	65	52	32	44	3 120	35	28	24	4 800	96
UPPER DIDIMANA	160	100	5	32	41	180	80	160	7 380	35	130	60	8 000	160
ENGOJINI	120	100	3	40	38	120	48	108	4 560	35	90	36	6 000	120
BECCLES	176	200	2	88	68	52	32	44	2 992	35	28	24	8 800	176
UPPER ZANGOOKWE	144	100	3	48	63	78	48	66	4 536	35	42	36	7 200	144
NYANA	120	100	3	40	37	120	48	108	4 440	35	80	36	6 000	120
LOWER LAHLANGUBO	96	100	2	48	60	52	32	44	2 880	35	28	24	4 800	96
ENGOBOKENI 2	96	100	2	48	63	52	32	44	3 024	35	28	24	4 800	96
LOWER HACKNEY	112	160	2	56	56	60	32	3	1 136	35	36	24	5 600	112
LOWER TSITSIKAMA	96	100	3	32	41	108	48	96	4 428	35	78	36	4 800	96
NTABELANGA	64	100	2	32	50	64	32	3	2 200	35	44	24	3 200	64
NTALENI	96	100	2	48	66	72	32	3	1 668	35	28	24	4 800	96
ENGOBOKENI 1	40	100	1	40	70	22	16	18	1 400	35	10	12	2 000	40
DYAHALA	128	160	2	64	47	88	32	3	3 008	35	44	24	8 400	128
ALLANWATER	48	100	1	48	66	28	16	22	1 584	35	14	12	2 400	48
NGOMU NGOMU	32	100	1	32	44	36	16	32	1 584	35	28	12	1 600	32
XALENI	96	100	2	48	63	52	32	44	3 024	35	28	24	4 800	96
ENTHA	112	160	2	56	54	60	32	3	1 024	35	36	24	5 600	112
ESIKOLWENI	96	100	2	48	64	52	32	44	3 072	35	28	24	4 800	96
HANGONDWANE	80	100	2	40	70	44	32	36	2 800	35	20	24	4 000	80
SAUTIYA	56	160	1	56	51	30	16	26	1 428	35	18	12	2 800	56
LOWER ZANGOOKWE	40	100	1	40	70	22	16	18	1 400	35	10	12	2 000	40
UPPER HUKUMA 1	64	100	2	32	44	72	32	3	1 168	35	52	24	3 200	64
ENTABAZO	24	(TR) 50	1	24	39	24	16	20	780	35	16	12	1 200	24
HANZIKRAKRA	48	100	1	48	60	26	16	22	1 440	35	14	12	2 400	48
UPPER HUKUMA 2	24	50	1	24	60	24	16	20	1 200	35	12	12	1 200	24
UPPER HUKUMA 3	12	(TR) 50	1	12	56	14	16	10	560	35	6	12	600	12
LOWER HUKUMA 2	20	(TR) 50	1	20	70	12	16	8	560	35	4	12	1 000	20
LOWER HUKUMA 1	10	(TR) 50	1	10	43	13	16	9	387	35	7	12	500	10
ANAGOLONGA	10	(TR) 50	1	10	39	13	16	9	351	35	7	12	500	10
QWABI	128	160	2	64	49	68	32	60	3 136	35	44	24	6 400	128
KWAKWANE	144	100	3	48	63	78	48	66	4 536	35	42	36	7 200	144
BUSHBY PARK	20	(TR) 50	1	20	58	12	16	8	464	35	4	12	1 000	20
TOTAL	15 688	-	246	-	-	8 284	3 936	7 300	367 606	-	5 418	2 952	784 400	15 688
AVERAGE VALUES	275	122	4	49	53	145	69	128	6 449	38	95	2 952	13 761	275

Table 5.6 Breakdown of the material costs of the low voltage reticulation networks for the Hewu district

NAME OF SETTLEMENT	NO. OF ERVEN TO BE ELEC-TRIFIED	BREAKDOWN OF MATERIAL COSTS (R)									COST ESTIMATE (MATERIALS ONLY)	
		TRANSFORMERS/ MINISUBS	POLES	STAYS	STREET LIGHTS	380V FEEDER	SUSPENSION CLAMPS	STRAIN CLAMPS	SERVICE CABLE	CONNECTORS	TOTAL COSTS (R)	TOTAL COST (R) PER ERV
THORNHILL	3 520	648 340	212 520	88 000	215 688	769 120	35 640	23 760	792 000	36 960	2 822 028	786
OKTON	1 360	170 280	43 700	20 000	43 860	250 553	7 020	5 400	306 000	14 280	861 073	617
TENTERGATE 1	1 080	208 125	65 550	30 000	65 790	226 395	10 530	8 100	243 000	11 340	868 830	777
HITFORD	2 184	357 546	72 450	42 000	70 434	442 588	10 206	11 340	491 400	22 932	1 520 896	674
LOWER DIDIMANA	256	99 120	29 440	16 000	28 896	124 800	4 752	4 320	57 600	2 688	367 616	1 384
MBEKWI	640	117 880	38 640	16 000	39 216	143 520	6 480	4 320	144 000	6 720	516 776	792
SIBONILE	160	49 560	10 120	8 000	9 288	54 600	1 080	2 160	36 000	1 680	172 488	1 031
UPPER HACKNEY	160	82 400	22 080	16 000	20 640	109 200	2 592	4 320	36 000	1 680	294 912	1 831
PELINDABA	480	88 410	28 980	12 000	29 412	110 400	4 860	3 240	108 000	5 040	390 342	797
ZWELEDINGA	480	88 410	28 980	12 000	29 412	110 400	4 860	3 240	108 000	5 040	390 342	797
ROCKLANDS	432	111 510	26 910	18 000	25 542	132 678	3 402	4 860	97 200	4 536	424 638	946
CHEZILE	160	61 950	18 400	10 000	18 060	73 320	2 970	2 700	36 000	1 680	225 080	1 355
TENTERGATE 2	256	56 500	15 640	8 000	15 480	61 152	2 376	2 160	57 600	2 688	220 596	829
SHILO 1	192	41 625	11 730	6 000	11 610	42 120	1 782	1 620	43 200	2 016	161 703	810
YONDA	160	49 560	10 120	8 000	9 288	52 260	1 080	2 160	36 000	1 680	170 148	1 016
KANASTONE	192	49 560	11 960	8 000	11 352	56 224	1 512	2 160	43 200	2 688	184 984	926
MOLISA	168	41 625	10 350	6 000	10 062	45 864	1 458	1 620	37 800	1 764	156 543	893
BULHOEK	96	24 780	5 980	4 000	5 676	27 144	756	1 080	21 600	1 008	92 024	921
SHILO 2	320	58 940	19 320	8 000	19 608	71 760	3 240	2 160	72 000	3 360	258 388	792
UPPER LAHLANGUBO	96	37 170	12 420	6 000	12 384	46 332	2 106	1 620	21 600	1 008	140 640	1 416
TSITSIKAMA	240	61 950	14 950	10 000	14 190	72 540	1 890	2 700	54 000	2 520	234 740	941
UNTWAKAZI	144	27 750	8 740	4 000	8 772	28 782	1 404	1 080	32 400	1 512	114 440	767
MOFULA	144	37 170	8 970	6 000	8 514	41 418	1 134	1 620	32 400	1 512	138 738	926
ROMANGLAAGTE	160	49 560	20 240	8 000	20 640	60 372	3 672	2 160	36 000	1 680	202 324	1 230
ZULLENHA	96	24 780	5 980	4 000	5 676	30 420	756	1 080	21 600	1 008	96 300	955
UPPER DIDIMANA	160	56 950	20 700	10 000	20 640	71 955	3 510	2 700	36 000	1 680	224 135	1 383
ENGOUJINI	120	37 170	13 800	6 000	13 932	44 460	2 430	1 620	27 000	1 260	147 672	1 194
BECCLES	176	29 470	5 980	4 000	5 676	34 408	756	1 080	39 600	1 848	122 818	679
UPPER ZANGOOKWE	144	37 170	8 970	6 000	8 514	44 226	1 134	1 620	32 400	1 512	141 546	946
NYANA	120	37 170	13 800	6 000	13 932	43 290	2 430	1 620	27 000	1 260	146 502	1 184
LOWER LAHLANGUBO	96	24 780	5 980	4 000	5 676	28 080	756	1 080	21 600	1 008	92 960	931
ENDSOKENI 2	96	24 780	5 980	4 000	5 676	29 484	756	1 080	21 600	1 008	94 364	946
LOWER HACKNEY	112	27 750	6 900	4 000	6 708	30 576	972	1 080	25 200	1 176	104 362	893
LOWER TSITSIKAMA	96	37 170	12 420	6 000	12 384	43 173	2 106	1 620	21 600	1 008	137 481	1 383
NTABELANGA	64	24 780	7 360	4 000	7 224	31 200	1 188	1 080	14 400	672	91 304	1 384
MABALENI	96	24 780	8 280	4 000	8 256	30 888	756	1 080	21 600	1 008	100 648	1 016
ENDSOKENI 1	40	12 390	2 530	2 000	2 322	13 650	270	540	9 000	420	43 122	1 031
DYAHALA	128	27 750	7 820	4 000	7 740	29 328	1 188	1 080	28 800	1 344	109 050	819
ALLANWATER	48	12 390	2 990	2 000	2 838	15 444	378	540	10 800	504	47 884	960
NGRONGU NGRONGU	32	12 390	4 140	2 000	4 128	15 444	702	540	7 200	336	46 880	1 416
XALENI	96	24 780	5 980	4 000	5 676	29 484	756	1 080	21 600	1 008	94 364	946
ENTHA	112	27 750	6 900	4 000	6 708	29 484	972	1 080	25 200	1 176	103 270	883
ESIKOLWENI	96	24 780	5 980	4 000	5 676	29 952	756	1 080	21 600	1 008	94 832	951
MANGONDWANE	80	24 780	5 060	4 000	4 644	27 300	540	1 080	18 000	840	86 244	1 031
SAUTIYA	56	13 875	3 450	2 000	3 354	13 923	486	540	12 600	588	50 816	868
LOWER ZANGOOKWE	40	12 390	2 530	2 000	2 322	13 650	270	540	9 000	420	43 122	1 031
UPPER HUKUMA 1	64	24 780	8 280	4 000	8 256	30 888	1 404	1 080	14 400	672	93 760	1 416
ENTABAZO	24	5 300	2 760	2 000	2 580	7 605	432	540	5 400	252	26 869	1 318
MANZIKRAKRA	48	12 390	2 990	2 000	2 838	14 040	378	540	10 800	504	46 480	931
UPPER HUKUMA 2	24	10 300	2 760	2 000	2 580	11 700	324	540	5 400	252	35 856	1 484
UPPER HUKUMA 3	12	5 300	1 610	2 000	1 290	5 460	162	540	2 700	126	19 188	1 976
LOWER HUKUMA 2	20	5 300	1 380	2 000	1 032	5 460	108	540	4 500	210	20 530	1 250
LOWER HUKUMA 1	10	5 300	1 495	2 000	1 161	3 773	189	540	2 250	105	16 813	2 131
AMAGOLONBA	10	5 300	1 495	2 000	1 161	3 422	189	540	2 250	105	16 462	2 096
QWABI	128	27 750	7 820	4 000	7 740	30 576	1 188	1 080	28 800	1 344	110 298	829
KWASHWANE	144	37 170	8 970	6 000	8 514	44 226	1 134	1 620	32 400	1 512	141 546	946
BUSHBY PARK	20	5 300	1 380	2 000	1 032	4 524	108	540	4 500	210	19 594	1 204
TOTAL	15 688	3 342 916	952 660	492 000	941 700	3 994 035	146 286	132 840	3 529 800	164 724	13 696 961	
AVERAGE VALUE	275	58 648	16 713	8 632	16 521	70 071	2 566	2 331	61 926	2 890	240 298	1 079 873

5.3 THE COST OF ELECTRIFICATION

According to the above cost estimates for the medium voltage distribution and low voltage reticulation systems it would cost about R1730 per household to make electricity available to every single household in the Hewu district of Ciskei. In other unelectrified parts of Ciskei the cost of electrification can be expected to be lower because of higher population densities and existing electrical infrastructure in some regions. It must also be remembered that this figure is an upper bound estimate which means that the actual cost will in all probability be lower if a more appropriate design strategy is adopted.

The cost estimate that has been presented here is an indication of the costs of a comprehensive electrification programme covering all unelectrified households in Ciskei. With an assumed number of approximately 100 000 households in unelectrified areas of Ciskei such a programme would cost of the order of R180 million.

A cost factor in electrification that has not been considered in the above estimate is the wiring of houses. During a survey among electrified houses in Mdantsane and Phakamisa (refer to Appendix 2) the author found that conventional wiring of a small three-roomed house, performed by a registered electrical contractor, costs around R700. A study by Eskom indicated that housewiring costs (excluding the meter) range between a lower limit of R500 per house and an upper limit of R1200 per house, with a median cost of R800 per house (Brooking, 1987: 18). Housewiring technologies that are more appropriate to the needs of poorer households, like prepayment meters and Rediboard-type switchboards (MCB, single lamp and several socket outlets), could reduce these costs significantly.

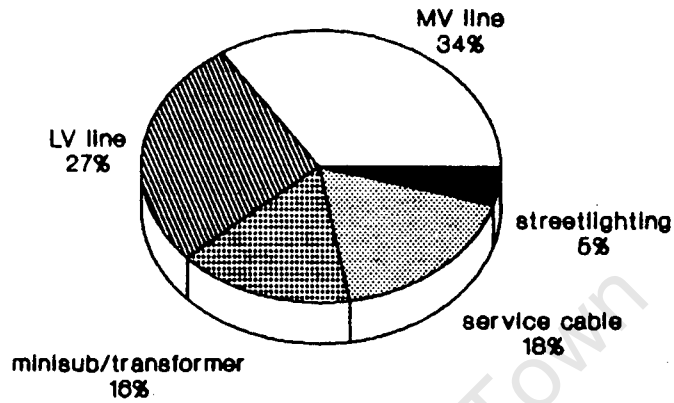
The relative costs of different elements of the proposed system are presented in the cost analysis in Figure 9 below. Both the LV line cost (poles, LV feeder, stays, strain

clamps and suspension clamps) and the minisub/transformer cost include transport and construction/installation costs estimated at 30% of their respective material costs. The service cable cost includes the cost of connectors, while a housewiring cost of R700 per household is assumed. Note the strong contribution of housewiring costs towards the overall cost of electrification.

Taking into account the financial situation of an average unelectrified household in Ciskei (refer to Chapter 4) it is obvious that people living in underdeveloped areas cannot afford the capital cost of this type of infrastructure. From the supply authority's point of view this means that the supply of electric power to these areas is uneconomical and would have to be subsidised (this could be justified in view of the wider benefits of electricity). In order to make electricity affordable to the people it might furthermore be necessary to give consumers access to credit and credit assistance. Most important of all, however, is appropriate consumer education and information which will make people aware of the ways and means of taking full advantage of electricity and credit.

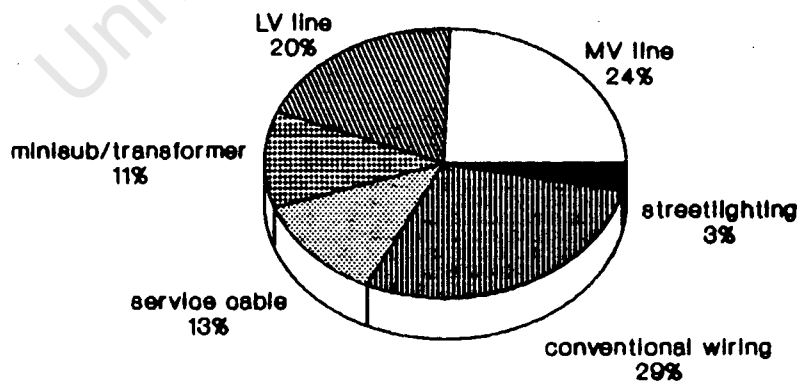
Key

HOUSEWIRING EXCLUDED:



AVERAGE TOTAL COST PER HOUSEHOLD: R1726

HOUSEWIRING INCLUDED:



AVERAGE TOTAL COST PER HOUSEHOLD: R2426

FIGURE 9: COST ANALYSIS OF RURAL ELECTRIFICATION IN CISKEI

5.4 AN APPROPRIATE ELECTRIFICATION STRATEGY

Key

In electrifying an area it is practical to prioritise different regions in that area according to economic, social and/or political viability and to begin with that region which promises to be most viable in terms of the goal to be achieved. The goal of a supply authority usually is a rapid return on its investment which is generally associated with a rapidly increasing demand for electricity. In underdeveloped areas this goal might not easily be achieved as people are generally poor. However, although it might be difficult to justify the electrification of underdeveloped areas on economic grounds alone, such a project might be very much in the interest of a government's upliftment policy and could so be justified on social and political grounds. This would also make the project eligible for government subsidy.

Electrifying high-priority regions first might have the drawback of migration of people from low-priority regions to the newly electrified towns and villages. Under the present circumstances in Ciskei, however, the cause of such a migration is unlikely to be the availability of electricity itself, but rather the possible increase in economic activity - and therefore the possibility of employment - as a result of the availability of electricity. The phenomenon of voluntary migration of people from underdeveloped rural areas to more developed urban areas in search of employment can be observed all over South Africa. If this urban drift is to be reduced an integrated rural development strategy, involving decentralisation of commerce and industry, would be required. Electrification can play an important and powerful role in such a strategy.

A major electrification programme for underdeveloped areas, covering many settlements, would be spread over several years. In order to avoid a drift of people from their present homes to sooner-to-be-electrified areas it might be wise to give them confidence in the promise that electricity

is also coming to their village. This might be accomplished by an early commencement with basic construction work (eg. digging holes for the poles) in as many different areas as possible. It would be of benefit to involve the local population in the project by, for example, employing locals as labourers.

Many development projects have failed because they have been imposed upon people through a top-down approach: these people were suddenly expected to pay for a service that someone else decided upon without having a say in the matter themselves. In electrifying underdeveloped areas people should be given a choice in the type of supply they require. Van Buren-Schele (1987: 53) argues that "If a stand owner can reasonably expect to have electricity supplied to him, he must also expect to pay for that availability. Is it, however, reasonable to expect him to pay for a complete system designed for say 3kVA ADMD when he only wanted 1kVA? ... Is it reasonable to expect him to pay for a streetlight he doesn't want?". While it is realised that a consumer has to pay for certain basic parts of a reticulation system, he should be given the possibility, through the use of appropriate electrification technologies, to invest in a type of supply that best suits his needs and financial capabilities. In order to give the consumer some control "over what he gets and what he pays for" (ibid: 57) van Buren-Schele proposes a system where a large portion of the reticulation network can be provided only when required (ibid: 55, 56). The system consists of a medium voltage reticulation network with small single phase transformers that supply groups of up to four consumers each. The transformers are only supplied and installed when required by a group of consumers and "can be replaced by a larger one if and when it is justified by the demand of the consumers supplied from it without affecting the system or other consumers in any way." (ibid: 56). No low voltage reticulation network is required (this drastically reduces the overall costs of the system!) as service connections are taken directly from the transformer to the individual houses. A simple plug-in connector that connects the

service cable to the transformer also houses a circuit breaker with the rating of the consumer's choice. Streetlights need only be installed when there is a request by a group of consumers or a neighbourhood community.

Key

Such a system, with all its advantages and drawbacks, is a good example of how to reduce reticulation costs through innovative designs rather than lowering the standard of supply as is often the case in underdeveloped areas. The initial cost of reticulation can be reduced by providing a major part of the system only when it is required. Van Buren-Schele estimates that fifty percent or more of the reticulation system expenditure could be deferred until the service is actually required (ibid: 53). Another important feature of this system is the possibility for a consumer to invest in an electricity supply that is within his means.

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CHAPTER 6

THE ELECTRIFICATION OF CISKEI: A CRITICAL ANALYSIS

"Electrification itself is not the magical agent of change: it can empower new possibilities for development, but the way that these proceed surely depends on the existing political and economic features of a region." (Cowan, 1986: 10)

The electrification of underdeveloped areas usually has far-reaching socio-political and economic implications for the affected regions. While the availability of electricity means access to an efficient, controllable and versatile source of energy that is capable of solving many energy-related problems, it can also have a strong impact on infrastructural development of these regions and social upliftment of the local communities. Potential long-term benefits of electrification of underdeveloped areas include the decentralisation of economic activity, the creation of employment opportunities, the slowing down of migration of people to more developed (urban) areas, improved health care and educational facilities and better communication between developing communities and the outside world.

For the above-mentioned and other potential benefits of electrification to materialise it is essential that priority needs are addressed and that the supporting infrastructure is developed simultaneously. This usually means a high-level commitment (eg. by government) towards upgrading of underdeveloped areas, with electrification playing a key role in achieving certain goals. In the United States, for example, the major aim of rural electrification was the reduction of rural unemployment, while India's rural electrification programme prioritised the use of electricity for pumping water and China has promoted rural electrification as a means of enhancing rural productivity

(Cowan, 1986). In many cases, unfortunately, "electrification is promoted as an end in itself, rather than as a means of reaching more basic goals." (Flavin, 1986: 33). The envisaged results of such development programmes are often frustrated. In Soweto, for example, where a sophisticated and therefore expensive electrification programme was implemented in the mid 1980s, the high monthly charge for the repayment of capital costs (R29) was rejected by the majority of residents who could simply not afford to pay this much. The refusal of many consumers to pay their electricity accounts, coupled with vandalism of electrical equipment (mainly substations and meter boxes), has resulted in the serious debt situation that the Soweto City Council finds itself in today.

cost-benefit analysis
K

This report has focussed on the supply of electricity for household use in underdeveloped areas, with the primary goal of achieving the upliftment of the local people from their relative poverty to a standard of living comparable to that of urban dwellers. Unfortunately, household use of electricity (which is generally low in underdeveloped areas) can in most cases hardly justify the vast capital expenditure required for such a programme. It might, however, be found that the wider benefits of electrification far outweigh the capital costs. Therefore, in order to decide whether to implement or abandon the development of an electricity supply to underdeveloped areas, a thorough cost-benefit appraisal, taking account of social costs and benefits (these are difficult to quantify!), not just financial implications, needs to be conducted.

The following discussion presents some arguments for the electrification of underdeveloped areas such as Ciskei and also looks at the affordability and priority of such schemes. In the belief that the high cost (relative to average household income) of reticulation and housewiring is a major obstacle to electrification, a framework for making electricity affordable to the people in these areas is then proposed.

6.1 THE NEED FOR AND BENEFITS OF ELECTRIFICATION

The non-availability of electricity has many disadvantages for underdeveloped communities. Dependence on firewood by ever-increasing numbers of people in rural areas has resulted in a severe shortage of this once freely available energy source. Eberhard (1986: 111-112) states that in the underdeveloped areas of South Africa "many households are perilously close to the minimum fuel required to meet basic needs and some are below this level. Cooked meals are skipped, extra food or meat cannot be cooked with the staple mielie because it requires more fuel, hot water cannot be heated to increase hygiene, and water collected from contaminated sources cannot be boiled before drinking." The firewood shortage also has a social cost for those households that still depend on this type of fuel. Woodcollection has become increasingly time-consuming, leaving little time for other household maintenance tasks and/or agricultural production. In contrast, as Linscott (1989) argues, "electricity provides time for gainful employment and leisure". Tapson (1986) states that the key factors in increasing productivity in underdeveloped areas are electrification and water reticulation. "Not only would the provision of electric power increase output during hours worked, but together with the reticulation of potable water to villages, it would release the bulk of the 16 to 44 hours per week currently absorbed by household maintenance tasks."

The environmental cost of a rapid denudation of natural woodland is soil erosion which in many areas has already rendered the land virtually useless for agricultural purposes. Dependence on combustible fuels can furthermore lead to a number of health problems. Respiratory ailments, caused by the inhalation of poisonous gases liberated during the combustion of fuels like paraffin and wood in confined spaces, are widespread in unelectrified areas while accidents causing burns and even fire are common. Reading by candlelight causes eyestrain.

Electricity, in contrast to the types of fuel commonly used in unelectrified areas, is a clean, easy to use and versatile source of energy that would provide households with conveniences like refrigeration, hot water on tap, good quality lighting and the possibility of using a variety of labour-saving domestic appliances, improving people's quality of life and raising their standard of living. While these benefits already make electricity a very attractive source of energy in the household, it is furthermore expected that the cost of electricity consumption will be of the same order as unelectrified households' current expenditure on commercial fuels (approximately R35 per month). Apart from the immediate benefits associated with the use of electricity in the household, electrification also has various important longer-term potential benefits, particularly in its impact on economic development and social upliftment. Some of these have already briefly been mentioned in the above discussion.

An indication of the cost of electrification in Ciskei was given in Chapter 5. The total average cost of extending the existing distribution network to all settlements in Ciskei, reticulating them and providing each house with a point of supply, but excluding housewiring, is estimated to be less than R2000 per household to be electrified. A rough estimate by Eskom (1988a) indicated a cost of R2000 per urban point of supply, using minimum cost technology, while a more detailed cost analysis of township reticulation (excluding housewiring), also performed by Eskom (Brooking, 1987: 17), revealed costs ranging between R700 per household (using an overhead system) and R1200 per household (using an underground system). Eskom's estimates are for urban reticulation and do therefore not include costs for an extensive distribution network as does the above estimate. (In the Hewu district of Ciskei the medium voltage line costs were found to account for 34% of the total electrical system costs).

From this comparison of cost estimates it appears that the electrification of underdeveloped areas in Ciskei would not be prohibitively expensive, as might have been thought. Although one might be tempted now to argue that these financial considerations could already justify such a development strategy, it is essential to first establish whether the desired results (social upliftment of local communities and an increase in economic activity) can at all be achieved by the implementation of an electrification programme in Ciskei. It must also be considered that, as the average consumer in underdeveloped areas will not have the necessary financial resources to pay for his supply, a suitable financing strategy will have to be adopted.

6.2 ELECTRIFICATION OF UNDERDEVELOPED AREAS: ITS AFFORDABILITY AND ITS PRIORITY IN INFRASTRUCTURAL DEVELOPMENT

The above-mentioned benefits of electricity seem to suggest that electrification of underdeveloped areas in Ciskei could play a very positive role in the upliftment of local communities, at a cost that is comparable to that of urban reticulation. However, although most people in underdeveloped areas of Ciskei are aware of at least some of the benefits of electricity, they do not regard electrification as an immediate development priority. In rural areas the supply of clean water, being a basic need, requires the most urgent attention while for urban dwellers education and employment opportunities are more important than access to the electricity grid. Electrification for household use would not directly address these felt needs.

For potential consumers in underdeveloped areas the major drawback of an electricity supply is its high capital cost, relative to average household income, which manifests itself through housewiring and appliance costs. Conventional reticulation and housewiring technologies are expensive and

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Let Review

often not appropriate for use in underdeveloped areas where people would initially only require a limited supply. Although the above cost estimate might be unexpectedly low from the supply authority's point of view, the average household in underdeveloped areas will hardly be in a position, nor will it be prepared, to pay such an amount just to have access to the grid without being able to make use of it because the house has not been wired and no electrical appliances have yet been purchased. Even without these hardware costs, electricity is generally perceived as an expensive source of energy to use in the household. This is mainly the result of a metering and billing system which makes it difficult for consumers to adjust their consumption according to their ability to pay (a solution to this problem are prepayment meters), but also due to a lack of consumer information on the real costs and economic uses of electricity.

Another factor that presents an obstacle to the electrification of underdeveloped areas in Ciskei is its low priority on the development agenda of the Ciskei government. The structure of the Department of Public Works, in its present form, is not geared towards this kind of development: there exists as yet no commitment to supply domestic electricity, on a large scale, to rural villages and informal settlements as township reticulation and centralised industrial development enjoy higher priority. With the present driving force behind the government's development philosophy being economic viability, the electrification of underdeveloped areas is at a definite disadvantage. Household electricity consumption, as Cowan (1986: 4) puts it, "is not directly economically productive". He furthermore states that, unless there are other balancing loads, the load factor (ratio of average demand to peak demand) is low due to high demand peaks at certain times of the day, raising the cost of supply.

From the supply authority's point of view, electricity consumption levels in underdeveloped areas tend to be too low to justify the capital costs of electrification. It is

believed, however, that, by making the use of electricity more attractive to people in these areas, consumption levels will rapidly increase as more households accept supply and electricity becomes the preferred source of domestic energy.

6.3 MAKING ELECTRICITY AFFORDABLE TO PEOPLE IN UNDERDEVELOPED AREAS

While average electricity consumption figures indicate that households in underdeveloped areas of Ciskei could afford using electricity at the current tariff (7.5c/kWh), it is evident that at their level of income they do not have the financial resources to meet the electrification costs. Capital expenditure of this nature is usually recovered by a built-in charge in the tariff or by a flat monthly capital repayment charge. In the underdeveloped areas of Ciskei, where people are generally poor, such a system would mean a higher electricity bill than in more affluent urban areas, with the result that very few households would accept supply. Eskom has admitted that "our product is overpriced for penetration into low income areas" (Eskom, 1988a). In order, thus, to make electricity available in these areas at a cost that local households can afford it would be necessary to shield them from the capital costs of the distribution and reticulation networks. Government subsidisation of an electrification programme for underdeveloped areas would be an obvious solution if the government considers such a programme to be in the country's interest. The supply authority might furthermore take up a long-term loan with fixed interest rate for this purpose. Ideally, the interest rate should be below commercial rates but this would depend on the degree of subsidisation.

Another factor that discourages many households from accepting supply is the high cost of housewiring. Conventional housewiring at present standards would cost in

Rediboard

the vicinity of R700 per house but more appropriate technologies that could be installed at much lower cost have recently been developed. A Rediboard-type switchboard (generally consisting of prepayment meter with built-in MCB, several socket outlets and a light fitting), which can be safely mounted inside almost any residential structure, from a brick house to a mud hut to a tin shack, currently costs about R400 and the price will come down as this technology becomes more popular. The unit counter on the prepayment meter allows the household to adjust its electricity consumption according to its means and ability to pay, i.e. it becomes possible for the household to budget for electricity consumption. Another big advantage of such a system is that meter-reading and billing of consumers fall away.

4/11/1981

The purchase of new electrical appliances would also put a financial burden on most households in underdeveloped areas. Initially, many newly electrified households can only make limited use of electricity because they cannot afford to buy the desired electrical appliances all at once. It is therefore a general characteristic in newly electrified areas that the demand for electricity can take several years to reach a steady level. Financing schemes, in the form of low-interest loans, should be introduced to ease the costs of both housewiring and electrical appliances. In addition, it would be essential for an electrification programme to make provision for supporting infrastructure that promotes and maintains the supply of electricity. The availability of materials and appliances, and the availability of expertise to install electricity and repair appliances at reasonable prices will greatly enhance the possibility of households opting for electricity in favour of other commercially available household fuels.

People living in electrified areas in Ciskei indicated that they do not regard electricity in a very favourable light. Although its benefits are widely appreciated, electricity is perceived as an expensive source of energy to use in the household. This is in direct contrast to the finding that

electricity consumption is not more expensive than the consumption of other popular fuels that are used in these areas. Eberhard (1986: 9), summarising his own findings and those by Rivett-Carnac, also writes that "once the initial extension fee has been paid, electricity is in most cases cheaper than other fuels for cooking, heating and lighting." He argues that "this data clearly dispels the popular myth that most black households cannot afford electricity: the truth is that they can no longer afford not to have electricity." (ibid). To create a more positive image of electricity, making the use of this energy source more attractive and acceptable to poorer sections of the community, the supply authority should embark on a specific electricity marketing strategy for low income areas. At the centre of such a strategy would be an awareness programme that educates and informs potential consumers about the real costs and the safe and economic uses of electricity in the household. As part of their awareness programme in Bapong in Bophuthatswana, Eskom in conjunction with Becor have established a demonstration house where the advantages of electricity, but also different housewiring systems, can be demonstrated to the public. They have found that it is important to promote less expensive options in such a manner that people do not regard them as inferior technology (Eskom, 1988a). A major constraint on propagating less expensive designs are statutory regulations which demand certain safety standards that might not be appropriate in underdeveloped areas.

In summary, it is believed that electricity can be made affordable to people in underdeveloped areas by a scheme that addresses, on the one hand, the main problems of high tariffs, housewiring costs and appliance prices and, on the other hand, people's negative perceptions of electricity.

Comparison
with other
fuels

Model
non-consumer

6.4 CONCLUDING REMARKS

The extent of poverty in underdeveloped areas of Ciskei is fairly well documented, particularly in various conference papers for the Second Carnegie Inquiry into Poverty and Development in Southern Africa. Although most of these areas are in desperate need of more basic services than an electricity supply, electrification could well speed up a region's infrastructural development, even with respect to the most basic services like water supply in rural areas. It is realised, however, that the supply of electricity for household use alone will initially merely solve energy-related problems and will not directly address those more important issues. It is therefore doubtful whether a poor household would spend money on a luxury like electricity when its priorities lie somewhere else. Cowan, in his analysis of energy consumption patterns in developing countries (1986: 5), suggests that "in the medium term it is unlikely that rural electrification would displace fuelwood consumption in poor rural African areas: the costs of supply, relative to the concentration of demand, coupled with the facts that poor people are less likely to connect even when supplies are available, and that if they do, the usage is most likely to be restricted to lighting and low power appliances rather than extended to heating and stoves, suggest that the rural poor, who use fuelwood for most of their energy requirements, would be slow to switch to electricity, ... It would seem, then, that the justification for electrification in poor rural areas of developing countries cannot depend on residents' domestic energy needs (which are the predominant energy needs in these areas) taken in isolation from (a) the potential in a given area for electrification to raise productivity in agriculture and rural industry, and (b) political and social

reasons for electrification." While it is conceivable that electrification might trigger an increase in economic activity in underdeveloped areas of Ciskei, especially when promoted in a way that will stimulate entrepreneurial development, political and social reasons for the supply of electricity to these areas definitely do exist.

The philosophy behind the electrification of underdeveloped areas, as suggested by Eskom (1988a), should be "to develop a model for the supply of electricity to the people of Southern Africa who have minimum resources available to pay for it, in such a manner that they perceive it as a product they prefer and can afford". Although there are many constraints to the implementation of an electrification programme in unelectrified areas of Ciskei, the immediate and long-term benefits of supplying these areas with electricity are manifest: access to electricity has virtually become a basic need itself. Eberhard (1986: 10) puts it succinctly: "There is no doubt that by denying electricity to these [underdeveloped] areas, communities are further impoverished, by having to meet the higher costs of fuels such as coal, gas, paraffin, candles, and batteries, and quality of life expectations are frustrated by being denied the opportunities and benefits of electrification. This situation can only exacerbate an already deteriorating social and political climate in these areas."

It is not easy to attach a value to the potential social and economic benefits of electrification, or indeed even to its direct benefits for the household. Thus, even though the cost of electrification can be estimated with some certainty, it is not possible to assess whether or not the benefits of electrification outweigh the capital costs.

But, nevertheless, it is believed that the following conclusion can be reached:

Although

1. an electricity supply is not the highest priority among people living in the underdeveloped areas of Ciskei,
2. these people cannot afford the capital costs of electrification, and
3. no suitable organisation at present exists in Ciskei to plan and implement a major electrification scheme for underdeveloped areas,

it would seem that access to electricity is a prerequisite for any long-term development above a subsistence level.

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APPENDIX A

THE SURVEY QUESTIONNAIRES

SURVEY AMONG UNELECTRIFIED HOUSEHOLDS

TOWN/VILLAGE AND DISTRICT

NAME OF HOUSEHOLD BEING INTERVIEWED

1. OCCUPANCY

a) HOW MANY PEOPLE (INCLUDING MIGRANT WORKERS) LIVE IN YOUR HOUSEHOLD?

MEN

WOMEN

CHILDREN

b) HOW MANY OF THESE PEOPLE ARE EMPLOYED: LOCALLY?

AS MIGRANTS?

2. INCOME

WHAT IS YOUR MONTHLY HOUSEHOLD INCOME?

SOURCES OF INCOME	TOTAL AMOUNT PER MONTH
LOCAL WORKERS/BUSINESS	R
MIGRANT WORKERS	R
SALE OF CROPS AND/OR LIVESTOCK	R
PENSIONS	R
OTHER (specify) 1.	R
2.	R
3.	R
TOTAL MONTHLY INCOME	<u>R</u>

3. FUEL CONSUMPTION

a) WHICH OF THE FOLLOWING FUELS DO YOU USE?

FIREWOOD DUNG PARAFFIN

CROP RESIDUES COAL CHARCOAL

PETROL GENERATOR GAS CAR BATTERY

DIESEL GENERATOR CANDLES OTHER BATTERY.....

OTHER (specify)

b) WHAT ARE THE MAJOR PROBLEMS THAT YOU EXPERIENCE WITH THE FUELS YOU ARE USING?

.....

.....

.....

.....

- c) DO YOU CONSIDER THE FUELS YOU ARE USING AS BEING EXPENSIVE?
- d) HOW MUCH MONEY DO YOU APPROXIMATELY SPEND ON FUEL EACH MONTH?

TYPE OF FUEL	MONTHLY EXPENDITURE
FIREWOOD	R
CANDLES	R
PARAFFIN	R
COAL	R
CHARCOAL	R
GAS	R
PETROL (FOR GENERATOR)	R
DIESEL (FOR GENERATOR)	R
BATTERIES	R
OTHER (specify)	R
TOTAL MONTHLY EXPENDITURE	R

4. ELECTRICITY

- a) HAVE YOU ALREADY HAD EXPERIENCE WITH ELECTRICITY?
- b) IF ELECTRICITY WAS BROUGHT TO YOUR AREA WOULD YOU LIKE TO BE CONNECTED?
- c) IF NOT, WHY NOT?
- d) IF IT WOULD COST ABOUT R500.- TO HAVE ELECTRICITY INSTALLED INTO YOUR HOUSE, WOULD YOU BE PREPARED TO PAY THIS AMOUNT?
- e) WOULD YOU LIKE TO USE ELECTRICITY FOR
 - LIGHTING? WATER HEATING?
 - COOKING - HOTPLATE HOUSE HEATING?
 - STOVE (WITH OVEN)?
- f) WHAT ELSE WOULD YOU LIKE TO USE ELECTRICITY FOR?
 -
 -
 -
- g) DO YOU THINK THAT YOU COULD AFFORD TO BUY THE NECESSARY ELECTRICAL APPLIANCES?
- h) WHAT DO YOU THINK WOULD BE THE MAJOR BENEFITS OF ELECTRICITY
 - 1. FOR YOUR HOUSEHOLD?
 -
 - 2. FOR THE VILLAGE OR AREA?
 -
- i) WHAT DO YOU SEE AS DISADVANTAGES OF ELECTRIFICATION OR ELECTRICITY?
-
- j) ARE THERE OTHER DEVELOPMENT ISSUES THAT YOU THINK NEED MORE URGENT ATTENTION AT THE MOMENT THAN THE SUPPLY OF ELECTRICITY?
 -
 -
 -

SURVEY AMONG ELECTRIFIED HOUSEHOLDS

TOWN/TOWNSHIP AND DISTRICT
 NAME OF HOUSEHOLD BEING INTERVIEWED

1. OCCUPANCY

a) HOW MANY PEOPLE (INCLUDING MIGRANT WORKERS) LIVE IN YOUR HOUSEHOLD?

MEN WOMEN CHILDREN

b) HOW MANY OF THESE PEOPLE ARE EMPLOYED: LOCALLY?

AS MIGRANTS?

2. INCOME

WHAT IS YOUR MONTHLY HOUSEHOLD INCOME?

SOURCES OF INCOME	TOTAL AMOUNT PER MONTH
LOCAL WORKERS/BUSINESS	R
MIGRANT WORKERS	R
SALE OF CROPS AND/OR LIVESTOCK	R
PENSIONS	R
OTHER (specify) 1.	R
2.	R
3.	R
TOTAL MONTHLY INCOME	<u>R</u>

3. ELECTRICITY

a) FOR HOW LONG HAVE YOU HAD ACCESS TO ELECTRICITY?

b) WHICH OF THE FOLLOWING FUELS DO YOU USE IN ADDITION TO ELECTRICITY?

FIREWOOD DUNG PARAFFIN
 CROP RESIDUES COAL CHARCOAL
 PETROL GENERATOR GAS CAR BATTERY
 DIESEL GENERATOR CANDLES OTHER BATTERY.....
 OTHER (specify)

c) HOW MUCH MONEY DO YOU APPROXIMATELY SPEND ON FUEL EACH MONTH?

TYPE OF FUEL	MONTHLY EXPENDITURE
ELECTRICITY	R
FIREWOOD	R
CANDLES	R
PARAFFIN	R
COAL	R
CHARCOAL	R
GAS	R
PETROL (FOR GENERATOR)	R
DIESEL (FOR GENERATOR)	R
BATTERIES	R
OTHER (specify)	<u>R</u>
TOTAL MONTHLY EXPENDITURE	R

d) BEFORE YOU HAD ACCESS TO ELECTRICITY, HOW MUCH MONEY DID YOU APPROXIMATELY SPEND ON FUEL EACH MONTH?

	(TICK)	AMOUNT
MORE?	R
THE SAME?	
LESS?	R

e) DO YOU USE: AN ELECTRIC HOTPLATE?
 AN ELECTRIC STOVE (WITH OVEN)?
 A HOT-WATER CYLINDER (GEYSER)?

f) WHAT OTHER ELECTRICAL APPLIANCES DO YOU USE?

g) PRIORITY ELECTRICAL APPLIANCES TO BE ACQUIRED IN FUTURE?

h) AT WHAT TIMES OF THE DAY DO YOU USUALLY USE ELECTRICITY FOR COOKING?
 FOR LIGHTS (duration)?
 OTHERWISE (eg. washing machine)?

i) DO YOU THINK THAT YOU BENEFITED BY GETTING ELECTRICITY?

j) WHAT ARE THE MAJOR ADVANTAGES OF ELECTRICITY FOR YOU?

k) DO YOU THINK THAT ELECTRICITY HAS ANY DISADVANTAGES?

l) WHAT EFFECT, IF ANY, DID ELECTRICITY HAVE ON YOUR LIFESTYLE?

m) IS YOUR TRADITION NEGATIVELY AFFECTED BY THE USE OF ELECTRICITY?

APPENDIX B

DETAILED RESULTS OF THE SURVEY AMONG
UNELECTRIFIED HOUSEHOLDS

1. RURAL VILLAGES

RURAL VILLAGES: (no. of households interviewed)	WELCOME WOOD(10)	HLAKA- LAKA(10)	NGKOPU NGKOPU(10)	BUSHBY PARK(10)	GUBEVU (10)	LOVER NCERA(10)	GUTUBENI (10)	BUMLETS (10)	BELL (10)	average values
1. OCCUPANCY (village averages)										
men	1.7	2.0	2.9	1.2	1.7	2.6	1.1	1.8	2.0	1.9
women	1.6	2.2	2.1	1.0	1.2	2.7	1.4	2.4	1.5	1.8
children	3.9	3.6	4.3	3.3	3.4	3.2	2.3	4.3	4.2	3.6
total	7.2	7.8	9.3	5.5	6.3	8.5	4.8	8.5	7.7	7.3
2. EMPLOYMENT (village averages)										
local	1.1	1.7	0.6	0.4	0.8	1.2	0.5	0.4	0.6	0.8
migrants	0	0.9	1.9	0.5	0.9	1.3	0.4	1.4	1.1	0.9
total	1.1	2.6	2.5	0.9	1.7	2.5	0.9	1.8	1.7	1.7
3. MONTHLY INCOME										
a) AVERAGE HOUSEHOLD INCOME FOR HOUSEHOLDS HAVING SPECIFIED SOURCE (R/month)										
local workers/business	361	841	267	207	455	778	234	118	433	410
migrant workers	-	130	87	80	179	305	57	169	120	141
sale of crops/livestock	-	15	14	-	-	-	-	-	-	14
pensions	98	93	93	147	75	203	129	78	160	119
other	28	-	70	10	80	-	38	20	35	48
b) AVERAGE HOUSEHOLD INCOME FOR ALL SAMPLE HOUSEHOLDS (R/month)										
local workers/business	289	757	80	83	318	467	117	36	130	253
migrant workers	0	52	61	32	90	244	17	138	60	77
sale of crops/livestock	0	2	3	0	0	0	0	0	0	0
pensions	30	74	83	44	23	142	52	23	96	63
other	6	0	14	2	8	0	15	2	11	6
total monthly income	324	884	241	161	438	853	201	195	296	399
c) AVERAGE INCOME PER EMPLOYED PERSON (R/month)										
local workers/business	256	529	158	207	427	419	234	77	298	290
migrant workers	-	118	31	80	90	163	52	96	74	88
d) AVERAGE PER CAPITA INCOME (R/month)										
village averages:	43	101	29	43	106	88	123	21	44	67
4. FUEL CONSUMPTION										
a) FUELS THAT ARE BEING USED (% of interviewed households)										
firewood	100	60	100	80	90	80	70	100	90	86
paraffin	100	100	100	90	100	100	100	100	100	99
candles	20	70	100	50	70	80	70	80	50	66
car battery	30	20	10	10	0	10	0	0	10	18
other battery	80	80	90	70	90	90	100	100	90	88
gas	0	20	10	0	10	40	0	0	10	10
coal	0	0	20	0	0	10	0	0	0	3
charcoal	0	0	0	0	0	0	0	0	0	0
dung	0	50	100	50	70	80	70	30	20	52
crop residues	10	20	0	10	20	30	40	0	0	14
petrol generator	0	10	10	0	0	10	0	0	10	4
diesel generator	0	0	0	0	0	10	0	0	0	1
other	0	0	0	0	0	0	0	0	0	0
b) ARE THESE FUELS EXPENSIVE? (% of interviewed households)										
yes:	90	90	90	100	90	90	100	100	90	93
no:	10	10	10	0	10	10	0	0	10	7
c) OTHER PROBLEMS THAT ARE EXPERIENCED WITH THESE FUELS? (% of respective fuel users)										
firewood										
scarce:	40	33	0	63	11	50	29	20	33	31
distance:	40	17	20	0	11	13	85	10	0	22
smoky:	0	0	10	0	11	13	0	10	0	5
wet:	0	0	10	0	0	0	0	0	0	1
have to buy:	0	0	0	0	0	0	0	50	22	8
conservation:	0	0	0	0	0	0	0	0	0	0
gathering:	0	0	0	0	0	0	0	0	0	0
hire truck:	0	0	0	0	0	0	0	0	0	0
none:	50	50	60	38	67	38	0	30	44	42
paraffin										
smoky:	0	50	0	0	0	10	20	10	0	10
smelly:	0	10	0	0	0	0	10	0	0	2
dirty:	0	0	0	0	0	0	10	10	0	2
burns eyes:	0	0	0	0	0	0	0	0	0	0
availability:	20	0	10	11	0	10	10	10	0	8
have to buy:	0	0	0	0	0	10	20	0	0	3
burns fast:	0	0	0	0	0	0	0	40	0	4
none:	80	40	90	89	100	70	50	40	100	73
candles										
smoky:	0	0	0	0	0	0	0	0	0	0
fire hazard:	0	14	0	0	0	13	0	0	0	7
availability:	50	0	10	0	0	0	0	0	0	7
burn fast:	0	0	10	0	0	0	0	0	0	1
have to buy:	0	0	0	0	0	0	29	50	0	9
none:	50	86	80	100	100	88	71	50	100	81

RURAL VILLAGES (continued)

car battery	recharging:	33	50	0	0	0	100	0	0	0	31
-----	doesn't last:	33	0	100	0	0	0	0	0	0	22
	have to buy:	0	0	0	0	0	0	0	0	0	0
	none:	33	50	0	100	0	0	0	0	100	47
other battery	have to buy:	0	0	0	0	11	0	10	40	0	7
-----	doesn't last:	13	0	11	0	0	0	0	0	0	3
	availability:	25	0	22	0	0	0	0	0	0	5
	none:	63	100	67	100	89	100	90	60	100	85
gas	availability:	0	0	100	0	0	25	0	0	0	25
---	child hazard:	0	0	0	0	0	25	0	0	0	5
	burns fast:	0	0	0	0	0	0	0	0	0	0
	have to buy:	0	0	0	0	0	0	0	0	0	0
	dirty:	0	0	0	0	0	0	0	0	0	0
	smoky:	0	0	0	0	0	0	0	0	0	0
	none:	0	100	0	0	100	50	0	0	100	70
coal	availability:	0	0	50	0	0	0	0	0	0	25
---	none:	0	0	50	0	0	100	0	0	0	75
dung	smoky:	0	60	10	0	14	13	0	0	0	12
---	scarce:	0	20	0	80	0	25	0	67	0	24
	wet:	0	0	10	0	0	0	29	0	0	5
	distance:	0	0	0	0	0	0	0	0	0	0
	none:	0	40	80	20	86	75	71	33	100	63
crop residues	availability:	0	100	0	100	50	67	100	0	0	69
-----	burn fast:	0	0	0	0	0	0	0	0	0	0
	none:	100	0	0	0	50	33	0	0	0	31
petrol generator	fuel far:	0	0	0	0	0	100	0	0	0	25
-----	none:	0	100	100	0	0	0	0	0	100	75
diesel generator	none:	0	0	0	0	0	100	0	0	0	100
d) MONTHLY FUEL EXPENDITURE?											
(i) AVERAGE HOUSEHOLD FUEL EXPENDITURE FOR HOUSEHOLDS USING SPECIFIED FUEL (R/month)											
	firewood	0	17	0	25	10	11	0	13	29	12
	candles	6	6	2	4	5	5	2	3	1	4
	paraffin	9	20	11	13	24	16	11	9	15	14
	batteries	4	12	3	9	9	15	7	3	6	8
	gas	-	50	31	-	16	44	-	-	28	34
	coal	-	-	9	-	-	36	-	-	-	22
	charcoal	-	-	-	-	-	-	-	-	-	-
	petrol (for generator)	-	40	10	-	-	35	-	-	16	25
	diesel (for generator)	-	-	-	-	-	80	-	-	-	80
	other	-	-	-	-	-	-	-	-	-	-
(ii) AVERAGE HOUSEHOLD FUEL EXPENDITURE FOR ALL SAMPLE HOUSEHOLDS (R/month)											
	firewood	0	10	0	20	9	9	0	13	25	10
	candles	1	4	2	2	4	4	1	2	1	2
	paraffin	9	20	11	12	24	16	11	9	15	14
	batteries	3	11	2	7	8	14	7	3	5	7
	gas	0	10	3	0	2	18	0	0	3	4
	coal	0	0	2	0	0	4	0	0	0	1
	charcoal	0	0	0	0	0	0	0	0	0	0
	petrol (for generator)	0	4	1	0	0	4	0	0	2	1
	diesel (for generator)	0	0	0	0	0	0	0	0	0	1
	other	0	0	0	0	0	0	0	0	0	0
	total expenditure	13	59	22	40	46	75	19	27	51	39
(iii) TOTAL HOUSEHOLD FUEL EXPENDITURE AS A PERCENTAGE OF TOTAL MONTHLY HOUSEHOLD INCOME (%)											
	village averages:	16	10	10	30	14	16	20	25	20	18
5. ELECTRICITY											
(X of interviewed households)											
a) PREVIOUS EXPERIENCE?	yes:	40	80	50	40	80	90	40	70	50	60
	no:	60	20	50	60	20	10	60	30	50	40
(X of interviewed households)											
b) IN FAVOUR OF ELECTRIFICATION?	yes:	40	80	100	40	90	90	90	100	80	79
	no:	60	20	0	60	10	10	10	0	20	21
(X of interviewed non-enthusiasts)											
IF NOT, WHY NOT?	expenses:	0	100	0	67	100	0	0	0	50	45
	too old:	0	0	0	17	0	100	0	0	0	17
	never used:	33	0	0	17	0	0	100	0	0	21
	no house:	0	0	0	0	0	0	0	0	0	0
	dangerous:	67	0	0	0	0	0	0	0	50	17
(X of interviewed households)											
c) PREPARED TO PAY AN INITIAL R500?	yes:	20	80	50	50	67	89	56	70	88	64
	no:	80	13	50	50	33	11	44	30	13	36

RURAL VILLAGES (continued)

d) PREFERRED USES? (X of enthusiasts)										
lighting	80	100	100	100	100	100	100	100	100	98
cooking	100	100	80	83	89	100	100	100	100	93
baking	80	100	80	83	89	100	100	100	100	91
water heating	100	100	90	83	78	100	100	100	100	93
house heating	80	88	90	83	78	89	100	100	100	88
refridgeration	20	88	40	33	22	78	44	10	13	39
ironing	60	88	80	33	78	56	56	80	63	66
radio/HiFi/TV	40	88	40	33	44	56	33	40	38	46
other household appliances	0	50	50	17	11	44	22	0	13	23
workshop appliances	0	38	20	17	33	33	11	0	13	18
everything	0	38	20	17	11	33	11	0	13	16
e) WOULD HOUSEHOLDS BUY THE NECESSARY APPLIANCES? (X of enthusiasts)										
yes:	20	88	30	33	78	89	67	50	88	60
no:	80	13	70	67	22	11	33	50	13	40
f) MAJOR BENEFITS FOR THE HOUSEHOLD? (X of enthusiasts)										
economical	0	56	20	33	11	33	11	20	33	24
cheaper appliances	0	0	0	0	0	11	0	0	0	1
clean/no smoke	0	33	50	0	22	44	0	10	11	19
neat	0	0	20	0	0	11	22	10	0	7
quick	0	22	70	67	67	44	67	80	22	49
safe	0	0	0	0	0	0	0	0	11	1
versatile	25	33	10	0	33	0	0	10	22	15
easy to use/convenient	50	78	40	50	33	33	11	20	0	38
gives bright light	0	11	30	33	11	11	78	0	33	23
no energy problems	75	11	10	17	22	22	0	40	11	23
makes no noise	0	0	0	0	0	0	0	0	0	0
hot water/warm house	0	0	10	17	0	0	22	0	0	5
g) BENEFITS FOR COMMUNITY? (X of enthusiasts)										
lights	-	-	20	17	11	0	22	20	22	16
less crime (streellights)	-	-	10	33	44	44	89	40	33	42
solves energy problems	-	-	10	0	22	22	0	10	22	12
makes life easy	-	-	30	17	22	11	0	30	22	19
improves living standard	-	-	18	0	0	11	11	10	11	8
creates job opportunities	-	-	0	0	22	0	0	0	0	3
evening schools	-	-	0	0	0	0	0	0	0	0
refridgeration in shops	-	-	0	0	0	0	0	0	0	0
no lightning stroke	-	-	0	0	0	0	0	20	0	3
h) DISADVANTAGES? (X of interviewed households)										
electrocution	33	0	10	0	0	11	20	0	0	8
child hazard	33	0	0	17	0	11	20	10	0	10
expenses/repairs	0	0	0	0	0	0	0	0	0	0
none	33	100	90	83	100	78	60	90	100	82
i) OTHER NEEDS THAT REQUIRE MORE URGENT ATTENTION THAN ELECTRICITY? (X of interviewed households)										
water supply	100	10	40	60	80	70	100	100	60	64
better education/schools	100	80	70	90	60	30	70	30	20	61
employment	70	20	40	80	50	40	10	20	10	38
higher salaries/pension	0	10	70	20	20	30	0	0	0	17
feeding scheme for people	0	0	0	0	0	0	10	0	0	1
healthcare facilities	0	0	8	0	0	0	100	40	10	17
agricultural development	0	10	0	0	0	0	50	60	20	16
better housing	0	0	0	0	0	0	10	0	10	2
toilets/sanitation	0	0	0	0	0	20	0	10	10	4
church/cemetery	0	0	0	0	0	0	80	20	0	11
shops	0	0	0	0	0	0	40	0	0	4
telephones	0	0	0	0	0	0	20	10	10	4
creche/playgrounds	0	0	0	0	0	0	0	0	10	1
transport/better roads	0	0	0	0	0	0	20	30	30	9
recreation facilities	0	0	0	0	0	0	0	0	0	0
none	0	10	0	10	10	20	0	0	0	6

2. TOWNS/TOWNSHIPS

TOWNS/TOWNSHIPS: (no. of households interviewed)	NDANTSANE (16)	PHAKAMISA (20)	SEYHOUR (20)	PEDDIE (20)	HANBURG (20)	FRANKFORT (10)	average values
1. OCCUPANCY (town averages)							
men	1.4	1.7	1.7	1.9	1.5	1.8	1.6
women	2.0	2.1	2.2	2.1	1.8	2.1	2.0
children	2.4	4.0	3.2	3.4	3.2	3.2	3.2
total	5.9	7.8	7.0	7.3	6.4	7.1	6.9
2. EMPLOYMENT (town averages)							
local	1.6	1.8	0.6	1.1	1.3	0.7	1.2
migrants	0.1	0.5	1.5	1.0	0.5	1.2	0.8
total	1.8	2.2	2.0	2.1	1.8	1.9	1.9
3. MONTHLY INCOME							
a) AVERAGE HOUSEHOLD INCOME FOR HOUSEHOLDS HAVING SPECIFIED SOURCE (R/month)							
local workers/business	737	429	459	303	219	438	444
migrant workers	150	146	170	126	158	225	163
sale of crops/livestock	-	-	60	-	-	-	80
pensions	75	75	123	75	83	138	95
other	12	75	134	175	105	200	117
b) AVERAGE HOUSEHOLD INCOME FOR ALL SAMPLE HOUSEHOLDS (R/month)							
local workers/business	691	408	161	268	187	305	337
migrant workers	19	37	119	75	48	113	68
sale of crops/livestock	0	0	3	0	0	0	1
pensions	14	19	49	19	37	41	30
other	2	15	27	26	11	20	17
total monthly income	726	478	359	388	282	479	452
c) AVERAGE INCOME PER EMPLOYED PERSON (R/month)							
local workers/business	379	267	272	171	170	436	282
migrant workers	150	126	99	111	125	188	120
d) AVERAGE PER CAPITA INCOME (R/month)							
town averages:	163	78	54	76	85	95	89
4. FUEL CONSUMPTION							
a) FUELS THAT ARE BEING USED (Z of interviewed households)							
firewood	13	20	90	75	90	90	63
paraffin	100	100	95	100	95	100	98
candles	19	70	90	65	80	60	64
car battery	13	20	10	5	5	30	14
other battery	81	85	80	70	85	100	84
gas	6	10	5	30	30	40	20
coal	0	0	5	0	0	0	1
charcoal	0	0	0	0	0	0	0
dung	0	0	20	20	35	40	19
crop residues	0	0	5	5	5	10	4
petrol generator	0	0	5	5	0	0	2
diesel generator	0	0	0	5	0	0	1
other	0	0	0	0	0	0	0
b) ARE THESE FUELS EXPENSIVE? (Z of interviewed households)							
yes:	61	90	85	85	100	90	89
no:	19	10	15	15	0	10	11
c) OTHER PROBLEMS THAT ARE EXPERIENCED WITH THESE FUELS? (Z of respective fuel users)							
firewood							
scarce:	0	0	44	8	11	11	11
distance:	50	25	28	13	0	0	19
smoky:	0	0	17	0	17	11	7
wet:	0	0	6	0	0	0	1
have to buy:	0	0	6	33	28	0	11
conservation:	0	0	0	40	0	11	9
gathering:	0	0	0	0	6	11	3
hire truck:	0	0	0	0	6	0	1
none:	50	75	28	27	56	56	48
paraffin							
smoky:	56	55	16	35	5	10	30
smelly:	0	0	0	10	5	0	3
dirty:	19	5	5	15	0	0	7
burns eyes:	6	5	5	5	0	10	5
availability:	0	0	0	0	0	0	0
have to buy:	0	0	0	5	11	10	4
burns fast:	0	0	0	5	0	0	1
none:	44	45	84	50	79	70	62
candles							
smoky:	0	7	0	0	6	0	2
fire hazard:	0	14	0	0	0	0	2
availability:	0	0	0	0	0	0	0
burn fast:	0	0	0	8	0	0	1
have to buy:	0	0	0	0	13	17	5
none:	100	79	100	92	81	83	89

TOWNS/TOWNSHIPS (continued)

car battery	recharging:	0	0	100	0	0	0	17
	doesn't last:	0	50	0	0	0	33	14
	have to buy:	0	0	0	0	0	33	6
	none:	100	50	0	100	100	33	64
other battery	have to buy:	0	0	0	7	6	10	4
	doesn't last:	0	29	13	7	0	10	11
	availability:	0	0	0	0	0	0	1
	none:	85	71	88	86	94	80	84
gas	availability:	0	0	100	0	0	0	17
	child hazard:	0	0	0	0	0	0	0
	burns fast:	0	0	0	17	0	0	3
	have to buy:	0	0	0	0	0	25	4
	dirty:	0	0	0	0	0	25	4
	smoky:	0	0	0	0	0	25	4
	none:	100	100	0	83	100	25	68
coal	availability:	0	0	100	0	0	0	100
	none:	0	0	0	0	0	0	0
dung	smoky:	0	0	25	0	0	25	13
	scarce:	0	0	0	0	0	0	0
	wet:	0	0	0	0	0	0	0
	distance:	0	0	0	25	0	0	6
	none:	0	0	75	75	100	75	81
crop residues	availability:	0	0	0	100	0	100	50
	burn fast:	0	0	100	0	0	0	25
	none:	0	0	0	0	100	0	25
petrol generator	fuel far:	0	0	0	0	0	0	0
	none:	0	0	100	100	0	0	100
diesel generator	none:	0	0	0	100	0	0	100
d) MONTHLY FUEL EXPENDITURE								
(i) AVERAGE HOUSEHOLD FUEL EXPENDITURE FOR HOUSEHOLDS USING SPECIFIED FUEL (R/month)								
firewood		20	1	15	11	4	1	9
candles		3	4	3	2	2	2	3
paraffin		16	20	18	15	7	15	15
batteries		8	10	9	12	5	10	9
gas		48	29	7	32	15	23	26
coal		-	-	0	-	-	-	0
charcoal		-	-	-	-	-	-	-
petrol (for generator)		-	-	3	20	-	-	12
diesel (for generator)		-	-	-	20	-	-	20
other		-	-	-	-	-	-	-
(ii) AVERAGE HOUSEHOLD FUEL EXPENDITURE FOR ALL SAMPLE HOUSEHOLDS (R/month)								
firewood		3	8	14	8	4	1	5
candles		1	3	3	2	1	1	2
paraffin		16	20	17	15	7	15	15
batteries		7	9	7	9	5	10	8
gas		3	3	0	10	5	9	5
coal		0	0	0	0	0	0	0
charcoal		0	0	0	0	0	0	0
petrol (for generator)		0	0	0	1	0	0	0
diesel (for generator)		0	0	0	1	0	0	0
other		0	0	0	0	0	0	0
total expenditure		30	35	42	44	22	36	35
(iii) TOTAL HOUSEHOLD FUEL EXPENDITURE AS A PERCENTAGE OF TOTAL MONTHLY HOUSEHOLD INCOME (X)								
town averages:		9	9	19	15	12	10	12
5. ELECTRICITY								
a) PREVIOUS EXPERIENCE? (X of interviewed households)								
yes:		81	75	65	55	60	90	71
no:		19	25	35	45	40	10	29
b) IN FAVOUR OF ELECTRIFICATION? (X of interviewed households)								
yes:		94	100	85	80	90	100	91
no:		6	0	15	20	10	0	9
IF NOT, WHY NOT? (X of interviewed non-enthusiasts)								
expenses:		100	0	33	50	50	0	58
too old:		0	0	0	0	0	0	0
never used:		0	0	0	25	0	0	6
no house:		0	0	67	0	50	0	29
dangerous:		0	0	0	25	0	0	6
c) PREPARED TO PAY AN INITIAL R500? (X of interviewed households)								
yes:		80	85	83	81	44	90	77
no:		20	15	17	19	56	10	23

TOWNS/TOWNSHIPS (continued)

d) PREFERRED USES? (X of enthusiasts)							
lighting	100	100	100	100	100	100	100
cooking	100	100	100	100	94	100	99
baking	100	100	94	100	94	100	98
water heating	87	100	100	100	94	100	97
house heating	93	95	100	94	94	90	94
refridgeration	53	65	44	44	44	40	48
ironing	80	85	78	69	61	90	77
radio/Wifi/TV	87	80	56	44	50	60	63
other household appliances	40	55	33	44	22	60	41
workshop appliances	7	50	28	25	33	30	29
everything	7	50	22	25	22	10	23
e) WOULD HOUSEHOLDS BUY THE NECESSARY APPLIANCES? (X of enthusiasts)							
yes:	53	85	61	69	39	100	68
no:	47	15	39	31	61	0	32
f) MAJOR BENEFITS FOR THE HOUSEHOLD? (X of enthusiasts)							
economical	60	55	39	35	6	30	37
cheaper appliances	0	0	0	6	0	10	3
clean/no smoke	60	40	22	18	33	40	36
neat	7	40	6	6	0	10	11
quick	13	50	50	41	56	50	43
safe	0	0	6	6	0	0	2
versatile	7	10	11	6	6	10	8
easy to use/convenient	47	20	56	35	56	20	39
gives bright light	7	0	17	41	39	30	22
no energy problems	13	25	22	29	11	10	19
makes no noise	0	0	0	0	6	0	1
hot water/warm house	0	0	0	0	6	0	1
g) BENEFITS FOR COMMUNITY? (X of enthusiasts)							
lights	-	-	28	12	39	40	38
less crime (streetlights)	-	-	33	18	39	20	27
solves energy problems	-	-	17	6	6	30	15
makes life easy	-	-	22	0	17	0	10
improves living standard	-	-	6	0	11	10	7
creates job opportunities	-	-	0	0	0	0	0
evening schools	-	-	0	0	0	10	3
refridgeration in shops	-	-	0	0	0	10	3
no lightning stroke	-	-	0	0	0	0	0
h) DISADVANTAGES? (X of interviewed households)							
electrocution	0	7	5	6	0	0	3
child hazard	17	0	15	12	0	0	7
expenses/repairs	33	7	5	6	0	0	8
none	50	87	80	76	100	100	82
i) OTHER NEEDS THAT REQUIRE MORE URGENT ATTENTION THAN ELECTRICITY? (X of interviewed households)							
water supply	0	0	42	15	80	100	40
better education/schools	94	75	63	20	55	20	54
employment	56	55	63	30	20	10	39
higher salaries/pension	25	30	16	15	60	0	24
feeding scheme for people	0	0	0	8	0	10	2
healthcare facilities	0	0	5	0	10	0	3
agricultural development	0	0	0	5	5	0	2
better housing	0	0	5	15	20	10	8
toilets/sanitation	0	0	5	15	0	20	7
church/cemetery	0	0	0	5	0	0	1
shops	0	0	0	0	5	0	1
telephones	0	0	0	0	0	20	3
creche/playgrounds	0	0	0	0	10	10	3
transport/better roads	0	0	0	0	5	10	3
recreation facilities	0	0	0	0	5	0	1
none	6	10	11	30	0	0	9

APPENDIX C

DETAILED RESULTS OF THE SURVEY AMONG
ELECTRIFIED HOUSEHOLDS

1. TOWNSHIPS

SURVEY TOWNSHIPS: (no. of households interviewed)	DIMBAZA (10)	ILITHA (10)	ZWELITSHA (20)	average values
1. OCCUPANCY (township averages)				
men	1.2	1.1	1.3	1.2
women	2.0	1.4	1.8	1.7
children	4.6	3.3	4.0	4.0
total	7.8	5.8	7.0	6.9
2. EMPLOYMENT (township averages)				
local	1.8	1.6	1.7	1.7
migrants	0.1	0.0	0.2	0.1
total	1.9	1.6	1.9	1.8
3. MONTHLY INCOME				
a) AVERAGE HOUSEHOLD INCOME FOR HOUSEHOLDS HAVING SPECIFIED SOURCE (R/month)				
local workers/business	1383	850	1158	1130
migrant workers	150	-	230	190
sale of crops/livestock	-	-	-	-
pensions	-	120	80	100
other	800	400	140	447
b) AVERAGE HOUSEHOLD INCOME FOR ALL SAMPLE HOUSEHOLDS (R/month)				
local workers/business	1383	850	926	1053
migrant workers	15	0	23	13
sale of crops/livestock	0	0	0	0
pensions	0	12	24	12
other	80	40	14	45
total monthly income	1478	902	987	1122
c) AVERAGE INCOME PER WORKING PERSON (R/month)				
local workers/business	737	557	558	617
migrant workers	150	-	130	140
d) AVERAGE PER CAPITA INCOME (R/month) (township averages)				
	268	217	152	212
4. ELECTRICITY				
a) HOW LONG IS ELECTRICITY AVAILABLE ALREADY? average years:				
	6.0	2.6	4.5	4.4
b) OTHER FUELS BEING USED (% of interviewees)				
firewood	0	0	0	0
paraffin	0	30	30	20
candles	0	0	0	0
car battery	0	0	0	0
other battery	0	0	0	0
gas	30	10	10	17
coal	0	0	0	0
charcoal	0	0	0	0
dung	0	0	0	0
crop residues	0	0	0	0
petrol generator	0	0	0	0
diesel generator	0	0	0	0
other	0	0	0	0
c) MONTHLY FUEL EXPENDITURE				
(i) AVERAGE HOUSEHOLD FUEL EXPENDITURE FOR HOUSEHOLDS USING SPECIFIED FUEL (R/month)				
electricity	55	34	40	43
firewood	-	-	-	-
candles	-	-	-	-
paraffin	-	6	10	8
batteries	-	-	-	-
gas	57	24	4	28
coal	-	-	-	-
charcoal	-	-	-	-
petrol (for generator)	-	-	-	-
diesel (for generator)	-	-	-	-
other	-	-	-	-
(ii) AVERAGE HOUSEHOLD FUEL EXPENDITURE FOR ALL SAMPLE HOUSEHOLDS (R/month)				
electricity	55	34	40	43
firewood	0	0	0	0
candles	0	0	0	0
paraffin	0	2	3	2
batteries	0	0	0	0
gas	17	3	0	7
coal	0	0	0	0
charcoal	0	0	0	0
petrol (for generator)	0	0	0	0
diesel (for generator)	0	0	0	0
other	0	0	0	0
total expenditure	72	38	43	51

TOWNSHIPS (continued)

(iii) TOTAL HOUSEHOLD FUEL EXPENDITURE AS A PERCENTAGE OF TOTAL MONTHLY HOUSEHOLD INCOME (%)				
township averages:				
	6	5	14	9
d) FUEL EXPENDITURE BEFORE ELECTRICITY WAS AVAILABLE? (% of interviewees)				
more:	0	20	55	25
same:	10	20	0	10
less:	90	60	45	65
amount (R):	41	29	47	39
e) ELECTRICAL APPLIANCES BEING USED (% of interviewees)				
hotplate	0	80	90	57
stove (with oven)	90	60	60	70
geyser	30	10	5	15
kettle	90	60	65	72
TV	90	90	80	87
HiFi/radio	90	70	65	75
iron	80	60	75	72
refrigerator	90	10	80	60
washing machine	10	0	10	7
fan	50	10	15	25
heater	70	40	45	52
power tools	10	10	5	6
vacuum cleaner	30	10	20	20
f) PRIORITIES FOR APPLIANCES TO BE ACQUIRED IN THE FUTURE (% of respondents)				
hotplate	0	0	0	0
stove (with oven)	50	67	50	56
geyser	50	17	0	22
kettle	50	0	50	33
TV	0	0	50	17
HiFi/radio	0	17	0	6
iron	50	67	0	39
refrigerator	50	100	100	83
washing machine	0	17	0	6
fan	0	17	0	6
heater	50	33	50	44
g) TIME OF DAY OF ELECTRICITY CONSUMPTION				
(i) FOR COOKING (% of respondents)				
morning:	0	0	0	0
day:	0	0	30	10
afternoon/evening:	100	100	75	92
(ii) FOR OTHER ELECTRICAL APPLIANCES (% of respondents)				
morning:	0	0	0	0
day:	56	30	75	54
evening:	44	70	25	46
(iii) FOR LIGHTS (hours/day)	4.0	3.2	3.5	3.6
h) IS ELECTRICITY OF BENEFIT? (% of interviewees)				
yes:	100	100	100	100
no:	0	0	0	0
i) MAJOR ADVANTAGES OF ELECTRICITY? (% of interviewees)				
quick	90	90	75	85
clean/no smoke	60	80	70	70
bright lights	50	10	15	25
economical	20	50	35	35
neat	50	80	50	60
safe/healthy	0	0	20	7
versatile	40	10	30	27
easy to use/convenient	30	30	50	37
no energy problems	50	0	40	30
safety (less burglaries)	0	0	0	0
hot water/warm house	0	0	0	0
j) DISADVANTAGES OF ELECTRICITY? (% of interviewees)				
electrocution	0	0	10	3
child hazard	0	0	10	3
expensive	40	0	40	27
expenses/repairs	20	10	0	10
power cuts	70	60	55	62
cannot predict bill	0	0	5	2
none	0	30	15	15
k) HOW IS PEOPLE'S LIFESTYLE AFFECTED BY ELECTRICITY? (% of interviewees)				
more comfortable	80	100	100	93
higher living standard	30	20	35	28
dependence	0	0	0	0
none	0	0	0	0
l) IS TRADITION LOST? (% of respondents)				
yes:	0	0	5	2
no:	100	100	95	98

2. TOWNS

SURVEY TOWNS: (no. of households interviewed)	ALICE (10)	KEISKAMMA- HDEK (10)	MIDDLE- DRIFT (6)	PEDDIE (10)	average values
1. OCCUPANCY (town averages)					
men	1.2	1.3	2.5	3.0	2.0
women	2.2	1.3	3.7	2.7	2.5
children	2.4	3.5	1.3	2.2	2.4
total	5.8	6.1	7.5	7.9	6.8
2. EMPLOYMENT (town averages)					
local	1.8	1.7	4.5	4.1	3.0
migrants	0.1	0.0	0.0	0.0	0.0
total	1.9	1.7	4.5	4.1	3.1
3. MONTHLY INCOME					
a) AVERAGE HOUSEHOLD INCOME FOR HOUSEHOLDS HAVING SPECIFIED SOURCE (R/month)					
local workers/business	1634	1938	3500	3260	2583
migrant workers	200	-	-	-	200
sale of crops/livestock	-	-	-	-	-
pensions	180	333	-	200	238
other	200	200	-	-	200
b) AVERAGE HOUSEHOLD INCOME FOR ALL SAMPLE HOUSEHOLDS (R/month)					
local workers/business	1471	1550	3500	3260	2445
migrant workers	20	0	0	0	5
sale of crops/livestock	0	0	0	0	0
pensions	36	133	0	20	47
other	20	20	0	0	10
total monthly income	1547	1703	3500	3280	2508
c) AVERAGE INCOME PER WORKING PERSON (R/month)					
local workers/business	776	823	1262	1312	1043
migrant workers	200	-	-	-	200
d) AVERAGE PER CAPITA INCOME (R/month) (town averages)					
	247	262	563	558	407
4. ELECTRICITY					
a) HOW LONG IS ELECTRICITY AVAILABLE ALREADY? average years:					
	11.3	5.6	2.8	6.8	6.6
b) OTHER FUELS BEING USED (% of interviewed households)					
firewood	0	70	0	0	18
paraffin	60	60	50	30	50
candles	0	0	17	0	4
car battery	0	0	0	0	0
other battery	0	0	0	0	0
gas	10	40	67	70	47
coal	10	10	0	0	5
charcoal	0	0	0	0	0
dung	0	0	0	0	0
crop residues	0	0	0	0	0
petrol generator	0	10	0	0	3
diesel generator	0	0	0	0	0
other	0	0	0	0	0
c) MONTHLY FUEL EXPENDITURE					
(i) AVERAGE HOUSEHOLD FUEL EXPENDITURE FOR HOUSEHOLDS USING SPECIFIED FUEL (R/month)					
electricity	66	68	83	56	68
firewood	-	12	-	-	12
candles	-	-	5	-	5
paraffin	4	15	30	12	15
batteries	-	-	-	-	-
gas	10	11	33	44	24
coal	40	10	-	-	25
charcoal	-	-	-	-	-
petrol (for generator)	-	15	-	-	15
diesel (for generator)	-	-	-	-	-
other	-	-	-	-	-
(ii) AVERAGE HOUSEHOLD FUEL EXPENDITURE FOR ALL SAMPLE HOUSEHOLDS (R/month)					
electricity	66	68	83	56	68
firewood	0	9	0	0	2
candles	0	0	1	0	0
paraffin	3	9	15	3	8
batteries	0	0	0	0	0
gas	0	3	22	33	15
coal	4	1	0	0	1
charcoal	0	0	0	0	0
petrol (for generator)	0	2	0	0	0
diesel (for generator)	0	0	0	0	0
other	0	0	0	0	0
total expenditure	73	91	121	92	94

TOWNS (continued)

(iii) TOTAL HOUSEHOLD FUEL EXPENDITURE AS A PERCENTAGE OF TOTAL MONTHLY HOUSEHOLD INCOME	town averages (%):				6
	7	11	4	3	
d) FUEL EXPENDITURE BEFORE ELECTRICITY WAS AVAILABLE? (% of interviewed households)					
more:	0	10	33	22	16
same:	0	20	17	11	12
less:	100	70	50	67	72
amount (R):	34	63	101	57	63
e) ELECTRICAL APPLIANCES BEING USED (% of interviewed households)					
hotplate	50	60	83	40	58
stove (with oven)	80	50	33	30	48
geyser	40	30	17	0	22
kettle	50	10	50	10	30
TV	50	90	67	80	72
HiFi/radio	80	30	83	50	61
iron	60	90	67	60	69
refrigerator	90	70	50	40	63
washing machine	0	20	0	0	5
fan	20	30	33	20	26
heater	20	50	50	20	35
power tools	0	20	0	0	5
vacuum cleaner	20	30	0	20	18
f) PRIORITIES FOR ELECTRICAL APPLIANCES TO BE ACQUIRED IN THE FUTURE (% of respondents)					
hotplate	0	0	50	0	13
stove (with oven)	25	50	50	75	50
geyser	25	50	0	0	19
kettle	25	100	0	0	31
TV	50	50	0	50	38
HiFi/radio	0	0	0	25	6
iron	75	50	100	75	75
refrigerator	25	100	0	100	56
washing machine	0	50	0	0	13
fan	0	50	0	0	13
heater	0	50	50	0	25
g) TIME OF DAY OF ELECTRICITY CONSUMPTION					
(i) FOR COOKING (% of respondents)					
morning:	0	43	0	29	18
day:	13	43	0	14	17
afternoon/evening:	88	57	100	86	83
(ii) FOR OTHER ELECTRICAL APPLIANCES (% of respondents)					
morning:	0	0	0	0	0
day:	20	60	50	50	45
evening:	80	50	67	50	62
(iii) FOR LIGHTS (hours/day)	2.9	3.4	5.7	4.3	4.1
h) IS ELECTRICITY OF BENEFIT? (% of interviewed households)					
yes:	100	100	100	100	100
no:	0	0	0	0	0
i) MAJOR ADVANTAGES OF ELECTRICITY? (% of interviewed households)					
quick	70	80	100	30	70
clean/no smoke	40	40	50	40	43
bright lights	60	30	17	50	39
economical	30	10	17	10	17
neat	40	40	50	40	43
safe/healthy	20	0	17	20	14
versatile	30	60	17	10	29
easy to use/convenient	40	60	50	70	55
no energy problems	30	50	33	50	41
safety (less burglaries)	0	30	0	0	8
hot water/warm house	0	10	0	0	3
j) DISADVANTAGES OF ELECTRICITY? (% of interviewed households)					
electrocution	50	50	33	10	36
child hazard	20	40	17	0	19
expensive	50	40	0	20	28
expenses/repairs	10	10	17	10	12
power cuts	30	40	33	50	38
cannot predict bill	10	10	0	0	5
none	20	10	33	40	26
k) HOW IS PEOPLE'S LIFESTYLE AFFECTED BY ELECTRICITY? (% of interviewed households)					
more comfortable	100	100	100	78	94
higher living standard	0	20	17	44	20
dependence	0	10	17	11	9
none	0	0	0	11	3
l) IS TRADITION LOST? (% of respondents)					
yes:	0	60	50	0	28
no:	100	40	50	100	73

APPENDIX D

PRICES OF THE COMPONENTS OF THE LOW VOLTAGE RETICULATION SYSTEMS

22kV/400V POLE-MOUNTED MINIATURE SUBSTATIONS/TRANSFORMERS

(supplier: Power Engineers (Pty) Ltd, Cape Town)

The table below presents Power Engineers' February 1989 budget prices (i.e. excluding transport and installation costs and general sales tax) for the 50kVA and 100kVA pole-mounted transformers and for the 160kVA, 200kVA and 315kVA 'Peanut' pole-mounted miniature substations. The budget prices for the 50kVA and 100kVA 'Peanut' are estimates by the author based on the quoted transformer prices and an assumed cost of R5000 for the low voltage switchgear chamber.

rating	type	budget price
50 kVA	transformer	R 5 300
50 kVA	'Peanut'	R 10 300
100 kVA	transformer	R 7 390
100 kVA	'Peanut'	R 12 390
160 kVA	'Peanut'	R 13 875
200 kVA	'Peanut'	R 14 735
315 kVA	'Peanut'	R 17 026

The pole-mounted transformers are completely self-protected and sealed, with open bushings and oil-immersed HV fuses between the HV bushings and windings as well as oil circuit breakers (OCBs) between the LV windings and bushings. The OCBs are operated with padlockable lever type handles.

The 'Peanut' pole-mounted miniature substation comprises the self-protected and sealed transformer with the same features as described above and a waterproof padlockable low voltage switchgear chamber with a set of busbars, four feeder MCBS and streetlighting control including three single pole MCBS.

THREE PHASE AERIAL BUNDLE CONDUCTOR

(supplier: Bernard Dudley, Cape Town)

Three phase ABC includes streetlighting. The prices quoted are for December 1988.

current rating	cross-sectional area	price per meter
130 A	35 mm ²	R 9.75
165 A	50 mm ²	R 11.50
205 A	70 mm ²	R 13.51
250 A	95 mm ²	R 16.02
290 A	120 mm ²	R 18.57

OTHER COMPONENTS

(suppliers: Bernard Dudley and GEC, Cape Town)

The prices quoted are for December 1988.

I T E M	P R I C E
three core <u>service connection cable</u> , includes earth cable, 10 mm cross-sectional area	R 4.50/meter
<u>Connectors</u>	R 10.50 each
10 meter high <u>wooden poles</u>	R 115.00 each
<u>Stays</u>	R 125.00 each
<u>Strain clamps</u>	R 45.00 each
<u>Suspension clamps</u>	R 27.00 each
80W mercury vapour <u>streetlights</u> (including arm)	R 129.00 each

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