HOUSEHOLD ENERGY USE IN NAMAQUALAND URBAN AREAS

A study of household energy consumption patterns in eleven un-electrified urban settlements

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ABSTRACT

Current household energy consumption patterns have been examined for the black and coloured urban settlements in Namaqualand of Port Nolloth, Pofadder, Garies, Vioolsdrif, Kamieskroon, Onseepkans, Nababeep, Bergsig, Okiep, Matjieskloof, and Hondeklipbaai. These settlements have either no, or only partial access to, electricity. Fuels used, expenditure on energy, preferred energy sources, and problems regarding energy supply have been studied. Gas is the most widely used fuel in the area, although wood and paraffin are more important energy sources in a few settlements. There is a strong preference for electricity in all areas. Grid electrification using the Eskom "S1" tariff system is clearly affordable in most settlements, and it is likely to reduce current energy expenditure levels. Full electrification with community participation is recommended for all settlements except for Vioolsdrif and Onseepkans, where the need for a more detailed study has been identified.

EXECUTIVE SUMMARY

Project objectives & methodology

The project objectives were to examine energy use patterns in the largely unelectrified coloured and black urban settlements of Namaqualand where residents either have no, or only partial access to electricity, and to formulate initial recommendations with respect to energy supply in the area. The settlements studied were : Port Nolloth, Pofadder, Garies, Vioolsdrif, Kamieskroon, Onseepkans, Nababeep, Bergsig, Okiep, Matjieskloof, and Hondeklipbaai.

Information was gathered by means of interviews based on questionnaires. In total, 572 questionnaires were completed. Information was also gathered from local authorities and community organizations.

Settlement characteristics, energy use patterns, and recommendations are summarised in the table on page vi.

Background to the area

Namaqualand is an arid region with a sparse population and little agricultural potential. The population in Namaqualand totals about 70 000, of which approximately 80% are coloured, 15% white, and the remainder black. This project covered about 45% of the total population of the area. Mining is the major economic activity in the region, and fishing is carried out along the west coast. Many people lead migrant lifestyles and incomes are generally low. The median income for the settlements studied is R 629, with the poorest being Onseepkans (R 260) and the wealthiest being Nababeep and the formal parts of Port Nolloth (R 800).

ENERGY USE PATTERNS

Fuels used

In most settlements, gas is the most commonly used fuel, as well as contributing the most to total energy consumption in both nett and useful energy terms. Wood and candles are used by the majority of households, while about 50% of the total population surveyed use batteries and paraffin. The two settlements along the Orange River, Onseepkans and Vioolsdrif, have significantly different energy use patterns, with wood being the most important energy source. The informal settlement in Port Nolloth is another exception - here paraffin is more widely used than gas.

Expenditure on energy

Lower income groups generally spend around 30% of their total income on energy requirements. This proportion reduces sharply for wealthier households. There are notable differences in Vioolsdrif and Onseepkans, where the abundance of free wood allows residents to spend less on energy (15% of total income).

In all settlements, it was found that gas constituted the largest proportion of energy expenditure where households use gas.

Electrified houses were generally found to spend significantly less on energy than those without access to electricity in the same income category. This was not the case in the lowest income group, where the monthly service fee constitutes a large proportion of total energy expenditure.

Energy preferences, problems and perceived solutions

In all areas there was an overwhelming preference for Eskom as an energy source. The majority of problems mentioned by households related to the affordability of fuels, generally referring to the expense involved in gas purchase. In Vioolsdrif, where houses are largely made from reeds, the safety of available fuels was considered problematic. In settlements where electricity is available, such as Okiep and Bergsig, residents often complained that connection costs were

excessive. Residents in many settlements also indicated that they found available fuels inconvenient.

The great majority of households that made suggestions concerning the improvement of energy supply indicated that settlements should be electrified.

DISCUSSION

Affordability of electricity

Many settlements where residents have access to electricity have low take-up rates. This may be attributed to the excessive expense involved in connecting to the network and installing housewiring (typically >R1500 in total), which places it out of the reach of most residents. This project has evaluated the affordability of electricity using the "S1 tariff system, which requires a small connection fee (about R30), and, if combined with a ready-board, does not require housewiring.

Based on actual amounts currently spent on energy, it is considered that all income groups in all but two of the settlements can afford electricity if supplied using the Eskom "S1" tariff system. The two possible exceptions are Onseepkans and Vioolsdrif, where incomes are low and energy expenditures are proportionately lower than in other places. The low amounts spent on energy in these two settlements is a result of the abundance of free wood along the Orange River. It is possible that residents in these places would be prepared to spend larger proportions of their incomes on electricity to enjoy its benefits, and this must be explored before decisions regarding its affordability are made.

Gas use

It is expected that gas use for cooking will continue in the settlements examined, even if far reaching electrification projects are implemented. There appears to be little potential for significant reductions in the price of gas as the gas market is already relatively competitive.

Wood use

Lower income groups typically depend more on wood than wealthier households. In many areas it is widely used for baking, and in settlements such as Onseepkans and Vioolsdrif it is also the principal cooking fuel.

In Port Nolloth, Hondeklipbaai and Nababeep, residents are not permitted to gather wood in the surrounding company owned area, thus forcing residents to spend more on energy. This has particular impact on energy expenditure by poorer households.

RECOMMENDATIONS

Due to the overwhelming preference for grid electricity, its widespread affordability and potential positive effect on communities, it is recommended that most communities be electrified. Before implementing any electrification plans in Onseepkans and Vioolsdrif, however, it is necessary to examine in more detail the willingness of residents to pay for grid power.

It must also be stressed that communities need to be fully involved in electrification projects from the planning phase if the project is to be successful in addressing community needs and aspirations and stimulating the development of the area.

Summary of settlement characteristics and recommendations

SETTLEMENT	Populatn surveyed	Persons/hs	Median monthly income	Most important fuels	Energy expenditure range (monthly) low - high	Percentage electrified	Main energy preference	Eskom "S1" affordable?	Recommendations
Port Nolloth (formal)	3728	6.6	R 800	gas	R 56 - R 136	36%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation ■ Free land for wood collection
Port Nolloth (informal)	1800	6.4	R 430	gas paraffin	R 109 - R 240	0%	Eskom	Yes	■ Electrify after land allocated ■ Engage community participation
Pofadder	4221	5.9	R 500	gas	R 87 - R 215	5%	Eskom	Yes	■ Electrify with S1 system ■ Eskom preferable to municipal ■ Engage community participation
Garies	792	5.9	R 430	gas	R 70 - R 116	23%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation
Vioolsdrif	400	5.3	R 320	wood	R 24 - R 59	0%	Eskom	borderline	■ Study in further detail
Kamieskroon	900	5.6	R 500	gas	R 53 - R 153	0%	Eskom	Yes	■ Electrify with S1 system ■ Eskom preferable to municipal ■ Engage community participation
Onseepkans	1041	6.9	R 260	wood	R 19 - R 83	0%	Eskom	borderline	■ Study in further detail
Nababeep	6192	4.9	R 800	electricity gas	R 76 - R 82	38%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation ■ Free land for wood collection
Bergsig	5830	5.9	R 720	gas	R 79 - R 125	24%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation
Okiep	5675	5.4	R 673	gas electricity	R 52 - R 129	37%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation
Matjieskloof	1738	5.3	R 500	gas	R 73 - R 192	0%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation
Hondeklipbaai	400	5.5	R 646	gas	R 74 - R 194	0%	Eskom	Yes	■ Electrify with S1 system ■ Eskom prefered developer ■ Free land for wood collection
OVERALL	32727	5.7	R 629	gas	R 19 - R 240	22%	Eskom	Yes	■ Electrify using Eskom S1 system

ACKNOWLEDGEMENTS

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CONTENTS

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

This report focuses on energy use in the unelectrified urban areas in Namaqualand. It forms a part of the current National Energy Council and Eskom investigation into energy supply to the region.

Previous studies have looked at energy use patterns and supply alternatives in the 'Coloured Rural Areas' and white owned farmland areas, but little is known about the largely unelectrified coloured and black urban settlements of Namaqualand, which constitute about 40% of the total population for the region. This report is intended to provide the necessary information for the formation of a rational energy supply policy to stimulate development and enhance the welfare of the local people.

1.2 OBJECTIVES

Broadly, the project aims to provide the information necessary for an understanding of present energy use patterns and problems. Preferred alternative supply options are explored, but their technical and economic viability is examined only superficially.

The specific objectives were to determine :

- population and household sizes in the various settlements
- house types
- settlement characteristics (formal, informal, serviced, etc.)
- fuels used by households
- income

- household expenditure on energy requirements
- preferred fuels
- perceived energy related problems
- social acceptability, affordability, and priorities of energy supply

1.3 RESEARCH METHODOLOGY

All the significant unelectrified urban settlements in Namaqualand were surveyed. These include : Bergsig, Matjieskloof, Onseepkans, the coloured and black settlements in Port Nolloth, and the coloured settlements of, Garies, Kamieskroon, Nababeep, Okiep, Hondeklipbaai, Vioolsdrif, and Pofadder. Settlements such as Koiingnaas and Spektakelberg were not included in the study as they are privately owned mining towns and access at short notice (less than six weeks) was not possible. The houses in these two settlements are in any case largely electrified.

1.3.1 Sampling

Information was gathered by means of interviews based on questionnaires in order to standardize the data collection. It was felt that information gained solely by questionnaires was inadequate to provide the depth of understanding necessary for the sensitive evaluation of each settlement. Interviews with municipal or other authorities augmented the information provided by the inhabitants, particularly with respect to technical and infrastructural aspects.

Where possible, local people were trained to administer the questionnaires. This was not done in the case of Pofadder, Onseepkans, Garies, and Kamieskroon, where members of the Kamieskroon Ontwikkelingsvereeniging were used. They had been trained in the use of questionnaires during the course of previous projects, including the Namaqualand Household Energy Survey (Borchers et al. 1990) done in the 'Coloured' Rural Areas. They were familiarised with the adapted questionnaire while working under supervision for two days.

Random cluster sampling was used for all the towns except Garies and Kamieskroon, where total numbers of houses were small and the settlements regularly laid out. Here every second and every third house, respectively, was

sampled. In the other areas cluster sampling points were selected from maps where they realistically represented the village layout (such as Bergsig) or where informally settled areas could be counted and clearly placed on maps (such as Matjieskloof). Settlements were also visually inspected before selecting the sample, to identify, for example, areas of vacant plots not indicated on maps.

Cluster sizes generally varied from 5 to 7 households, depending on housing density, regularity of village layout, and number of cluster points selected. In the informal settlements around Port Nolloth (Tentedorp and Bloukamp), however, larger cluster samples were taken because of the irregular and highly diversified housing layout. It was also necessary to increase the overall sample size to ensure effective coverage.

Table 1.1: Numbers of questionnaires filled in at the different settlements.

SETTLEMENT	No. QUESTIONNAIRES
Bergsig	86
Matjieskloof	47
Port Nolloth (formal areas)	60
Port Nolloth (informal areas)	67
Garies	30
Kamieskroon	30
Nababeep	61
Okiep	67
Hondeklipbaai	26
Vioolsdrif	32
Pofadder	45
Onseepkans	21
TOTAL	572

1.3.2 The Questionnaire

The questionnaire design was based on previous ones used in Namaqualand energy studies. It was condensed (to two pages) to extract only information essential to fulfil the project objective, and because of the extremely short time available for data collection. The questionnaire was thus condensed to two sides of one sheet. The questionnaire used is shown in appendix A.

1.4 PRESENTATION

Data for each settlement is presented separately. Although this results in a certain degree of duplication, it was felt that this would be a more useful format as settlements are widely dispersed and energy supply for each area is likely to be considered separately. The overall energy use characteristics of all areas studied is presented in the final chapter.

CHAPTER 2

BACKGROUND TO THE AREAS SURVEYED

2.1 PHYSICAL

Namaqualand is located in the north west corner of South Africa, bordered by the Orange River in the north and the Atlantic Ocean in the west (see Map 2.1). There are a number of small settlements scattered throughout the area, of which Springbok, the regional centre, is the largest with a population of around 8500. Three main topographical areas may be identified :

(1) The coastal plain - these landscapes are typically very arid and flat, rainfall is low (mean annual rainfall of ±100mm), and there is very little vegetation. Temperatures are moderated by the effect of the ocean.

(2) The central region - in the central longitudinal belt of Namaqualand are low mountain ranges where the coastal plain rises up to the Bushmanland plateau. The mountains are more pronounced in the south and the north, while in the centre, just north of Springbok, they reduce to hills. Although rainfall is also low in this belt, it is higher than in other parts of Namaqualand. The highest rainfall occurs in the southern Kamiesberg mountains, where the mean annual rainfall is around 200mm. Vegetation in the northern part is very sparse, and becomes more dense in the Kamiesberg area. Temperatures can vary from close to 40°C to a few degrees below freezing.

(3) The Bushmanland plateau - this forms the eastern part of Namaqualand and is typically drier than the rest of the region, with a mean annual rainfall of only ±70mm in parts. The landscape is very flat and vegetation sparse. Temperatures here are much the same as for the central belt - i.e.varying from around 40°C to below freezing.

Generally, Namaqualand is a very arid territory, with the Orange River being the only perennial river. The scarcity of water imposes a major constraint on the development of the region.

2.2 HISTORY

Before the influx of white settlers to the area, the Nama-speaking Khoi, who were nomadic pastoralists, roamed the area. With the increasing pressure on the land during the eighteenth century as white farmers and miners moved into the area, some of the Khoi moved out of the area into Namibia, while others gathered on land surrounding mission stations, which eventually became the "Coloured" Rural Areas.

The first whites to encroach on the land were farmers. The discovery of copper in 1852 (the first copper mined in South Africa), and later diamonds (in 1926), brought many more whites to the area and hastened the adoption of a cash economy which replaced the traditional subsistence lifestyles of the indigenous people. Many of the settlements existing today developed as a result of mining activities, which fast became the major contributor to the GGP[1] of the area, and the main employer of Namaqualand residents. Dependence on international mineral prices and exchange rates has resulted in great fluctuations in production over the years. These fluctuations have led to periods of widespread unemployment and impoverishment, and today there are large sections of the population with neither access to land nor secure employment.

2.3 DEMOGRAPHY

Table 2.1 gives an indication of population characteristics in the Namaqualand area. Although it is only for the Namaqualand magisterial district, and this project deals with the Pofadder and Onseepkans settlements which fall outside this area, the trends shown are valid for all areas covered by the study. It can be seen that the population is overwhelmingly composed of coloured people, while there are very few blacks.

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[1] GGP is defined as the remuneration received by the production factors, land, labour, capital, and entrepreneurship for their participation within a defined area (Department of Statistics, quoted in Dunne, 1988).

Table 2.1: Namaqualand population distribution by race (1985)

RACE	URBAN	CRA's*	WHITE FARMS	NUMBER	% OF TOTAL
Coloured	49%	46%	5%	51 460	81%
White	85%	2%	13%	9 001	14%
Black	99%	-	1%	2 872	5%

* - Coloured Rural Areas.
Source : Springbok Regional Services Council

The population group on which this project focuses, the urban coloured population, comprise around 40% of the total. Populations for specific settlements dealt with in this project are shown in Table 2.2.

Table 2.2: Population estimates for specific settlements

PLACE	WHITE	COLOURED	BLACK	TOTAL
Bergsig	0	5830	0	5830
Matjieskloof	21	1738	0	1759
Port Nolloth	428	3728	1800	5956
Garies	458	792	0	1250
Kamieskroon	154	900	0	1054
Nababeep	1047	6182	10	7239
Okiep	367	5664	11	6042
Hondeklipbaai	57	400	4*	461
Pofadder	670	4221	0	4891
Onseepkans	0	1041	0	1041
Vioolsdrif	60	400	0	460
TOTAL	3262	30896	1825	35983

* - excludes seasonal residents (between 30 and 200)

Overall population growth rates have been estimated by the Springbok Regional Services Council as 3% for whites and 5% for coloureds. A large percentage of the black population live in Port Nolloth where the population is growing rapidly, and overall black population growth is not known.

Obtaining accurate population figures in the area is difficult. This is largely due to the high proportion of migrant labourers in many settlements and to the significant number of school children moving to different settlements during term times.

2.4 INFRASTRUCTURE

Namaqualand has a poorly developed infrastructure, with few major roads and no rail links. The major roads are shown on Map 2.1. Most of the settlements dealt with here are on or close to the main roads, usually the main Cape Town - Windhoek road. Hondeklipbaai, however, is only connected to the main Cape Town - Windhoek route by a minor dirt road.

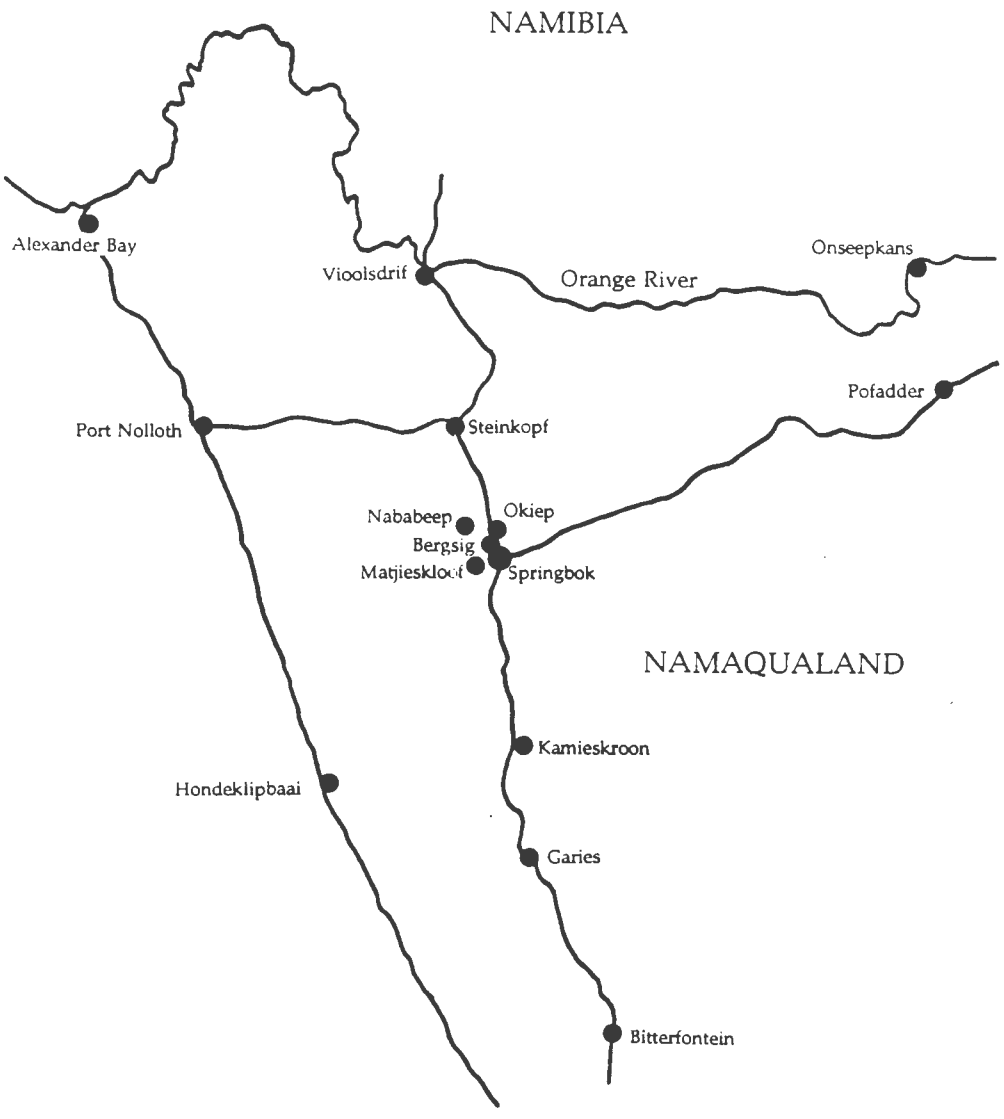
The Eskom electricity supply grid in the area has largely been routed to supply the main settlements and mining companies, and does not generally extend to rural settlements and farms. Settlements considered in this study are often suburbs or satellite settlements of larger electrified towns, and therefore electricity is generally nearby, if not available in these villages.

2.5 ECONOMICS

The mining industry, in particular copper and diamond mining, constitutes the backbone of the Namaqualand economy, providing employment for about 40% of the economically active population, and generating around 70% of the local GGP. The copper mines are largely situated in the Springbok/Okiep/Nababeep area, and diamonds are mostly mined along the banks of the Orange River and along the coast. The wealth of the area is largely dependent on the productivity of the mines, and because this fluctuates greatly according to international mineral demand, employment in mining has historically been insecure.

The fishing industry, centred at Port Nolloth and Hondeklipbaai, is of less importance to the local economy. Employment here is seasonal, leaving inhabitants without a source of income for many months.

Because of the harsh climate, agricultural potential is limited and does not contribute significantly to the wealth of the area. The most fertile lands are in the Kamiesberg area in the south, and along the banks of the Orange River in the



Map 2.1 : The location of different settlements in Namaqualand.

north. The environment is generally more suitable for stock farming than for cultivation. Employment opportunities on farms are limited, and are also often seasonal or irregular. Many inhabitants, particularly in the "Coloured" Rural Areas, keep stock on a subsistence level as a form of security against insecure employment.

Income distribution of households in all the areas surveyed are given in figure 2.1. It must be stressed that this figure does not give an indication of the great diversity in incomes between settlements, but nonetheless shows the

characteristically skewed distribution common to most settlements. Median incomes are shown for the different settlements in figure 2.2. (Note: medians were used rather than averages because they are more robust indicators of the central trend in data where distributions are skewed).

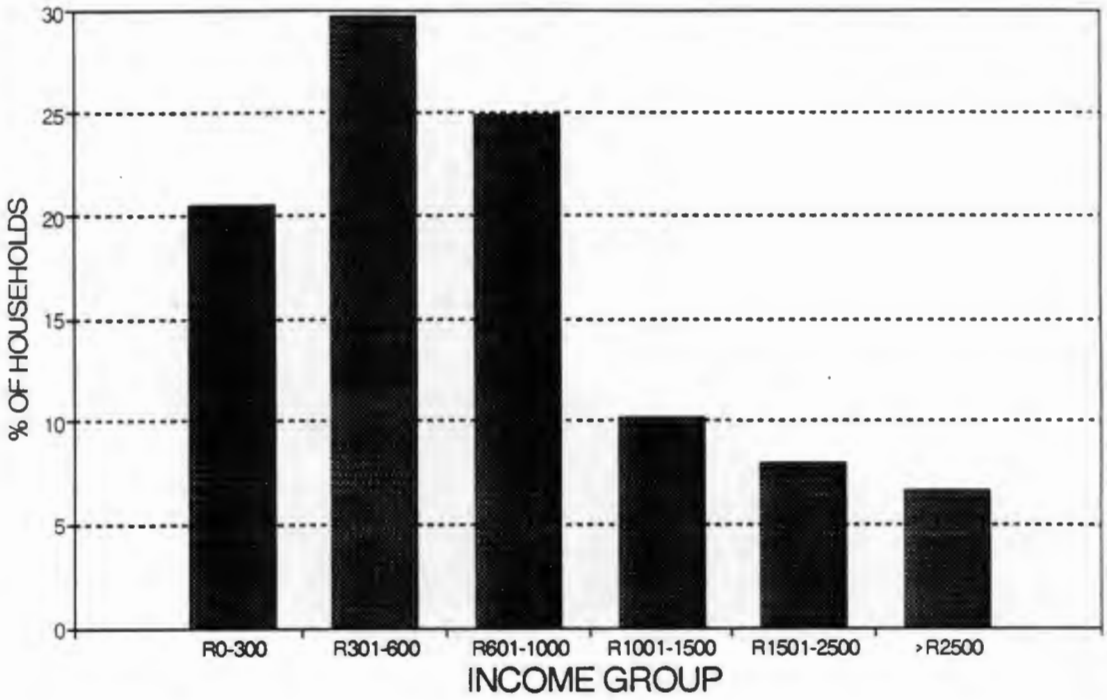


Figure 2.1 : Income distribution - all settlements surveyed.

It can be seen in figure 2.2 that the wealthier settlements are generally those associated with the mining industry at Okiep and Nababeep, or those close to central town such as Springbok with their associated employment opportunities. The poorest settlements are Vioolsdrif and Onseepkans on the Orange River.

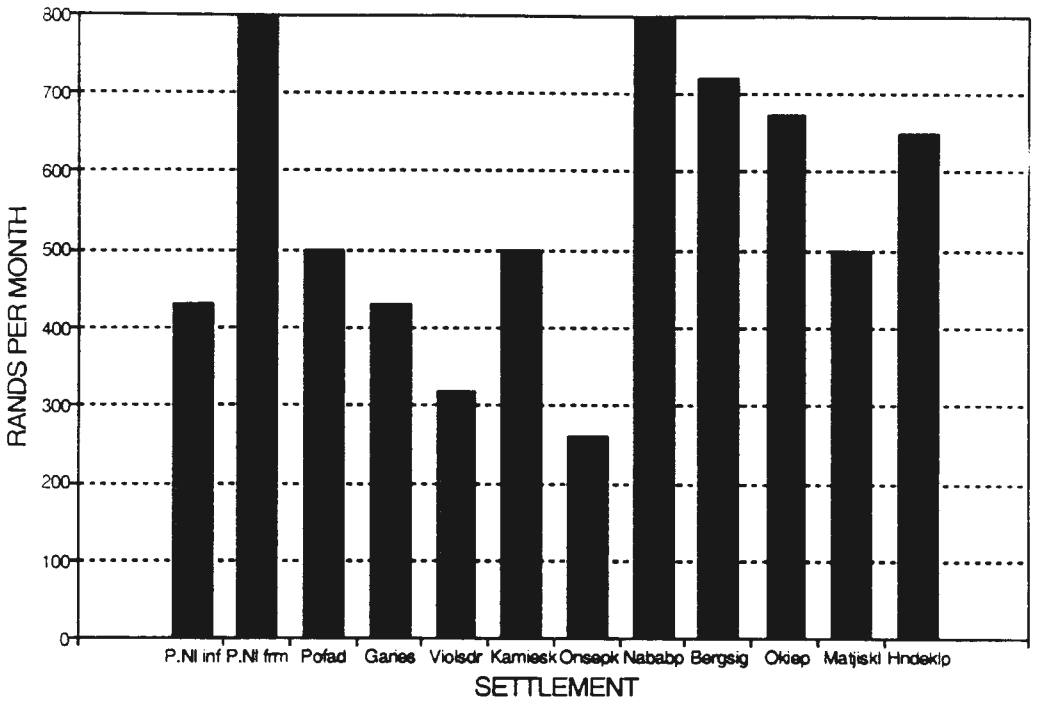


Figure 2.2 : Median incomes of different settlements.

CHAPTER 3

ENERGY TRANSITION & ELECTRICITY

3.1 ELECTRICITY SUPPLY

Electricity supply is widely considered as the most convenient and beneficial energy supply form for communities. It has the potential for extending productive opportunities and improving the quality of life on a household level. It allows for the use of the range of electrical appliances, and can be used for more purposes than most other fuels, from T.V. to kitchen appliances and workshop equipment. It also stimulates a range of night-time activities due to its superior lighting abilities.

3.2 AFFORDABILITY OF ELECTRICITY

Since electricity is such a sought after energy source, it will be examined in more detail here to establish some guidelines with respect to its affordability in settlements.

3.2.1 Demand scenarios

Household electricity demand has been observed to vary from 150kWh per month to 500kWh per month in the Namaqualand area. The latter is typical for a household with the full range of electrical appliances, including a stove, geyser, fridge, heater, kitchen appliances, and T.V. The 150kWh/month demand is typical for a newly electrified house where there are few appliances, or for households where low incomes limit the use of electrical appliances. A medium demand household would use around 240 kWh/month.

3.2.2 Cost of electricity

Most, if not all of the areas considered in this project would qualify for the Eskom "S1" tariff structure, which involves the use of pre-pay meter/ready board[1] installations in the house. This system requires a nominal connection fee (around R30). Users then only pay for the energy used at 16c/kWh - a slightly higher rate than the "tariff C" rate ("tariff C" includes a monthly service charge) to allow some capital cost recovery. Since this is the most affordable of available tariff structures, including those provided by municipalities, it will be used here as a measure of affordability of electricity by low income houses. Typical household monthly costs associated with the demands discussed above are :

MONTHLY DEMAND	ELECTRICITY BILL
150 kWh	R 24
240 kWh	R 38
500 kWh	R 80

3.2.3 Energy transition

Household energy use in households typically shifts over time from traditional fuels, usually wood, to a mix of fuels such as gas, paraffin, and candles, and finally electricity. The move from traditional fuels is generally motivated by desire for a more modern lifestyle, but it may also be forced because wood and other energy sources often become increasingly scarce due to over-utilization. This forced transition is particularly burdensome to the poor and aged, who often struggle to obtain commercial fuels and the associated appliances. Namaqualand societies are typically well into the transitional phase, using gas, paraffin, candles, batteries and other energy sources, while some areas are using electricity extensively.

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[1] A pre-pay meter is a meter that accepts a pre-bought card which allows the use of a certain amount of power. A ready-board is a board holding the meter, contact breakers, a light, and three 15-amp sockets.

This project generally encountered settlements where residents are eager for electrification. But the transition from using a mix of fuels to full electrification is often a slow one because of the expense involved in obtaining appliances. It is therefore to be expected that households will continue to use transitional fuels, particularly gas for cooking, for a number of years after connection to the grid. When considering the affordability of electricity in a settlement, it must therefore be remembered that not all present energy expenditure can be transferred to electricity payments. This is particularly the case for lower income houses where only the basic appliances will initially be affordable.

3.2.4 Community participation in electrification projects

In some areas of Namaqualand, electrification projects have been implemented without the full involvement of the community or representative organizations. The projects have thus not been able to address the needs of the residents properly, and this has led to dissatisfaction and even active resistance to the schemes. Namaqualand residents are becoming less willing to have developments imposed upon them by groups that they feel are not fully aware of their needs or aspirations.

It is therefore important that any development initiatives in the area involve community organizations from the planning phase through to implementation in a manner which addresses the needs of residents adequately.

CHAPTER 4

PORT NOLLOTH

4.1 BACKGROUND

4.1.1 Location, history & infrastructure

Port Nolloth is the largest port in Namaqualand, and is situated on the coast about 140km north-west of Springbok. It is linked by road to Steinkopf in the west (about 90km away) and Alexander Bay in the north (also about 90km away). The town originated as a port for the copper industry in the 1850's. After the crash of the copper industry, the town became dependent on the fishing industry and the coastal diamond mining operations. During the early seventies the fishing industry collapsed, and during the late eighties the diamond price dropped significantly, with a concomitant effect on the local economy.

Of all the settlements dealt with in this project, Port Nolloth was found to have the greatest socio-economic diversity, including settlement, employment, and income patterns.

4.1.2 Demography

Table 4.1: Port Nolloth population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	3728	70%
White	428	8%
Black	1800*	22%
TOTAL	5956	100%

* - based on estimate of number of houses in black areas

Note : populations based on projections from 1985 population census and average population growth rates.

The study found an average of 6.4 persons per household in the Tentedorp/Bloukamp areas, which are the predominantly black informal areas of Port Nolloth, and 6.6 persons per household in Nollothville, the coloured part of the town.

4.1.3 Settlement characteristics

Residents generally regard Port Nolloth as having three distinct areas:

(1) Port Nolloth -	the central area including the CBD and white housing area.
(2) Nollothville -	the largely coloured community to the south and south east of the centre.
(3) Tentedorp and Bloukamp -	the principally black community living in informal settlements about 3km to the east of the centre.

MacDougals Bay, about 5km south of Port Nolloth consists mainly of holiday houses although land on the north edge is being developed as middle class coloured housing. MacDougals Bay and the Port Nolloth central area are fully electrified and hence are not included in the survey.

Many of the Nollothville residents were moved from the now industrial area on the eastern border of the centre. Many Nollothville residents have very low incomes and sometimes cannot pay service fees to the municipality, which then sometimes evicts them.

Nollothville consists of mainly municipal housing (± 360 houses) but also has an area of approximately 30 private homes as well as about 20 middle class houses that have been bought from the municipality. It also includes mining or fishing company houses - known as Single City, Silver City, and Rainbow city - together comprising around 60 houses. In another mining owned area in Nollothville, Diamond City, the approximately 60 houses are presently being sold.

One of the informal settlements in the area - Tentedorp - is located on a salt pan, the other - Bloukamp - on the dunes next to Tentedorp. The settlements are not regarded as permanent by the local municipality, the CPA, or even the inhabitants of the settlements, who would rather live in other areas around Port Nolloth. At present, residents of the informal area are negotiating for a place to establish a permanent settlement and for the access to existing developed areas.

The majority of households in Tentedorp (±200 houses) and in Bloukamp (±100 houses) expressed the wish to settle on the land between Nollothville and MacDougals Bay, one of the three areas selected by the municipality as possible sites for a settlement. Another site being considered is to the south east of Port Nolloth, which would probably be accepted by the informal area residents, and the third site is a few kilometres to the north of Port Nolloth, near Muisvlak, which will not be accepted by residents of Tentedorp and Bloukamp.

4.1.4 Economic activity

Most of the employment in the area is provided by Alexcor (offshore diamond mining), the fishing industry (often seasonal), and the CPA roads department. Unemployment is typically around 30% of the economically active population, although this varies seasonally. Incomes are typically low and vary significantly during the year due to the seasonal nature of work in the fishing industry. Tentedorp and Bloukamp residents are mostly self employed, and incomes obtained in this survey must therefore be regarded as of limited accuracy for these areas. Household income distribution for Nollothville is shown in figure 4.1, and for the informal settlements in figure 4.2. While the income distribution in the informal settlement is highly skewed, income in the formal areas is more normally distributed. Median household incomes are R 800 for Nollothville, and R430 for the Bloukamp/Tentedorp area.

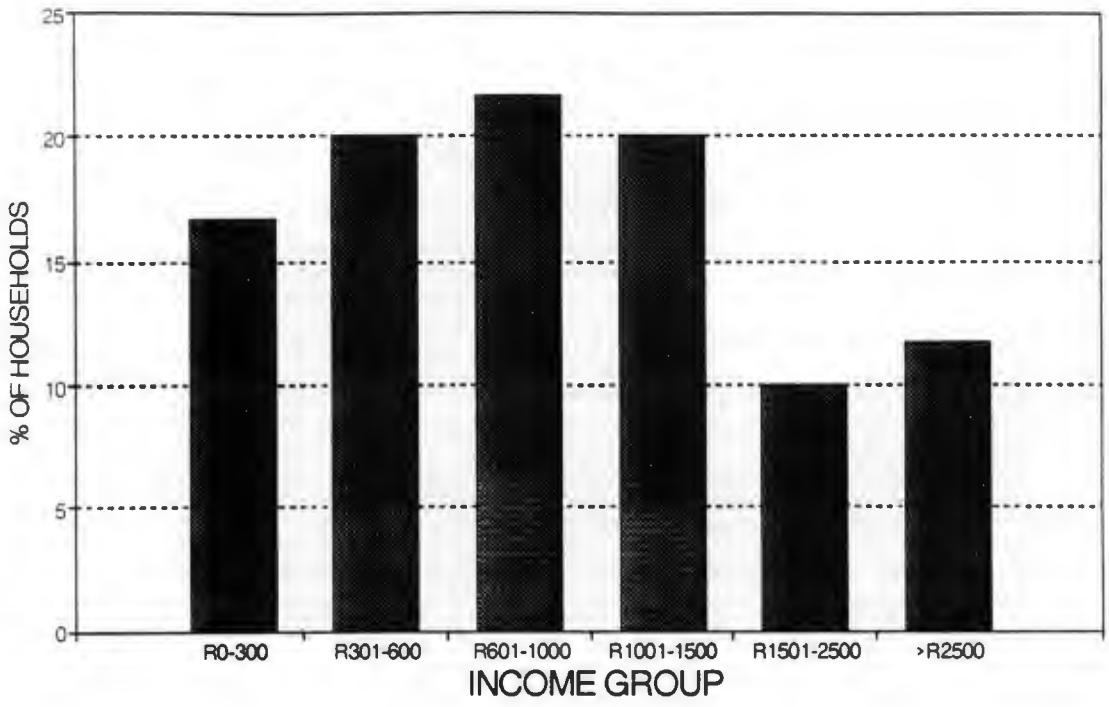

Figure 4.1 : Income distribution - formal settlement.

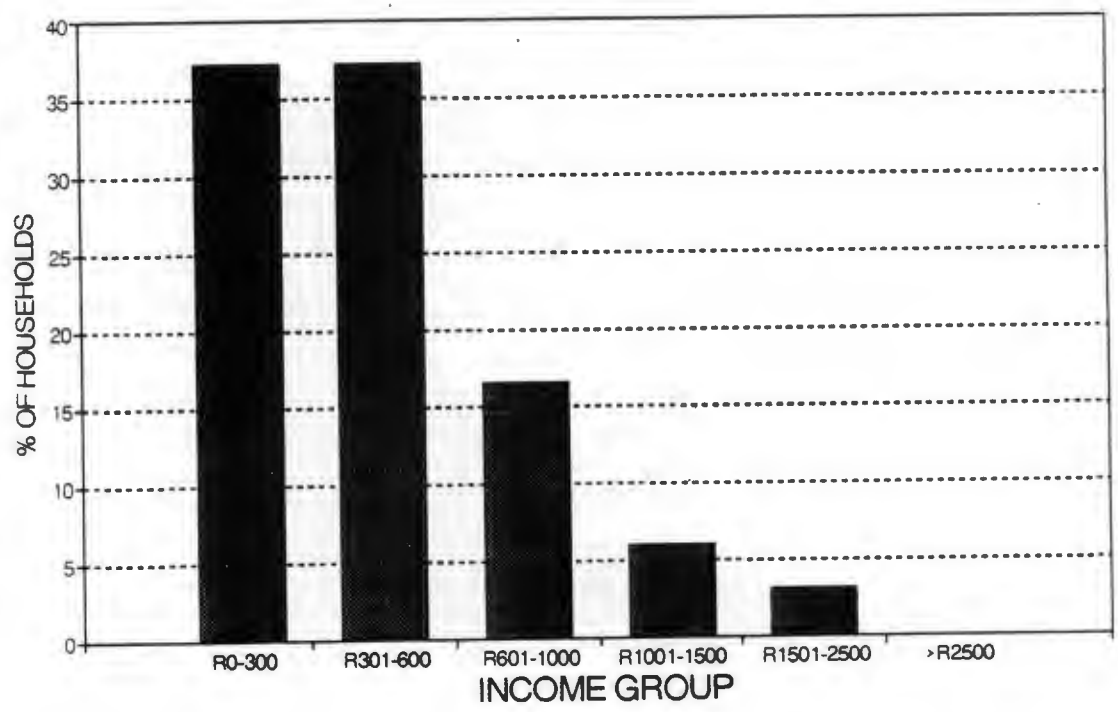

Figure 4.2 : Income distribution - informal settlement.

4.2 ENERGY CONSUMPTION PATTERNS

4.2.1 General

The land around Port Nolloth, besides being extremely arid, is strictly controlled by mining concerns and hence wood is practically unobtainable. People therefore must buy wood which is trucked in from inland sites and sold at relatively high prices.

While Diamond City, which comprises about 50 houses, is fully electrified (although houses do not have geysers), only 30% of the approximately 60 houses in the other three "Cities" are electrified. In the rest of Nollothville, only 20% of the municipal houses are electrified while most of the privately owned houses are supplied. The low connection rate in Nollothville can be ascribed to the high connection fee (±R1000 and higher, excluding house wiring costs). There is a monthly service fee of R20.16 and an energy charge of 12.3c per kWh. The informal areas have no access to electricity.

4.2.2 Fuels used

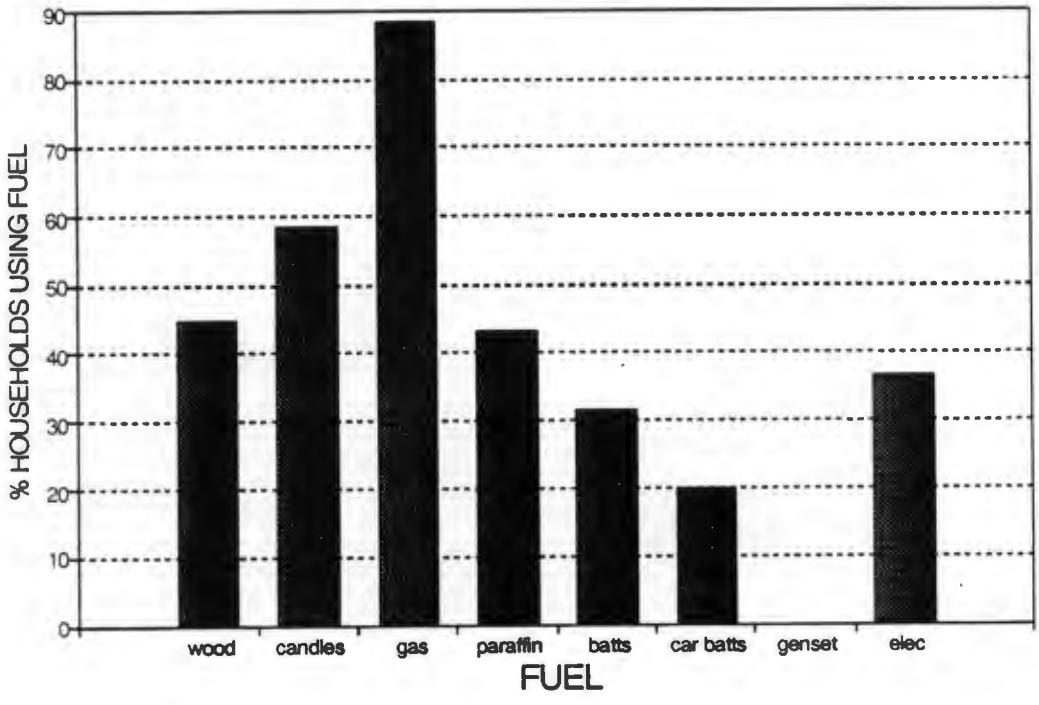

Figure 4.3 : Percentage of households using different fuels - formal areas.

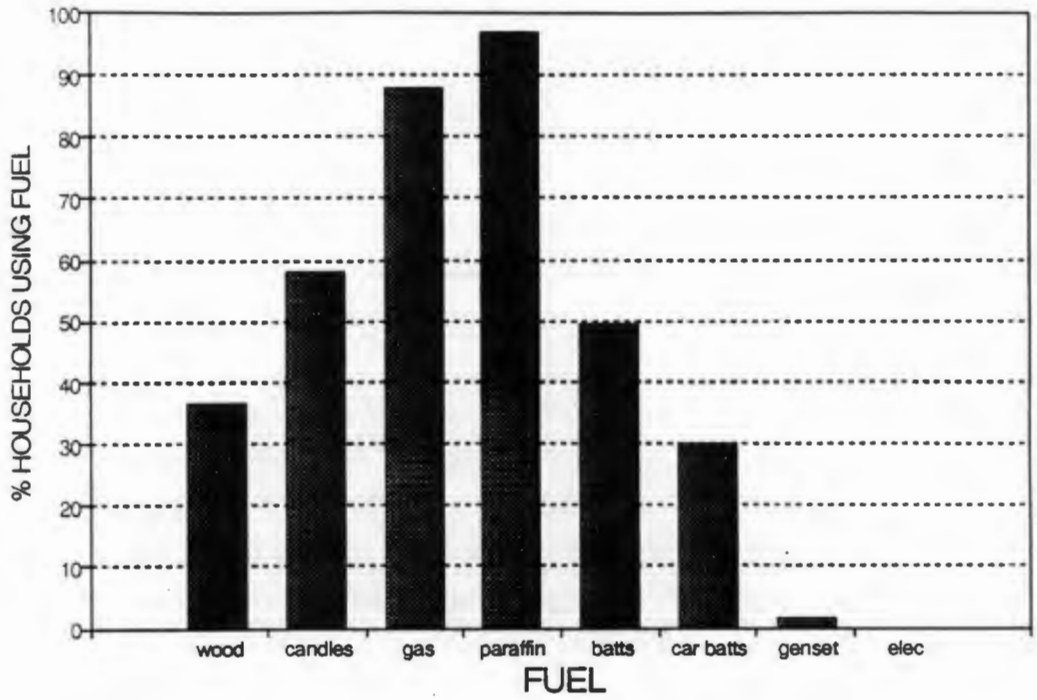

Figure 4.4 : Percentage of households using different fuels - informal areas.

The fuels used by houses in the formal and informal parts of Port Nolloth are shown in figures 4.3 and 4.4 respectively. Gas use is very popular in both the formal and informal areas, while candles, wood, and batteries are less used. The proportion of households using paraffin is significantly lower in the formal settlements, while in the informal parts it is the most widely used fuel.

The nett and useful energy contributions of each fuel for the formal settlements are shown in figure 4.5. Assumptions made regarding the calorific values and the nett/useful conversion are stated in appendix B. Gas is the major contributor of both nett and useful energy, followed by electricity. In the informal areas (figure 4.6), both gas and paraffin are large contributors to total energy consumption in terms of nett and useful energy.

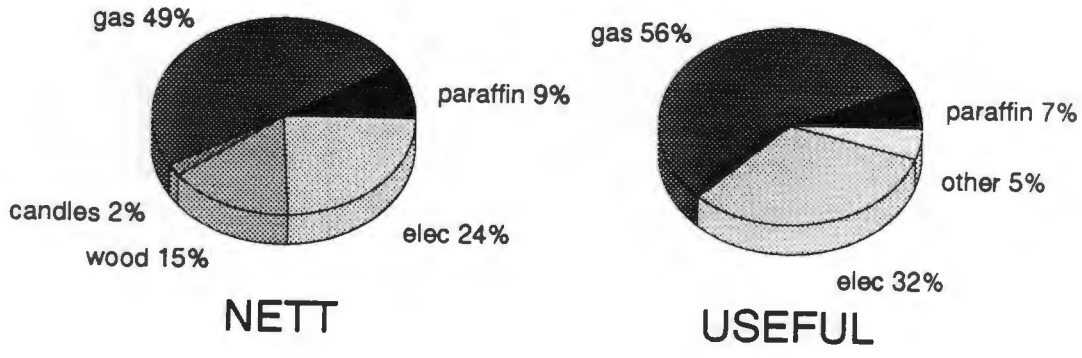

Figure 4.5 : Contribution of each fuel to total nett and useful energy consumption - formal areas.

4.2.3 Expenditure on energy

The proportion of household income spent on energy for different income groups is shown in figure 4.7 (formal areas) and figure 4.8 (informal areas). It is clear that in both the formal and informal parts of Port Nolloth the financial burden of obtaining energy is significant for the lower income groups, particularly for the informal areas, where the lower income group spends over 50% of their income on energy. In the informal areas, the transport of gas involves further expense. Actual amounts being spent are indicated in tables 4.2 and 4.3.

The higher amounts spent by informal area residents may be attributed to the greater need for heating because of the poor thermal properties of the housing, their location on the relatively cold salt pan as well as the non availability of electricity - a relatively cheap energy source.

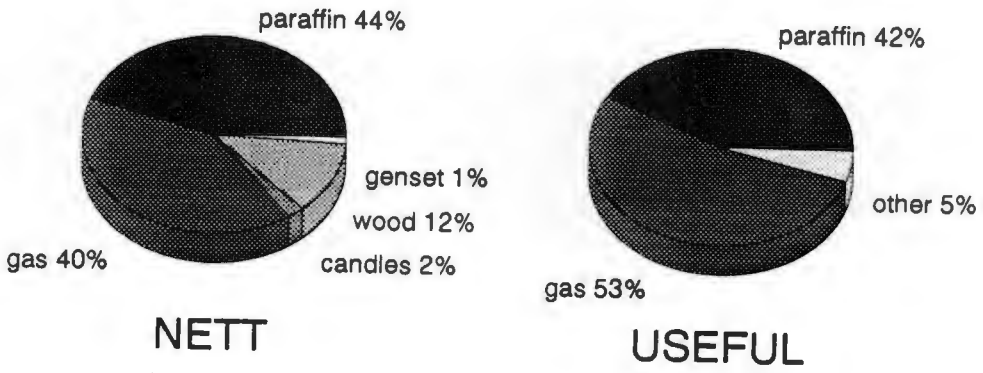

Figure 4.6 : Contribution of each fuel to total nett and useful energy consumption - informal areas.

Table 4.2: Average monthly household energy expenditure for different income groups (Rands) - Nollothville

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	56	94	92	89	136	102	91

Table 4.3: Average monthly household energy expenditure for different income groups (Rands) - Bloukamp & Tentedorp

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	109	167	129	240	134	-	143

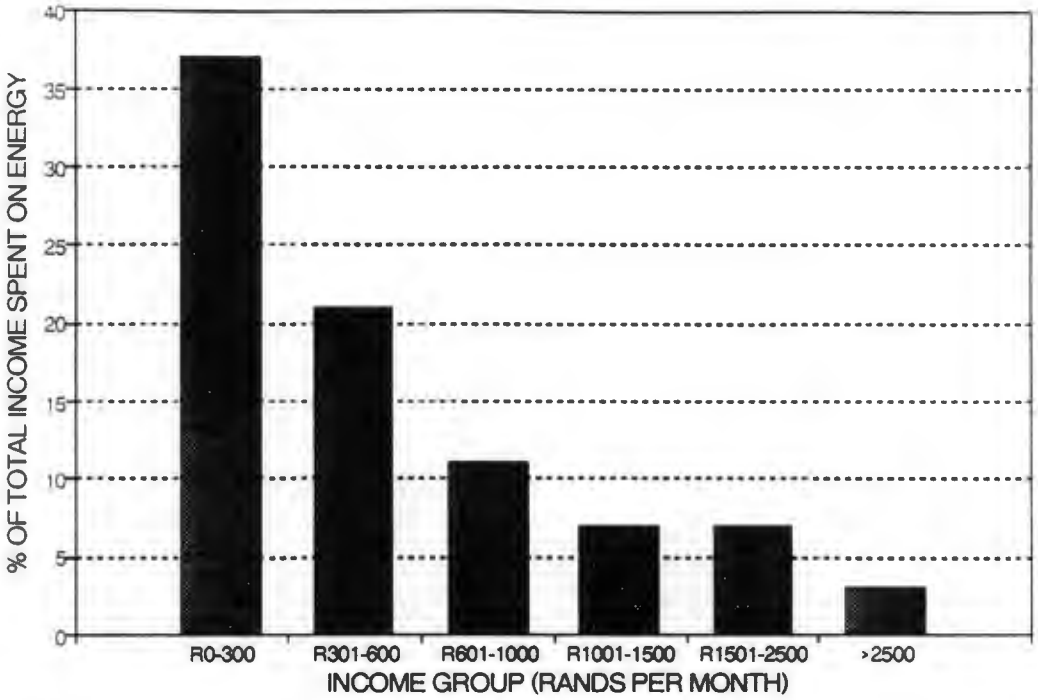

Figure 4.7 : Percentage of total income spent on energy - formal areas.

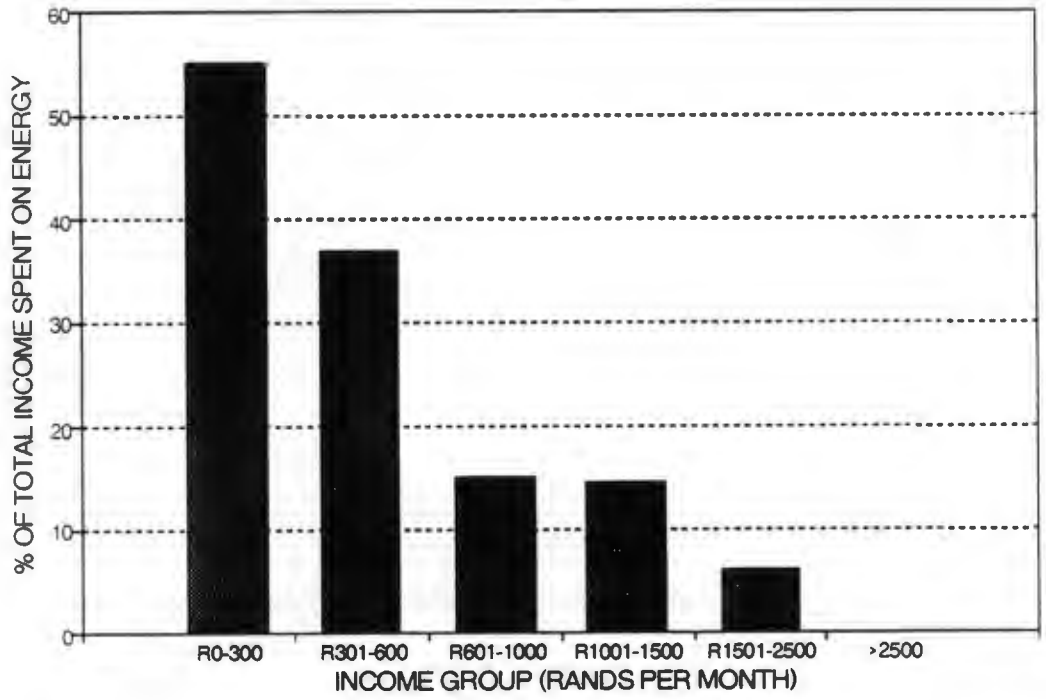

Figure 4.8 : Percentage of total income spent on energy - informal areas.

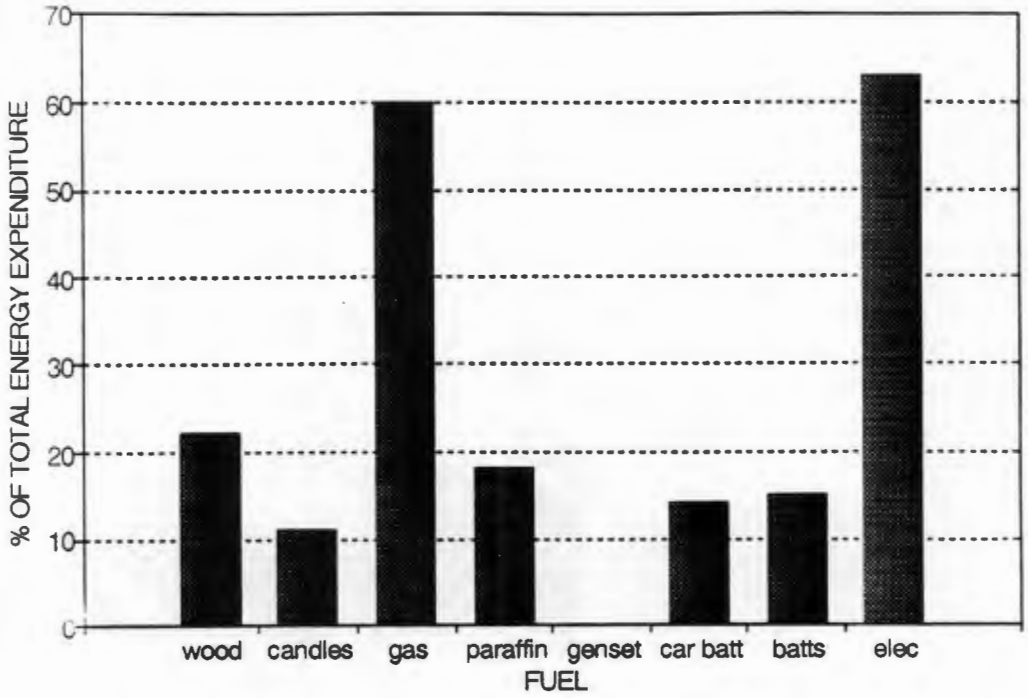

Figure 4.9 : Proportions of energy expenditure on each fuel for those using the fuel - formal areas.

The proportions of total energy expenditure on each fuel are shown in figures 4.9 (formal) and 4.10 (informal). In the formal settlement it can be seen that gas and electricity generally absorb the greatest proportions of energy expenditure, while in the informal settlements fuel use is more mixed, with expenditure on a range of fuels, mainly gas and paraffin.

4.2.4 Energy preferences

Energy source preferences by households are shown in figures 4.11 (formal) and 4.12 (informal). The overwhelming preference for Eskom power is apparent.

4.2.5 Energy related problems and perceived solutions

Figures 4.13 and 4.14 show the main energy related problems as perceived by households in the formal and informal areas respectively. The affordability of fuels is the most frequent problem in all areas, including, in the formal areas, the affordability of electricity. In the informal areas, safety was often regarded as a problem, due to the flammable nature of the structures.

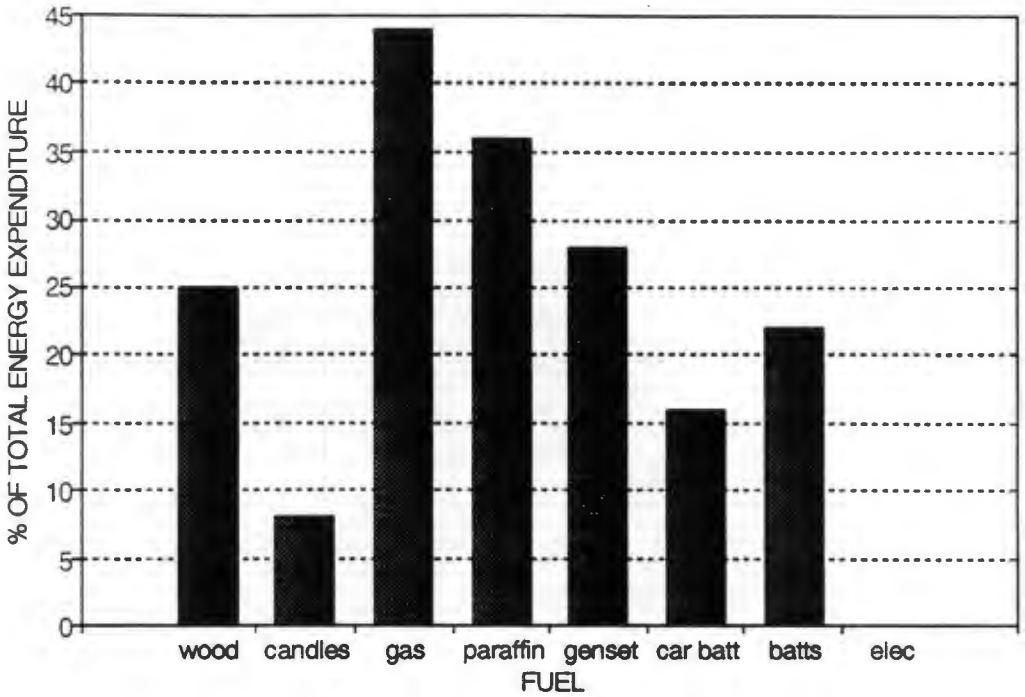

Figure 4.10 : Proportions of energy expenditure on each fuel for those using the fuel - informal areas.

Electrification was considered a means to alleviate the present energy related problems by over 95% of respondents.

4.3 SUMMARY AND DISCUSSION

There is a great diversity in income and energy use characteristics between the formal areas (Nollothville) and the informal parts (Tentedorp and Bloukamp). The informal settlements register lower incomes, higher paraffin use, higher proportions of income spent on energy, and higher actual energy expenditure. It must however be remembered that the informal commercial sector is very active in these areas, and the lower incomes as registered by the questionnaire survey are probably unrealistic. Gas is an important fuel in both areas, contributing most to useful energy consumption, though paraffin is nearly as significant in the informal areas.

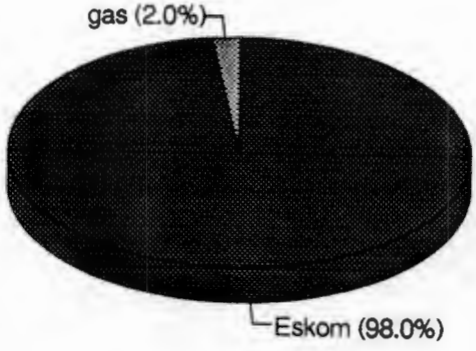

Figure 4.11 : Preferred energy sources - formal areas.

Figure 4.12 : Preferred energy sources - informal areas.

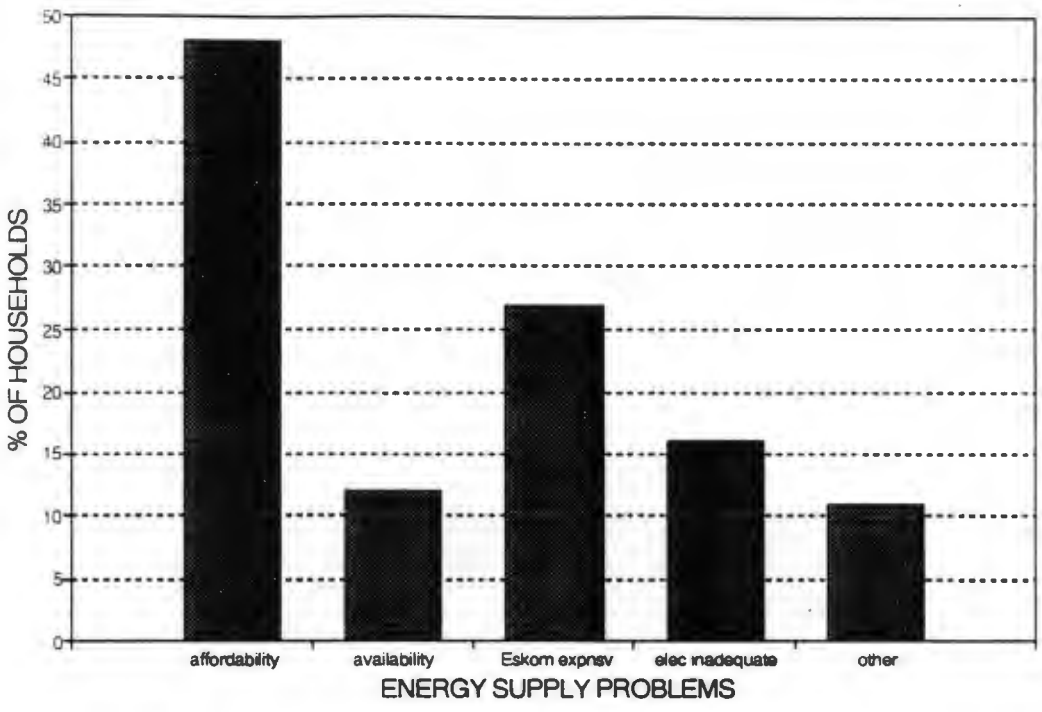

Figure 4.13 : Energy related problems - formal areas.

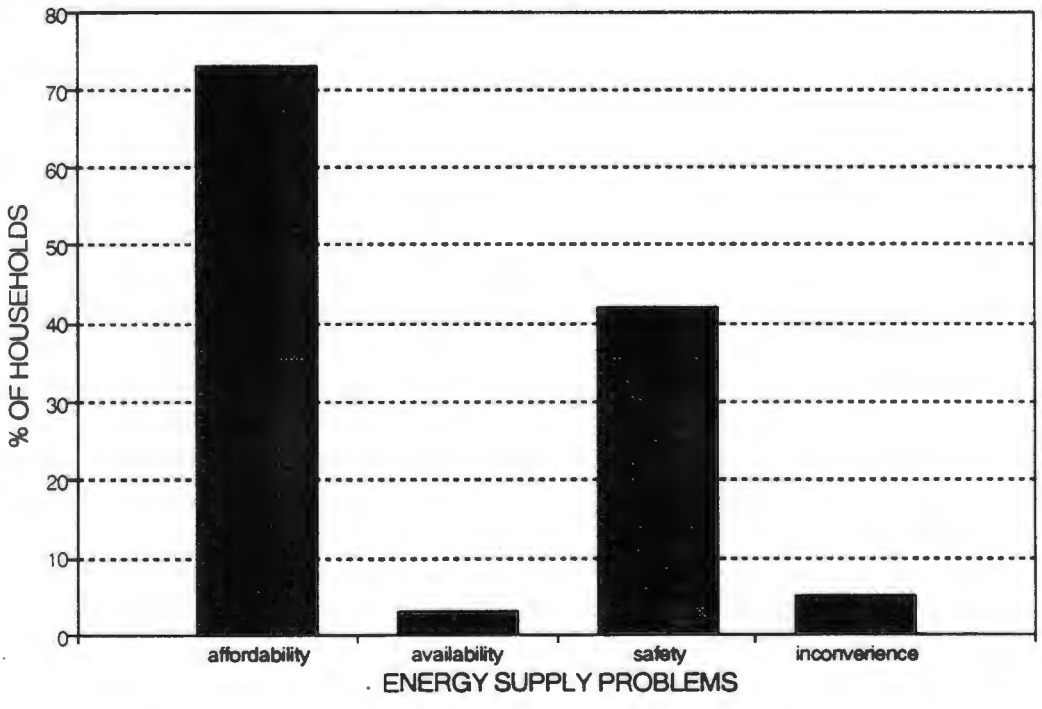

Figure 4.14 : Energy related problems - informal areas.

4.3.1 Affordability of electricity

From the amounts presently spent on energy, it seems that even the lowest income groups in both the formal and informal settlements could afford Eskom power on the "S1" tariff structure. Assuming that the lowest income houses would spend about R30 p.m. on electricity, tables 4.3 and 4.4 show that all households are presently spending significantly more than this on energy. It must be remembered that new electricity users, particularly amongst the lower income groups, would still use a mix of fuels for some time, and slowly convert more fully to electricity. Electricity bills would therefore only be a part of the total energy expenditure. Nonetheless, the information presented here indicates that electricity is affordable, and would lessen the financial burden of obtaining energy rather than increase it.

An electricity supply for residents presently in the informal areas is likely to stimulate the existing strong informal business sector, adding to the welfare of the households and to the wealth of Port Nolloth in general.

4.3.2 Other fuels

Although there are cheap supplies of gas and paraffin available, from a large oil company depot in the town who market direct to the users, it appears that very few consumers make use of this service. A significant reduction (±20%) in amounts spent on these fuels could be attained if consumers bought directly from this depot.

Because wood cannot be collected in the surrounding privately owned land, residents have to pay for wood. This is particularly burdensome to the poorer households. Alexcor should therefore consider allowing woodgathering on their land surrounding the settlement.

4.3.3 Social perspective

Electrification and other developments are strongly desired and needed by residents of all the communities surveyed - but any development initiatives must be handled with great sensitivity to the politics in these areas. At present, the Port Nolloth municipality is not viewed as capable of dealing with the

communities in a constructive way, and therefore any development negotiations should be facilitated by other parties acceptable to the existing democratically elected community organizations. The present formal authority for these areas, the Management Committee, is unpopular with residents. It is recommended that groups such as the Development Action Group (DAG), who are presently working with communities in the area, the CPA, and the existing democratically elected community structures be approached when considering development plans for these settlements.

4.4 RECOMMENDATIONS

- Considering the overwhelming preference for electricity, its affordability, and the large amounts presently spent on alternative fuels, it is apparent that the area is ready for full electrification using the "S1" tariff structure system.

- An electrification project here should be sensitively implemented, and should include the participation of the existing democratically elected community organization from the outset.

- Alexcor should consider allowing some woodgathering on the land around Port Nolloth.

CHAPTER 5

POFADDER

5.1 BACKGROUND

5.1.1 Location & infrastructure

Pofadder is situated in the north-east corner of Namaqualand, approximately 30km south of the Orange River and 200km from both Springbok and Upington. The main Springbok-Upington route runs through the town.

5.1.2 Demography

Table 5.1: Pofadder population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	4221	86%
White	670	14%
Black	0	0%
TOTAL	4891	100%

Note : population based on projections from 1989 study by the Health Department of Pofadder Municipality and average growth rates.

The study found an average of 5.9 persons per household in the Pofadder coloured settlement.

5.1.3 Settlement characteristics

The Pofadder coloured community live in a well established settlement of substantial size, with two schools, a library, shops, clinic, community centre, and an orphanage. The southern side of the settlement consists of larger plots, irregularly laid out, while the northern side consists of regularly spaced municipal

houses. There are 591 houses in the settlement - 281 municipal houses, and 310 private houses.

5.1.4 Economic activity

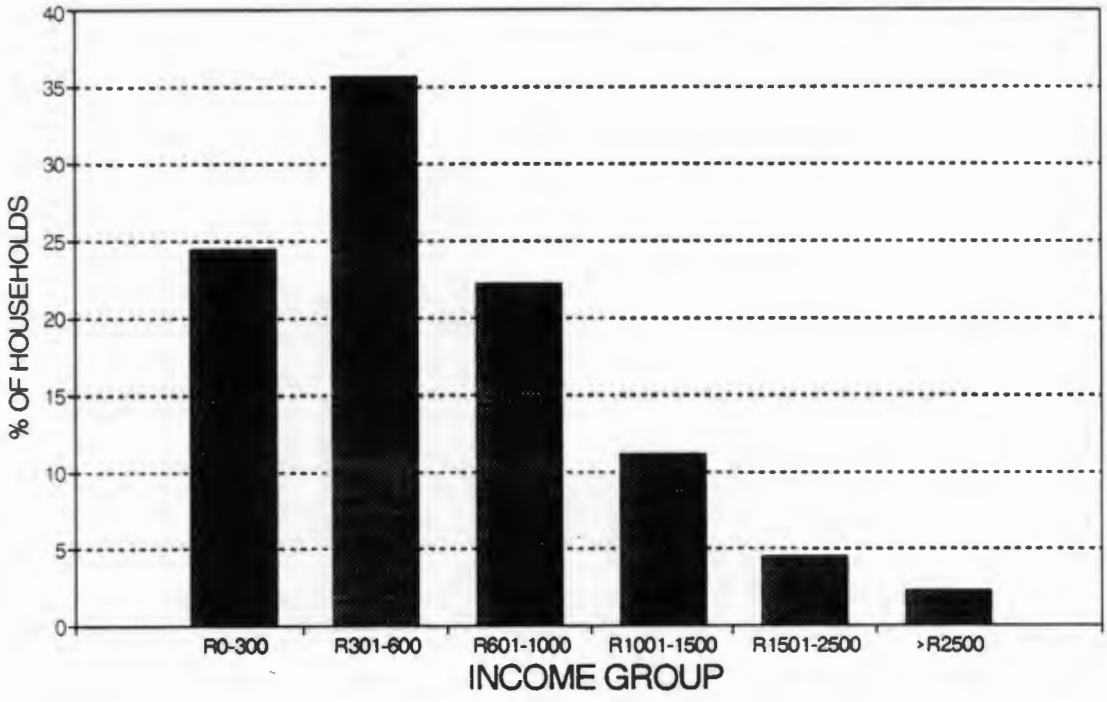

Figure 5.1 : Income distribution.

The nearby mines provide much of the employment available to residents, and many people are thus forced into migrant lifestyles. Household income distribution is shown in figure 5.1, and the median household income is R 500.

5.2 ENERGY CONSUMPTION PATTERNS

5.2.1 General

Some (approximately 10%) of the private housing in the village is electrified, while the municipal houses are not. The municipality considers that the occupants of these houses, being amongst the poorer inhabitants, would not be

able to afford Eskom power. According to the local municipality, the connection fee is R250 and the household must bear the cost of house wiring. Thereafter the monthly electricity service charge is R20, and the unit price is 21c/kWh. The town has high-mast street lighting.

5.2.2 Fuels used

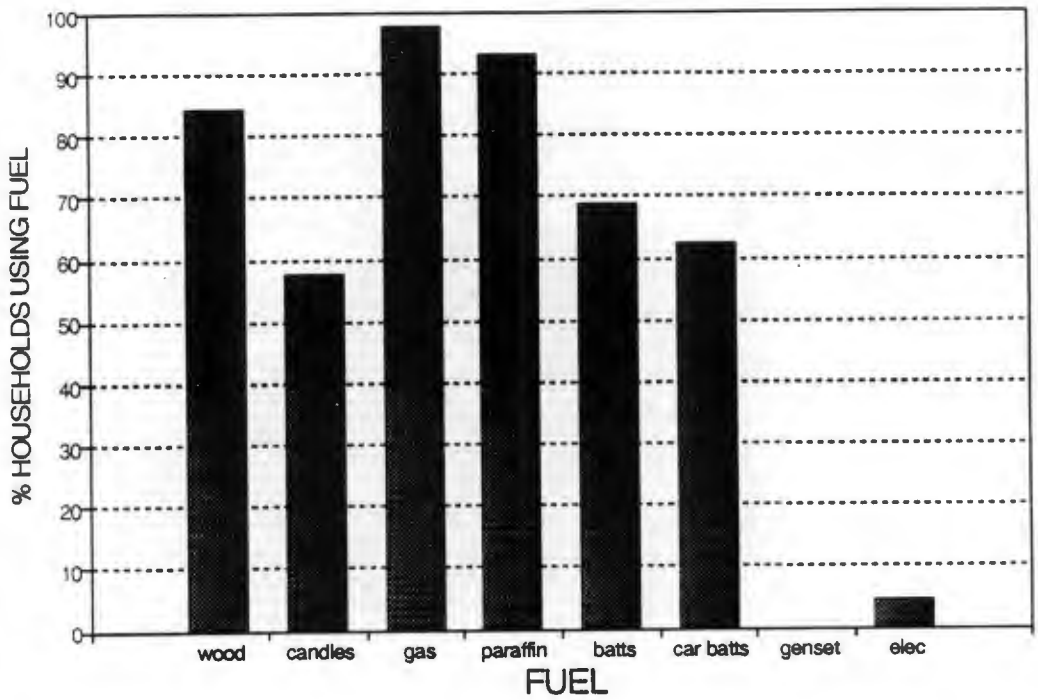

Figure 5.2 : Percentage of households using different fuels.

The fuels used in different households are shown in figure 5.2. Gas, paraffin and wood are the most widely used energy sources, while candles, batteries (dry cell), and car batteries are less common but still used by over 50% of the population.

The contribution of each fuel to the total nett and useful energy consumption is shown in figure 5.3. It is apparent that gas is the major contributor, particularly with respect to useful energy.

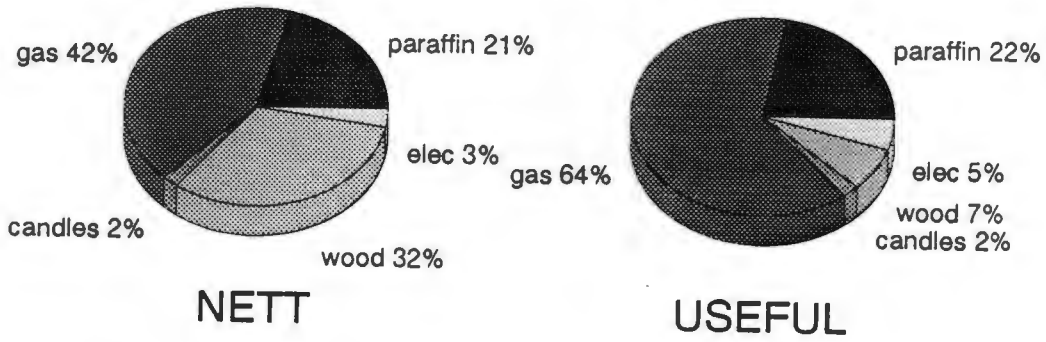

Figure 5.3 : Contributions of each fuel to total nett and useful energy consumption.

5.2.3 Expenditure on energy

The percentage of total household income spent on energy (figure 5.4) is far higher for lower income groups (37%) than for higher income groups. Table 5.2 shows actual amounts spent on energy requirements for the different income groups.

Table 5.2: Average monthly household energy expenditure for different income groups (Rands)

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	87	116	131	166	215	98	122

Figure 5.5 shows the proportion of total energy expenditure spent on each fuel for households that use those fuels. Gas expenditure is shown to typically constitute

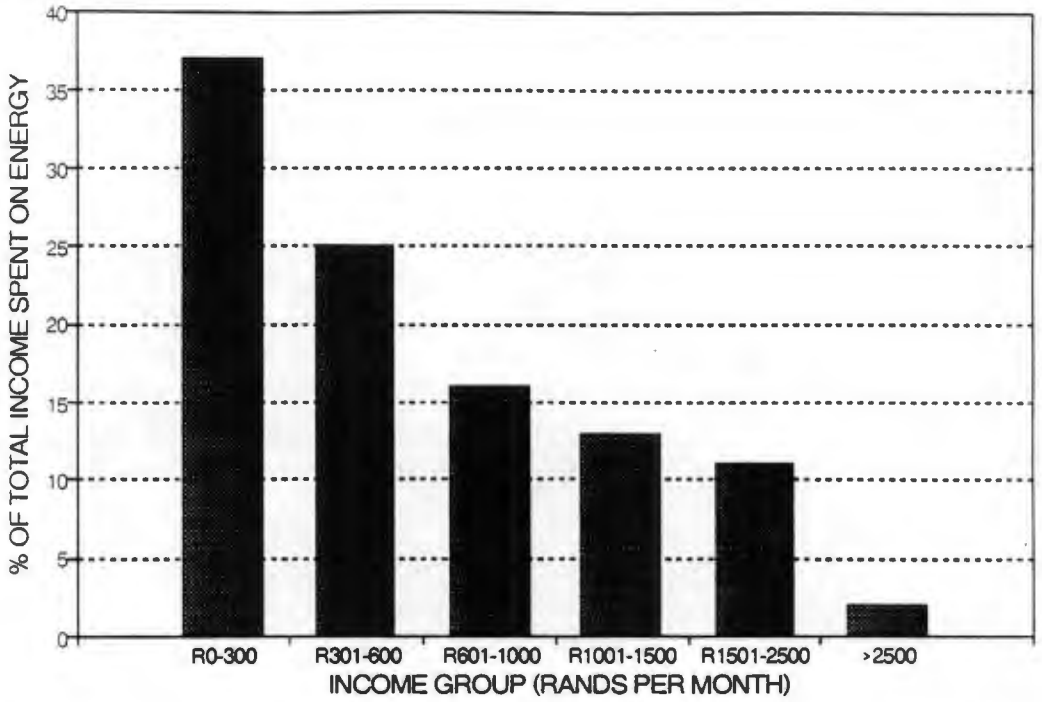

Figure 5.4 : Percentage of total income spent on energy.

the largest proportion of household energy expenditure where it is used, while energy expenditure in houses connected to the Eskom grid goes mainly to electricity payments.

5.2.4 Energy preferences

The overwhelming preference of households for Eskom electricity is illustrated in figure 5.6. Many households mentioned that they would prefer Eskom to electrify the area rather than the local municipality.

5.2.5 Energy related problems and perceived solutions

Figure 5.7 shows that most households surveyed considered the affordability of energy sources to be a problem. Of those that suggested ways in which to improve the situation, 100% indicated that the installation of Eskom power would be to their advantage.

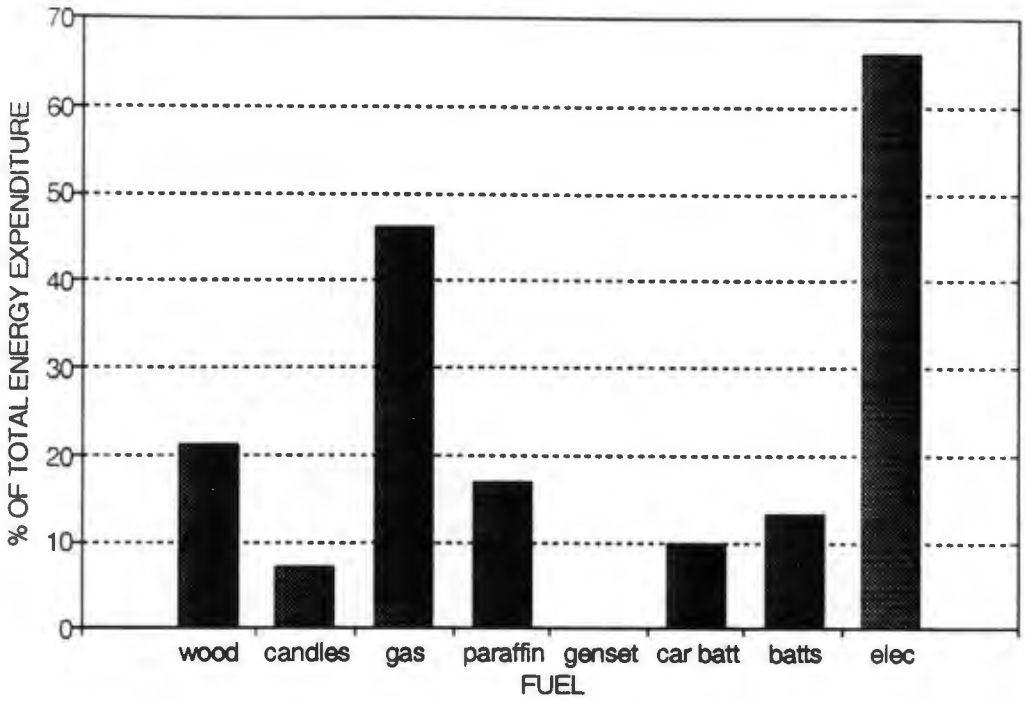

Figure 5.5 : Percentage of total energy expenditure on different fuels for those using the fuel.

5.3 SUMMARY AND DISCUSSION

Pofadder residents rely largely on gas, but also on paraffin and wood for their main energy requirements. Amounts spent on energy are above R80 p.m., even in the lower income groups, which spend significantly higher proportions of their income on energy.

5.3.1 Affordability of electricity

The expected monthly expenditures of electrified households, as discussed in chapter 3, are well below current expenditure on energy by all income groups, which are shown in table 5.2. Although some expenditure on other fuels, particularly gas, is likely to continue even after electrification, it is probable that total expenditure will be reduced due to lower expenditure on other sources such as batteries, candles, and paraffin.

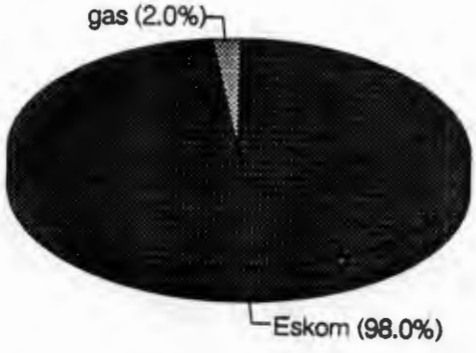

Figure 5.6 : Energy source preferences.

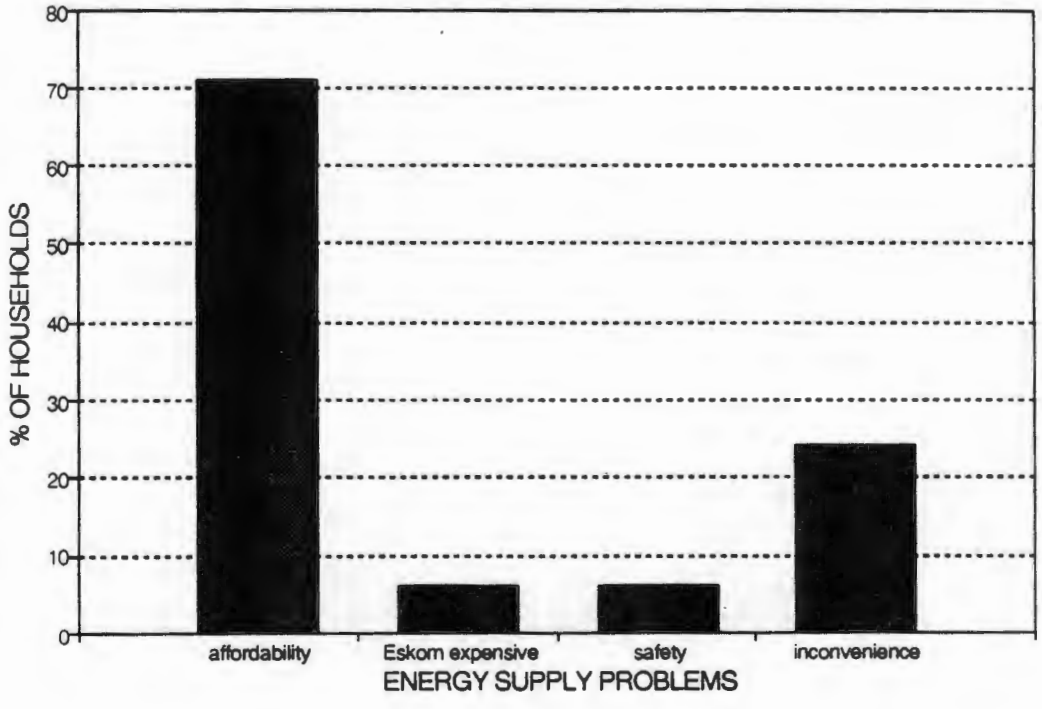

Figure 5.7 : Energy related problems.

5.3.2 Other fuels

Energy expenditure of households may be reduced by reducing the price of gas, but previous studies (Borchers et al.1990) have indicated that the resulting savings would be minimal.

5.4 RECOMMENDATIONS

- Considering the widespread preference for electricity, its potential beneficial effect to households and the community in general, its affordability, and the potential to reduce present excessive energy expenditure, it is recommended that the area be fully electrified using the Eskom "S1" tariff system.

- The electrification of the settlement should be carried out by Eskom due to the preference of the community for Eskom over the local municipality, and should be done with the full participation of the community.

CHAPTER 6

GARIES

6.1 BACKGROUND

6.1.1 Location & infrastructure

Garies lies on the main Cape Town - Windhoek route through Namaqualand, and is about 120km south of Springbok. There are no mines in the immediate vicinity, and the town is more agriculturally oriented as it is situated close to the Kamiesberg mountains with their associated relatively high rainfall (±200mm p.a.) and correspondingly higher agricultural productivity.

6.1.2 Demography

Table 6.1: Garies population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	792	63%
White	458	37%
Black	0	0%
TOTAL	1250	100%

Note : population based on figures obtained from Garies Municipality.

The study found 5.9 persons per household on average in the coloured settlement.

6.1.3 Settlement characteristics

The coloured settlement lies 0.5km to the south west of the town, and is distinct from the white town. It comprises 142 houses, 122 are rented out by the municipality and the remaining 20 privately owned. The municipality is in the process of selling off the rented houses. Plot sizes range from 300 to 820 m^2, and

there are no informal areas to the settlement. About 19 houses are presently being constructed as part of an owner-builder scheme available to residents. The village has a primary school.

6.1.4 Economic activity

Most of the inhabitants of the Garies coloured village are employed either on mines or as farmworkers in the surrounding area. Household income distribution

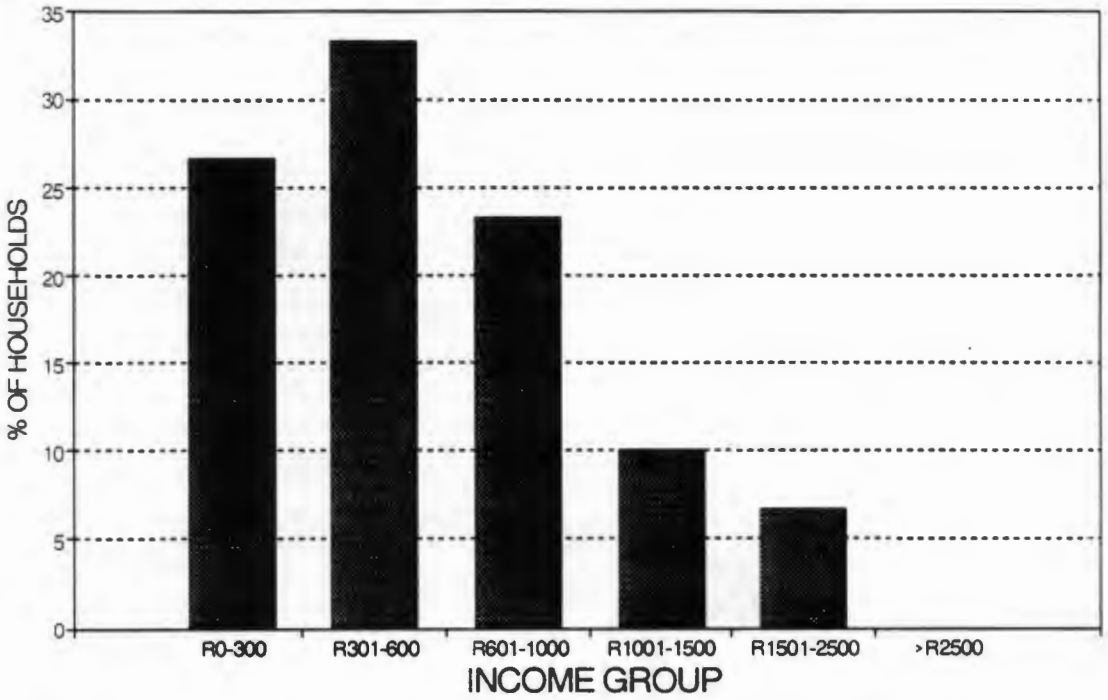

Figure 6.1 : Income distribution.

is shown in figure 6.1, and is typically skewed. The median household income is R 430 p.m.

6.2 ENERGY CONSUMPTION PATTERNS

6.2.1 General

Thirteen of the 20 private homes are electrified, compared with 20 of the 122 municipal houses. The 19 owner-builder scheme houses will all be electrified. The overall electrification level is thus 23% (excluding the owner-builder houses under construction). The municipality undertook the electrification of the coloured settlement (about 5 years ago), covering the capital costs out of general taxes. The present basic charge per user is R23.50, and the unit energy charge is 14c/kWh. The connection expenses include a connection fee typically between R500 and R700 (cost of connection + 20%), an R80 deposit, and housewiring costs, generally totalling over R1500. The settlement also has streetlights.

Typical power consumptions registered by the municipality ranged between 120 and 520 kWh, with an average of about 300kWh.

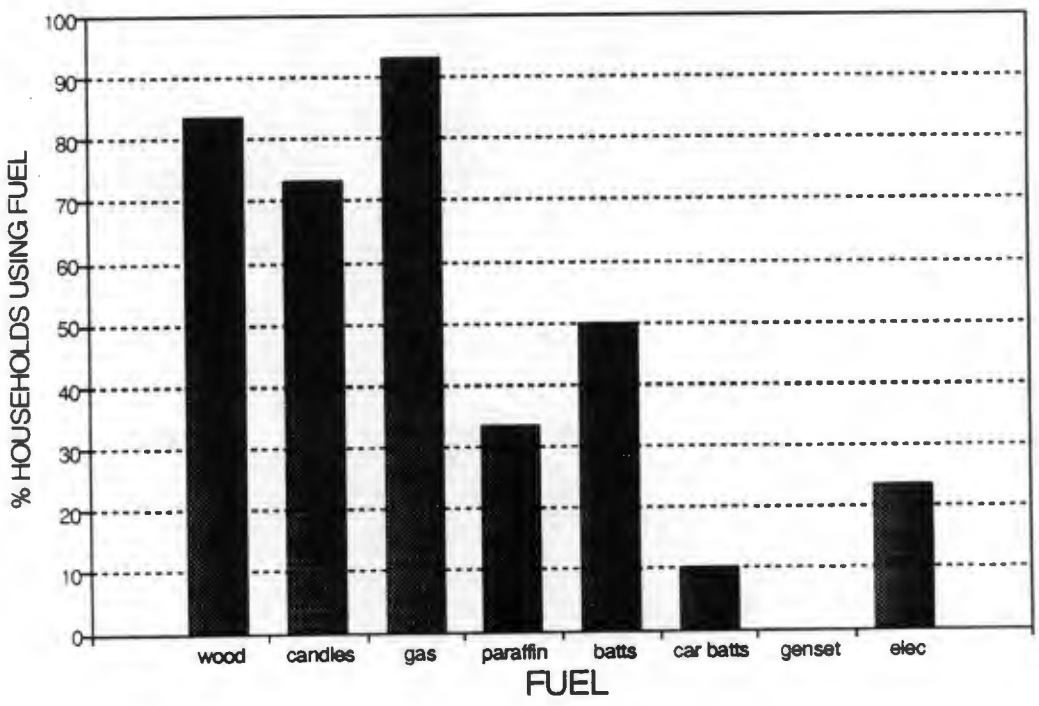

Figure 6.2 : Percentage of households using different fuels.

6.2.2 Fuels used

The majority of households use gas, wood, and candles, as can be seen from figure 6.2. Gas is the main contributor to total nett and useful energy consumption in the village (figure 6.3), with wood contributing significantly only in nett energy terms. Electricity contributes around 20% to useful energy consumption.

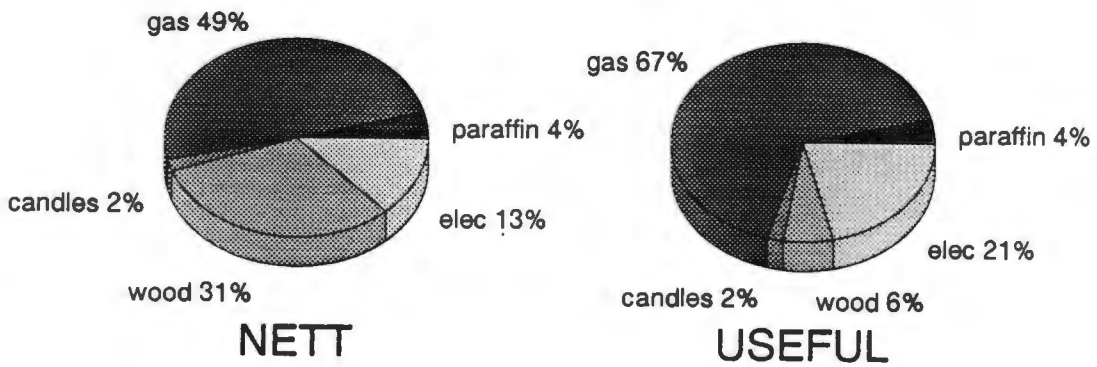

Figure 6.3 : Contributions of the different fuels to total nett and useful energy consumption.

6.2.3 Expenditure on energy

Figure 6.4 shows that the poorer households in Garies spend an unusually high percentage of their income on energy requirements - close to 40% - indicating a particular burden on these inhabitants. Actual expenditures on energy are shown in table 6.2.

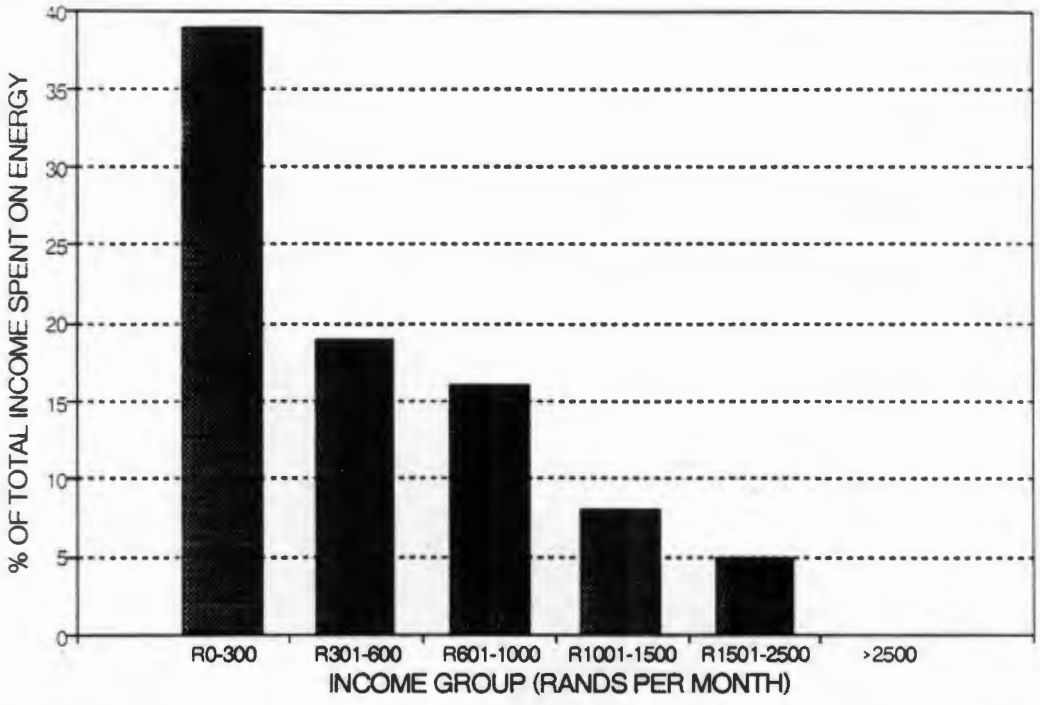

Figure 6.4 : Percentage of total income spent on energy.

Table 6.2: Average monthly household energy expenditure for different income groups (Rands)

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	82	70	116	78	77	-	85

Figure 6.5 indicates that gas and electricity comprise the major energy expenditure for households using those fuels.

6.2.4 Energy preferences

While Eskom power is the most widely preferred energy source in Garies, it is interesting to note that a significant number of households still prefer gas use above electricity (figure 6.6).

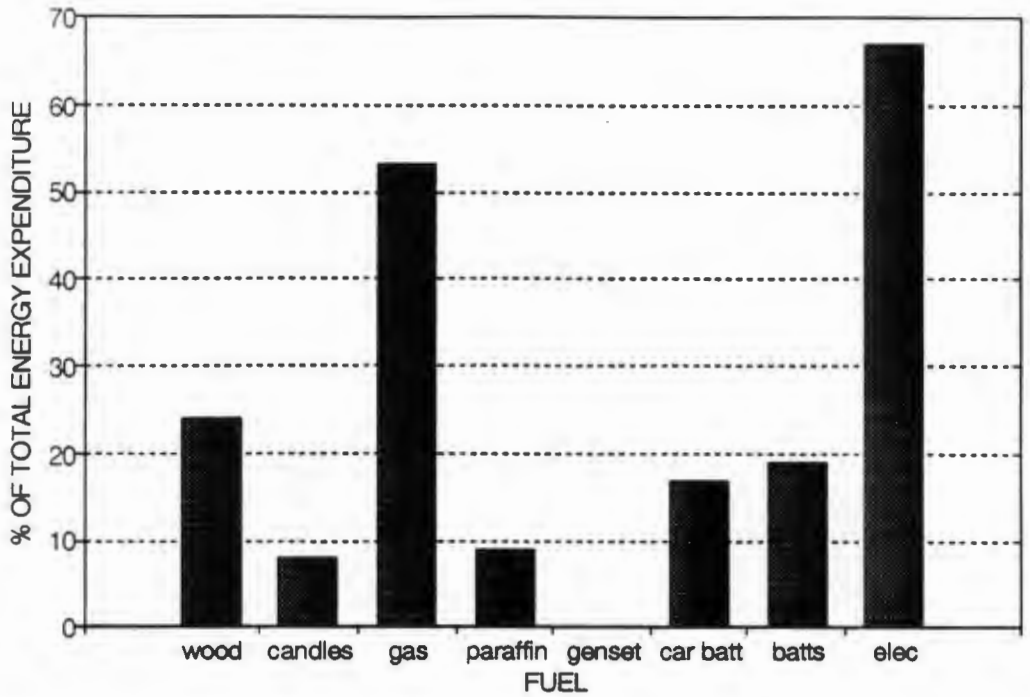

Figure 6.5 : Percentage of total energy expenditure on different fuels for those using the fuels.

6.2.5 Energy related problems

As is the case in most settlements studied in this project, the affordability of existing energy sources was mentioned by most households as being a problem (figure 6.7). The inconvenience of existing fuels was also considered problematic by many households.

6.3 SUMMARY AND DISCUSSION

Garies households are largely dependent on gas and wood use for their energy requirements, with gas involving the largest portion of household energy expenditure. The lowest income group spends an unusually high proportion of income on energy.

Figure 6.6 : Energy source preferences.

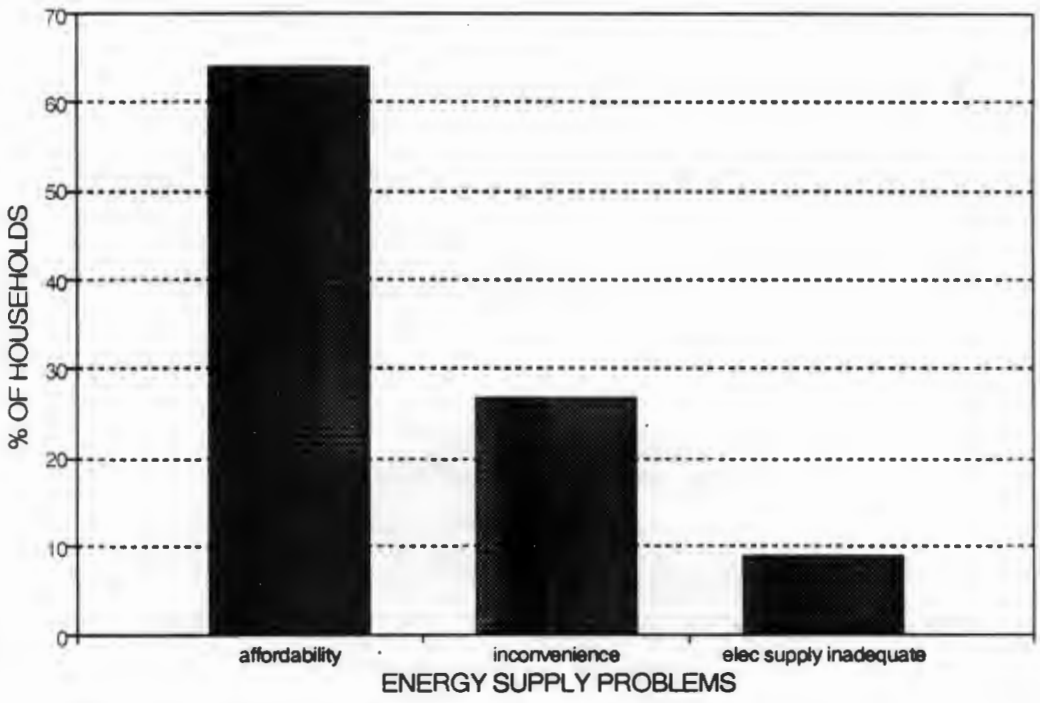

Figure 6.7 : Energy related problems.

6.3.1 Affordability of electricity

Electricity connection costs are high in Garies, and this has effectively limited access to the higher income groups. At present, households generally spend over R70 p.m. on energy requirements as seen in table 6.2. It is likely that monthly electricity costs for the Eskom "S1" tariff system in lower income households will be significantly less than this (see chapter 3) and therefore it appears that the community can afford electrification, and that it would result in reduced energy expenditures.

6.3.2 Other fuels

Previous studies previously done in Namaqualand have shown that no significant improvements would be obtained in reduced gas prices.

6.4 RECOMMENDATIONS

- Electricity is affordable, is a preferred energy source amongst 76% of households, and is likely to reduce current energy expenditure. It is therefore recommended that the settlement be electrified using the Eskom "S1" tariff system.

- The electrification of the settlement should be done with the full participation of the community.

CHAPTER 7

VIOOLSDRIF

7.1 BACKGROUND

7.1.1 Location & infrastructure

Vioolsdrif is situated on the Orange River, at the border post on the main Cape Town - Windhoek road. The environment is extremely arid, (some locals refer to the location as "Die Gat").

7.1.2 Demography

Table 7.1: Vioolsdrif population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	400*	89%
White	60	11%
Black	0	0%
TOTAL	460	100%

Note : population based on projections from the 1985 population census using average population growth rates.

* - corrected for depopulation (1985 - 1990, 97 - 75 houses).

An average of 5.3 persons per household was recorded by the study.

7.1.3 Settlement characteristics

Vioolsdrif coloured settlement is approximately 1km outside the centre of the town. The settlement has no formal structure and the 75 households are very spread out. Most households are either made entirely of reed, or a reed and zinc combination. There is a school which belongs to the church, and provides

education up to std 5. The town includes a shop, a police station and the border post.

The village falls under the local Regional Services Council (RSC) and has no services or public transport (the bi-weekly bus to Steinkopf and Springbok has been discontinued), and no access to medical care. While many locals wish to remain in Vioolsdrif, there is, however, a tendency for families to move south to Steinkopf due to these practical considerations. Such people are not always freely accepted into the Steinkopf community, possibly due to their relatively poor economic status.

The RSC is considering implementing a formal structure plan in the village, although it is doubtful whether the inhabitants will be able to afford the associated service charges.

7.1.4 Economic activity

Most of the Vioolsdrif inhabitants are employed on the surrounding farms, and work is generally seasonal rather than permanent, often limited to harvest times. Incomes are therefore typically low and irregular. Apparently many families left the area after the 1988 floods, when there was no work on the surrounding farms - the 1984 census recorded 97 families, compared with the 75 presently resident there. Over 50% of households receive state benefits (welfare, pensions, etc.).

Household income distribution is shown in figure 7.1, and can be seen to be very skewed towards the lower income groups. The median household income is R320.

7.2 ENERGY CONSUMPTION PATTERNS

7.2.1 General

Due to its location on the banks of the Orange River, wood is freely available to inhabitants of Vioolsdrif. Because there are no shops in the settlement, purchase of other commonly used fuels such as gas, paraffin, batteries, and candles involves having to transport them from town. There are no electrified homes in the

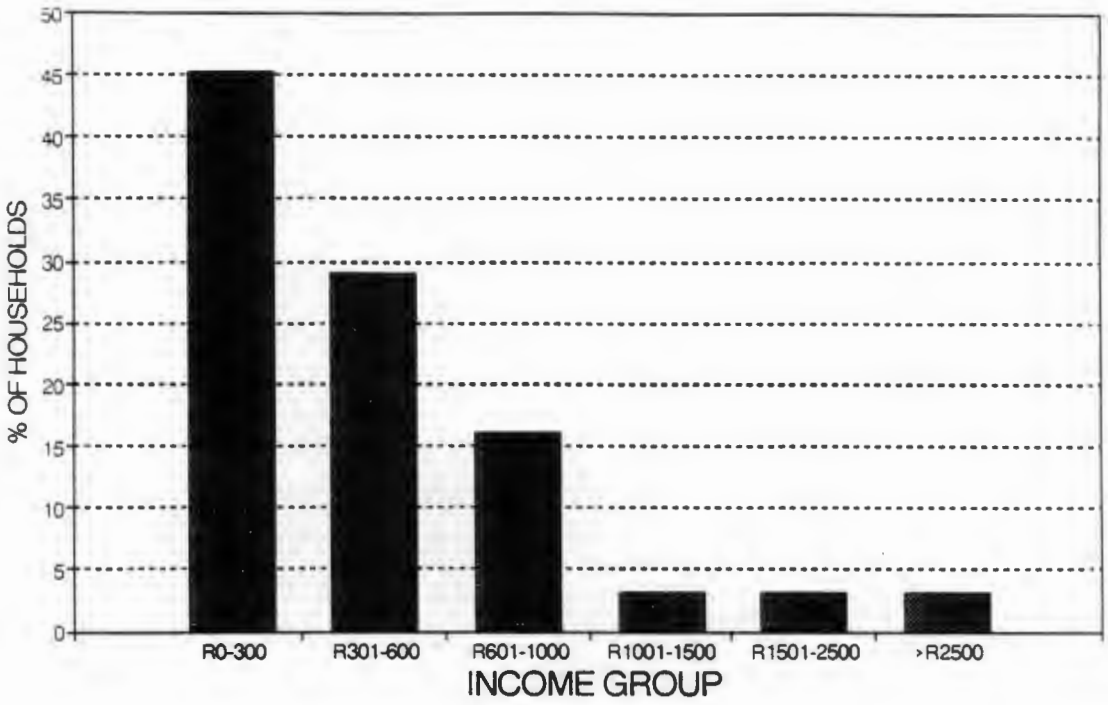

Figure 7.1 : Income distribution.

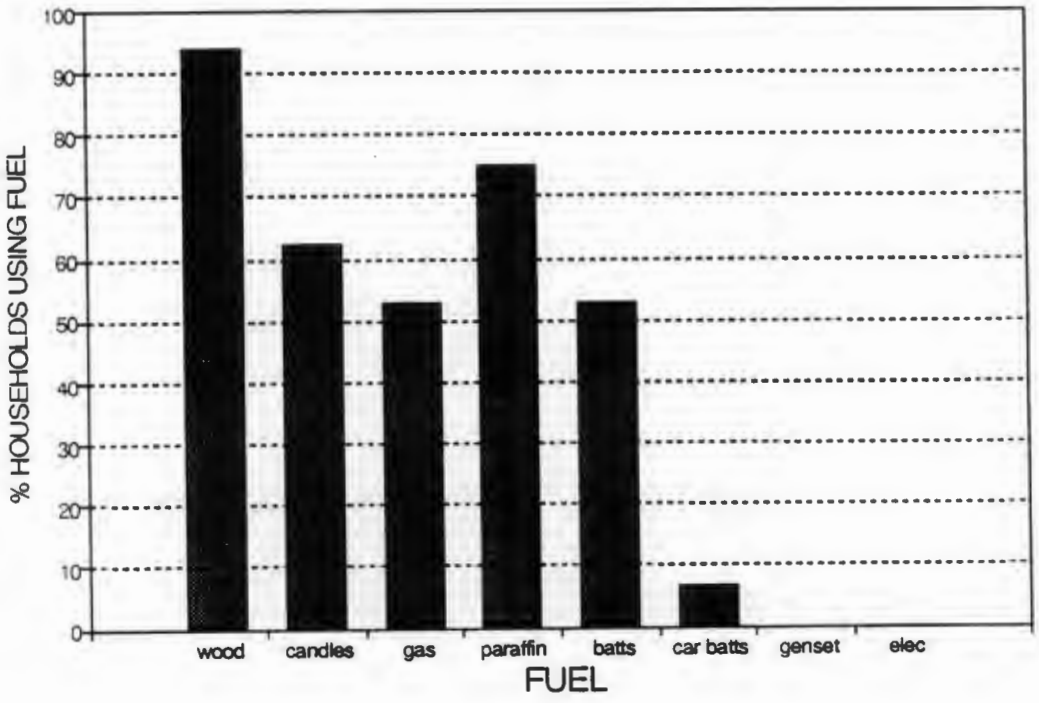

Figure 7.2 : Percentage households using different fuels.

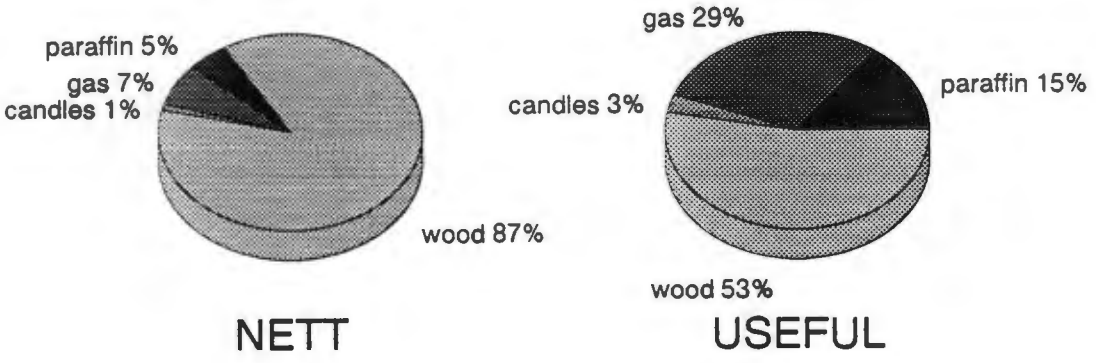

Figure 7.3 : Contribution of each fuel to total nett and useful energy consumption.

settlement, although the school is wired and receives power from a generator (incurring a running cost of approx. R60 p.m.).

7.2.2 Fuels used

The fuels used in different households are shown in figure 7.2. It can be seen that wood is the most widely used fuel, while candles, dry cell batteries, paraffin and gas are less used but still common.

The contribution of each fuel to the nett and useful energy consumption is shown in figure 7.3. Wood is by far the major contributor even in terms of useful energy.

7.2.3 Expenditure on energy

The percentage of total household income spent on energy is shown in figure 7.4 which indicates that a higher percentage is spent by the lower income group than the higher income groups. Overall, the relatively low percentages of household

incomes spent on energy (15% and less) are a result of the predominant use of firewood - a free resource in the area.

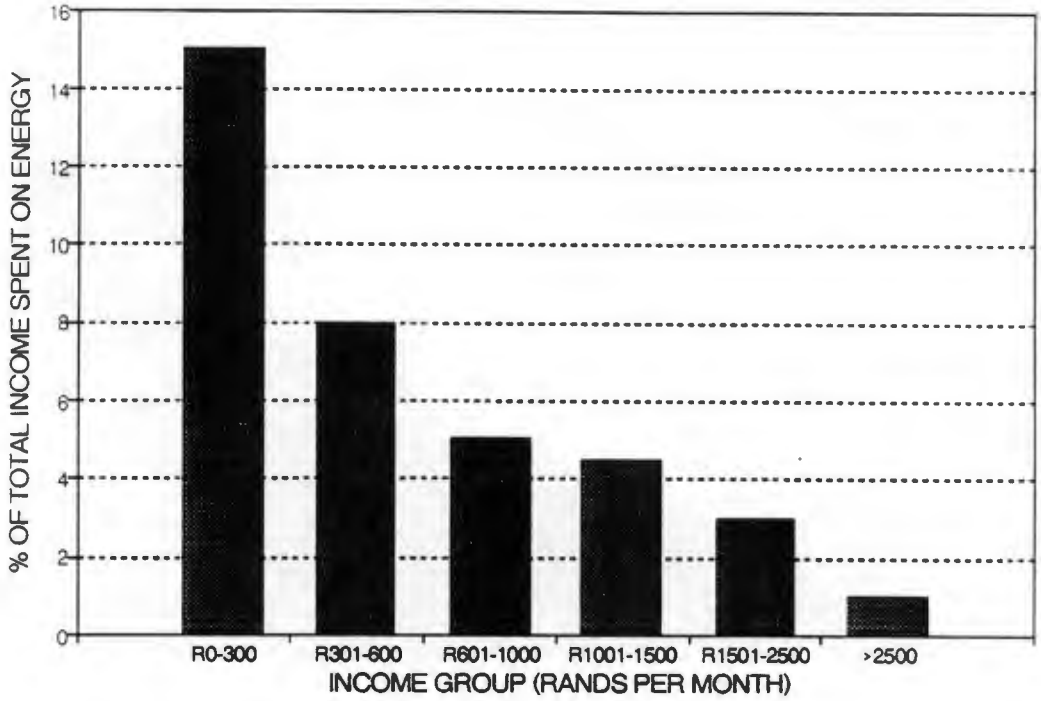

Figure 7.4 : Percentage of total income spent on energy.

Table 7.2 shows that actual energy expenditure comprises relatively small amounts.

Table 7.2: Average monthly household energy expenditure for different income groups (Rands)

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	24	34	38	59	48	28	31

The high proportion of household energy expenditure is illustrated by figure 7.5.

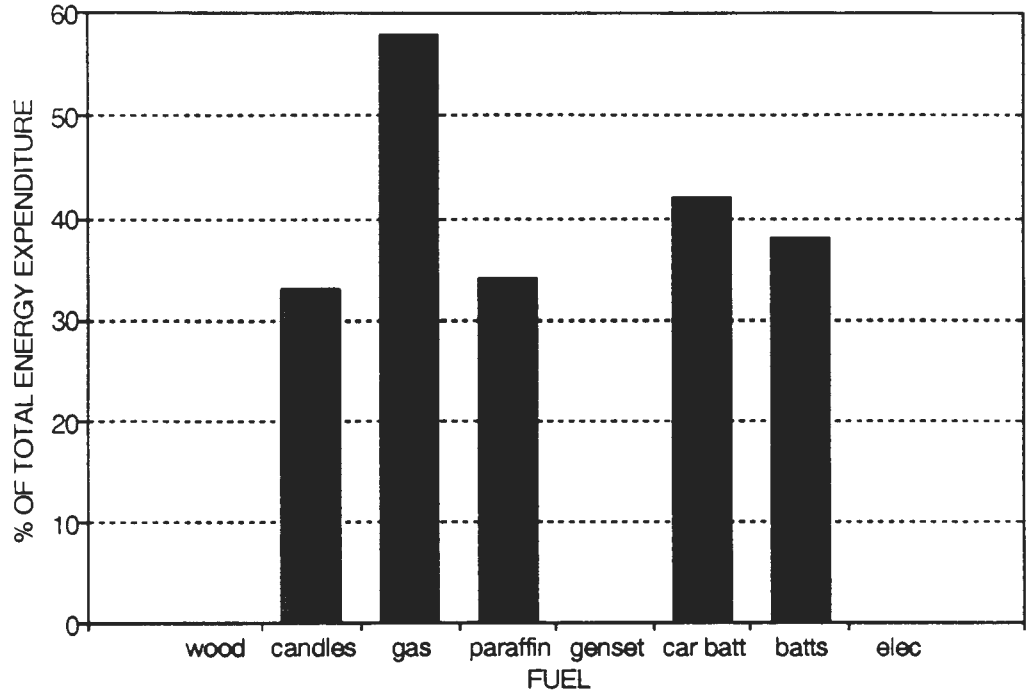

Figure 7.5 : Percentage of total energy expenditure on different fuels for those using the fuels.

7.2.4 Energy preferences

From figure 7.6 it can be seen that Eskom power is by far the preferred energy supply alternative, with a small percentage of the households sampled preferring gas.

7.2.5 Energy related problems and perceived solutions

The safety of existing fuel use was perceived as a problem by more than 60% of the respondent households, which can be related to the danger and severe consequences of fires in reed houses. Figure 7.7 also shows that affordability of the fuels used and the inconvenience of using them were perceived to be problems. This relates to the cost of gas and the problem of transporting the gas bottles to and from the shop in town. The collection of wood was also mentioned as an inconvenience.

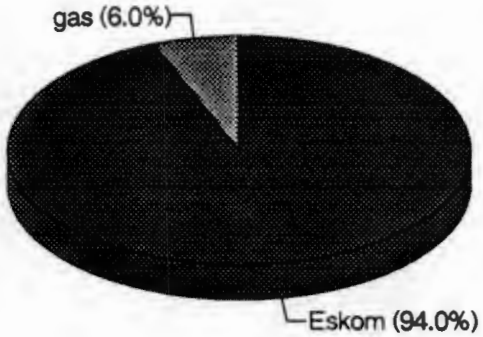

Figure 7.6 : Energy preferences.

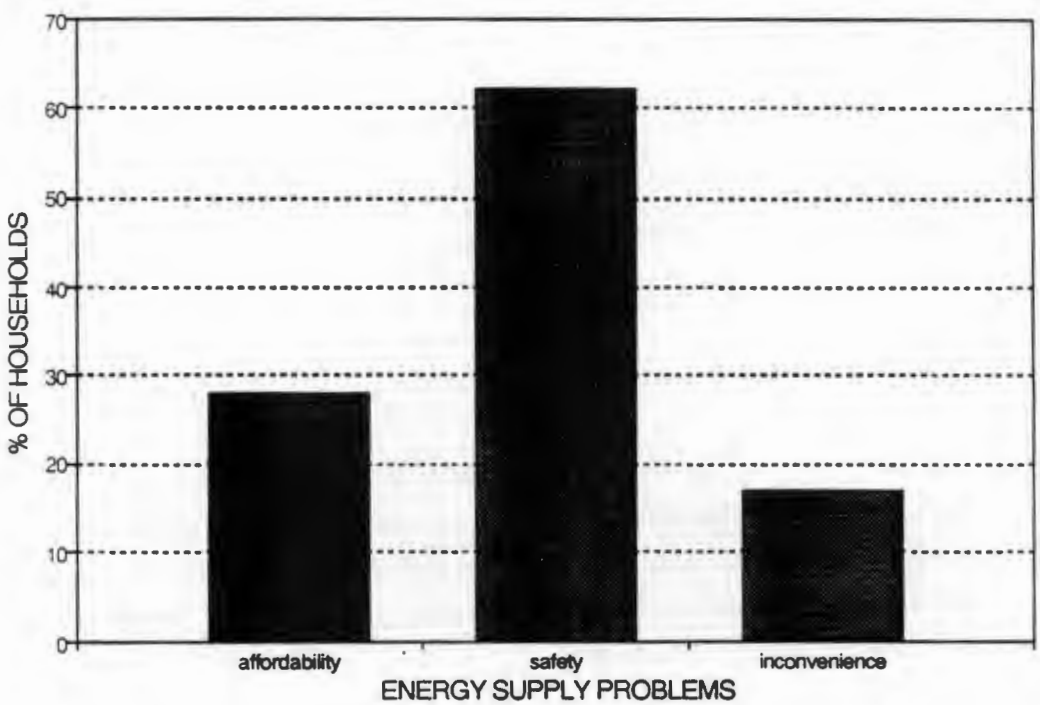

Figure 7.7 : Energy related problems.

Only a couple of respondents made suggestions to alleviate the energy problems, suggesting that the settlement be electrified and that installation costs be subsidised.

7.3 SUMMARY AND DISCUSSION

The low incomes in the area and the abundance of free wood along the Orange River result in relatively low expenditure on energy amongst the inhabitants of Vioolsdrif. The percentage of total income spent on energy is particularly low, 15% or less for all income groups, compared with many of the other areas where an amount of around 30% was typical.

Even though Eskom power is the most preferred energy source, it is unlikely that it would totally replace wood considering the social function of the hearth within the society.

7.3.1 Affordability of electricity

If Vioolsdrif were electrified, the energy expenditure of households in the lower income groups would not necessarily decrease. This does not, however, indicate that they could not afford electrification. These households are at present spending small percentages of their total income on energy, and may be willing to spend more for the convenience grid power. Assuming that the low income households would be prepared to spend 20% of their total monthly income on electricity (not an uncommon level of expenditure), this would amount to around R32, which is sufficient for the purchase of 150kWh per month at the current "S1" tariff, as well as allowing for the purchase of gas or other fuels.

It is important that before electrification of this area is undertaken the residents realise the financial implications, in terms of energy costs as well as appliance costs, and weigh these up against the increased safety and their preference for Eskom power.

9.4 RECOMMENDATIONS

- The viability of electrifying Vioolsdrif should be further investigated especially with respect to the ability of the poorer residents to pay for the service as well as the appliances.

CHAPTER 8

KAMIESKROON

8.1 BACKGROUND

8.1.1 Location & infrastructure

Kamieskroon is situated on the main Cape Town - Windhoek route about 60km south of Springbok, and 40km north of Garies. Like Garies, it is in the Kamiesberg mountain area, enjoying a higher rainfall than the rest of Namaqualand, and the surrounding area is therefore agriculturally relatively productive.

8.1.2 Demography

Table 8.1: Kamieskroon population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	±900*	85%
White	154	15%
Black	0	0%
TOTAL	1054	100%

Note : population based on projections from 1985 census using average population growth rates.

* - figure obtained from Kamieskroon Municipality.

On average the study found 5.6 persons per household.

8.1.3 Settlement characteristics

The coloured settlement is approximately 2km from the white area. Of the 84 houses in the village, 80 are owned by the municipality and are rented to

inhabitants, while the remainder are private. There is also a school and a boarding house accommodating about 300 people. The municipality intends to sell its houses. There are no informal dwellings in the settlement.

8.1.4 Economic activity

The majority of employed inhabitants work on mines or in the fishing industry on the coast, and thus lead migrant lifestyles. There is also some employment locally in Kamieskroon or on surrounding farms. As with many of the

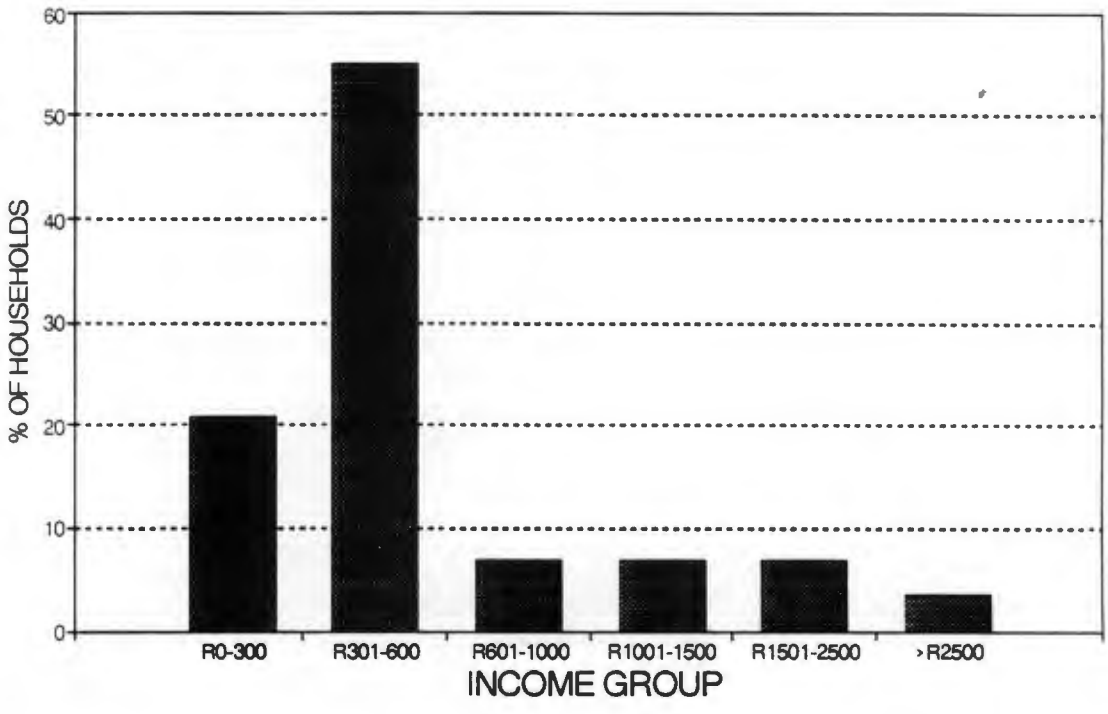

Figure 8.1 : Income distribution.

settlements, unemployment is a problem. Household income distribution for the settlement (figure 8.1) shows an unusual concentration of households in the R300-600 income group, with very few earning above this. The median household income is R 500.

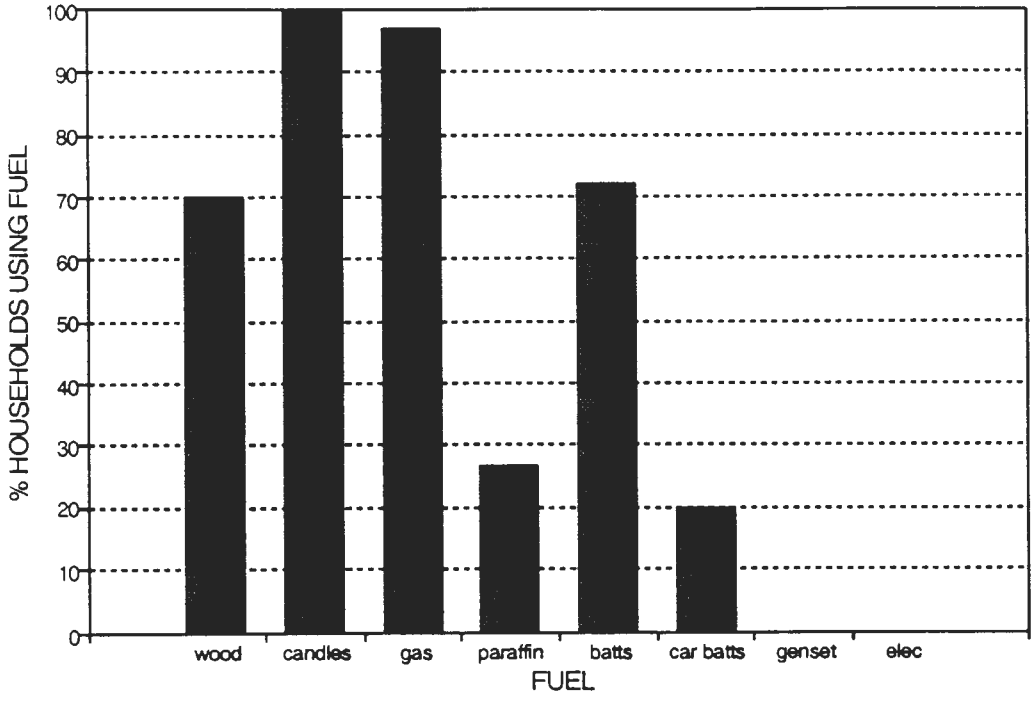

Figure 8.2 : Percentage of households using different fuels.

8.2 ENERGY CONSUMPTION PATTERNS

8.2.1 General

Only one of the private houses and the school and boarding house are electrified. The settlement has streetlights. The basic monthly electricity charge per user is R26.00, which includes the first 100 kWh, and thereafter the cost per unit is 15c/kWh. The connection fee must be carried by households also, typically amounting to around R700 (cost of connection + 20%). In addition, any housewiring costs must be borne by the household.

8.2.2 Fuels used

Figure 8.2 shows gas and candles to be the most widely used fuels. While wood contributes a significant amount to the total nett energy consumption in the settlement (figure 8.3), it plays a small part in the useful energy consumption, which is dominated by gas.

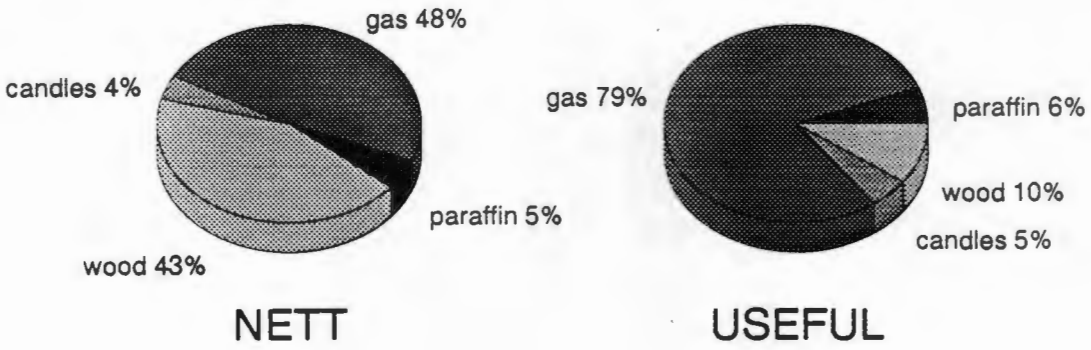

Figure 8.3 : Contribution of each fuel to total nett and useful energy consumption.

8.2.3 Expenditure on energy

Figure 8.4 shows that poorer households have to spend high proportions of their income on their energy needs, although they generally spend much less than the higher income groups, as shown in table 8.2. Gas absorbs the greatest proportion of this expenditure for those households that use gas, as can be seen in figure 8.5.

Table 8.2: Average monthly household energy expenditure for different income groups (Rands)

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	53	69	68	66	133	153	74

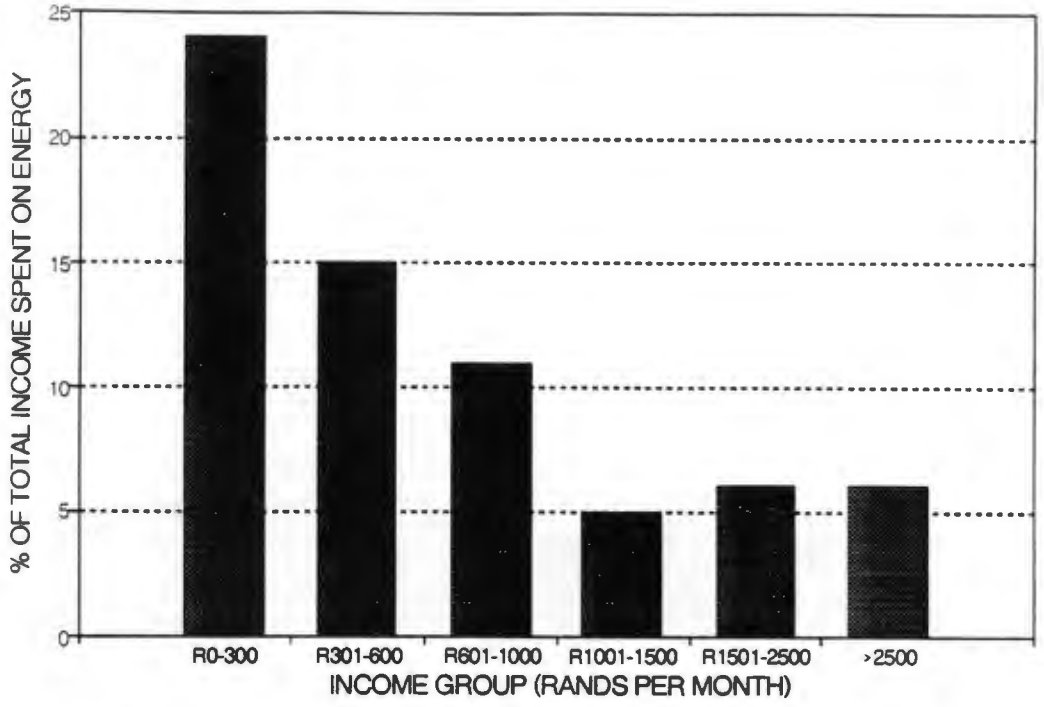

Figure 8.4 : Percentage of total income spent on energy.

8.2.4 Energy preferences

The great majority of households surveyed expressed a preference for Eskom power over other energy supply alternatives, as shown in figure 8.6. A significant proportion of households interviewed stressed that they would prefer Eskom to be involved in any electrification projects rather than the local municipality.

8.2.5 Energy related problems and perceived solutions

Of the households that mentioned problems relating to energy use, the affordability of fuels was the most common problem (figure 8.7). This relates principally to the affordability of gas. About 25% of respondents also mentioned that they considered the to be inconvenient.

Although only a few houses made suggestions to alleviate energy problems, these all proposed that the settlement be electrified.

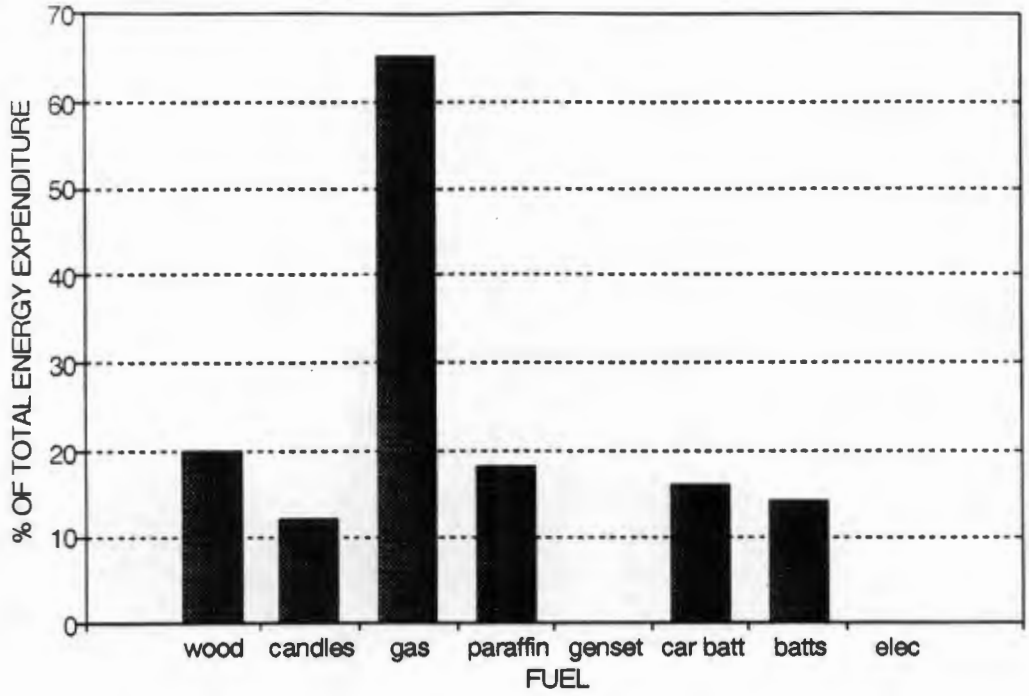

Figure 8.5 : Percentage of total energy expenditure on different fuels for those using the fuels.

8.3 SUMMARY AND DISCUSSION

The Kamieskroon residents are principally dependent on gas, which contributes the most to energy consumption and absorbs most of the energy expenditure of households.

8.3.1 Affordability of electricity

The actual energy expenditures shown in table 8.2 indicate that electrification using the Eskom "S1" tariff system is likely to be affordable to all residents. The energy expenditure of the lowest income group, R53 p.m., would be sufficient to cover a basic electricity bill for a low demand house of around R25p.m., leaving over R25 for the purchase of gas or other fuels. At present, the high connection costs effectively prohibit households from using grid power.

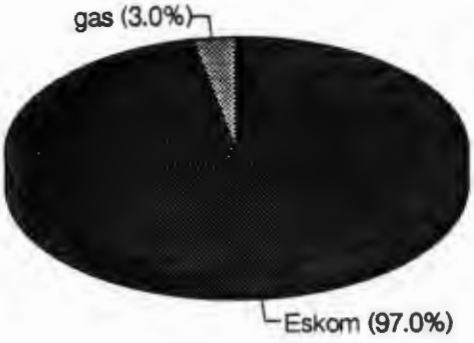

Figure 8.6 : Energy source preferences.

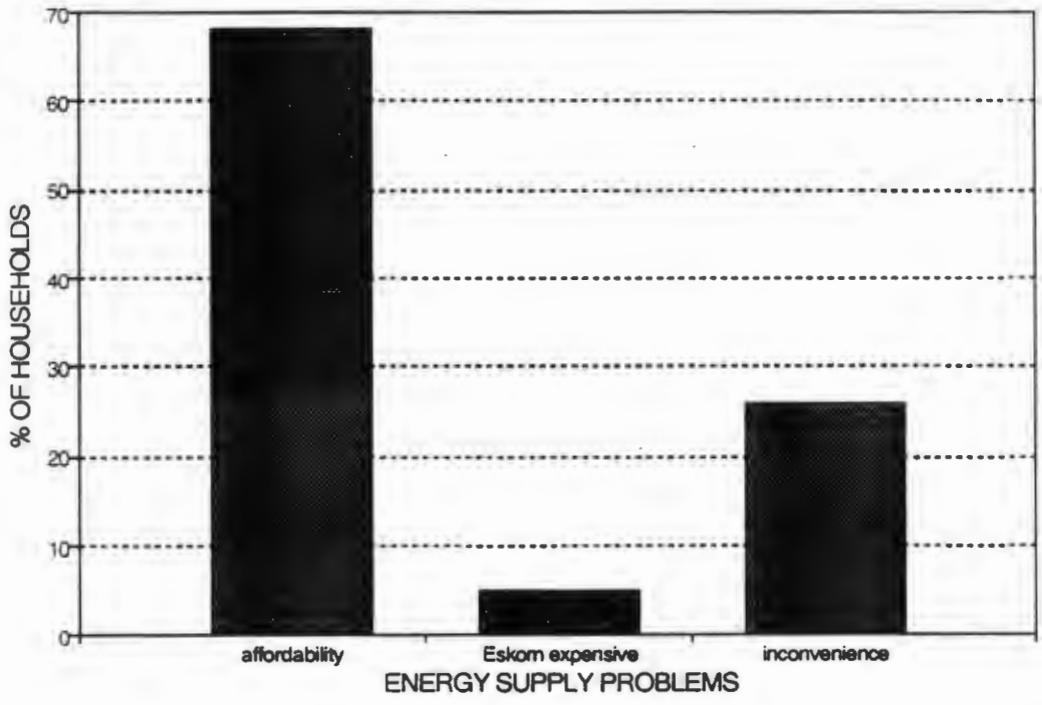

Figure 8.7 : Energy related problems.

8.3.2 Other fuels

Other studies have indicated that there is little potential for substantial savings to be made by reducing the gas price to consumers in Namaqualand.

8.4 RECOMMENDATIONS

- Because electricity is affordable and widely sought after in Kamieskroon, and is expected to reduce current energy expenditure and have other beneficial effects on the community, it is recommended that the settlement be electrified using the Eskom "S1" tariff system.

- Electrification of the area should be carried out with the full participation of community organizations, and should be undertaken by Eskom rather than the local municipality.

CHAPTER 9

ONSEEPKANS

9.1 BACKGROUND

9.1.1 Location & infrastructure

Onseepkans originated from a Roman Catholic Mission station. It is situated on the Orange river, at the border post on the road leading from Pofadder to Karasburg in Namibia. Pofadder is about 70km away, and Upington and Springbok, the closest large settlements, approximately 270km distant.

9.1.2 Demography

Table 9.1: Onseepkans population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	1041	100%
White	0	0%
Black	0	0%
TOTAL	1041	100%

Note : population based on projections of 1985 population census using average growth rates.

The study found that on average there were 6.9 persons per household, which is the highest encountered in all settlements surveyed.

9.1.3 Settlement structure

The settlement is informally structured, comprising 183 households, and has a relatively low population density. It has shops and a mission station. The houses are almost entirely made from reed, except for the mission buildings which are brick.

9.1.4 Economic activity

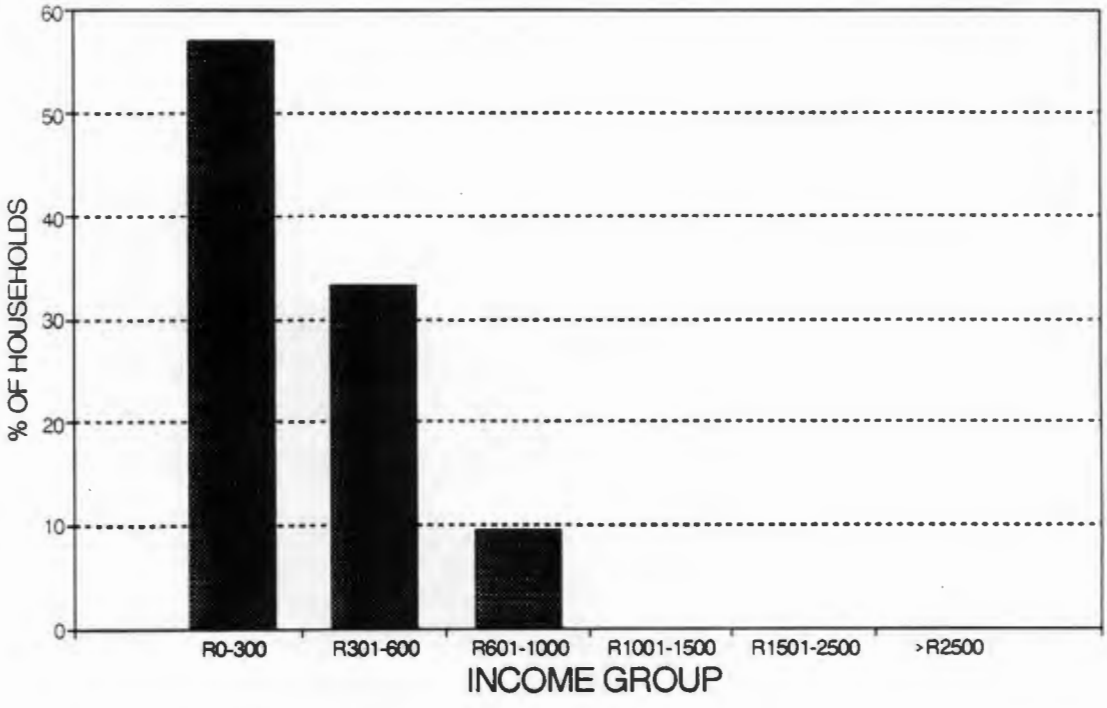

Figure 9.1 : Income distribution.

Most of the available employment is on the mines in the area, such as the Black Mountain Mine at Aggenys, and the diamond mines at Alexander Bay. As in many Namaqualand communities, therefore, many people lead migratory lifestyles.

From the household income distribution, shown in figure 9.1, it is apparent that Onseepkans is a poor settlement. The median household income of R 260 p.m. bears this out.

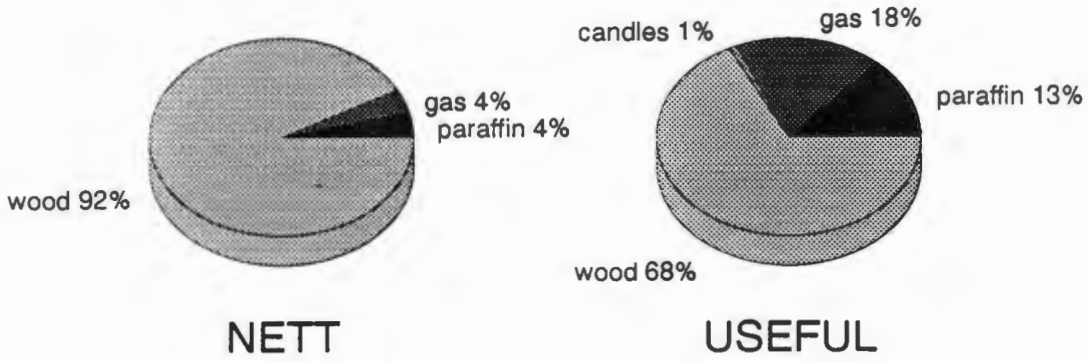

Figure 9.3 : Contribution of each fuel to total nett and useful energy consumption.

wood is illustrated in figure 9.3, which shows the high percentage contribution to total energy use of wood, although paraffin and gas are important contributors in terms of useful energy consumption.

9.2.3 Expenditure on energy

Households spend relatively small proportions of their total income on energy requirements, as illustrated by figure 9.4. Figure 9.5 shows that gas and batteries absorb the highest proportion of the total expenditure where households use these fuels.

Table 9.2: Average monthly household energy expenditure for different income groups (Rands)

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	19	26	83	-	-	-	28

9.2 ENERGY CONSUMPTION PATTERNS

9.2.1 General

Wood is plentiful due to the proximity of the Orange River. Because houses are constructed largely from reed, fuels such as wood, candles, paraffin, and gas constitute a serious fire hazard to households.

Eskom power is not available in the village.

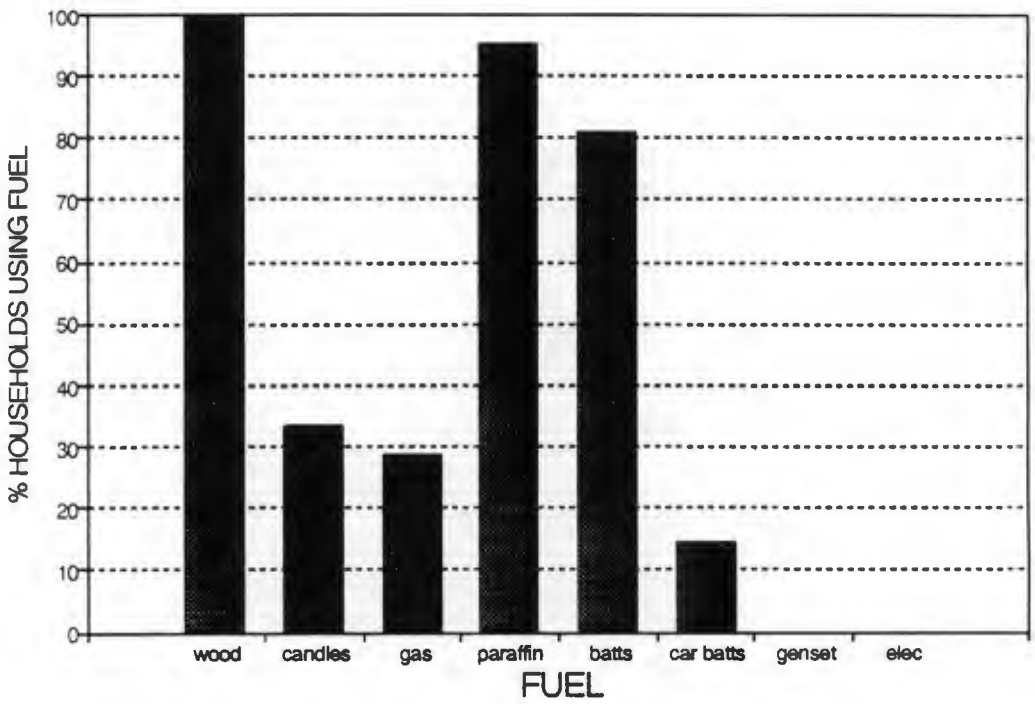

Figure 9.2 : Percentage households using different fuels.

9.2.2 Fuels used

Energy use patterns in Onseepkans are significantly different to most other settlements dealt with in this project. Figure 9.2 shows that wood is used by all households, while paraffin and batteries are also extensively used. A relatively low percentage of households use gas. The dependence of the community on

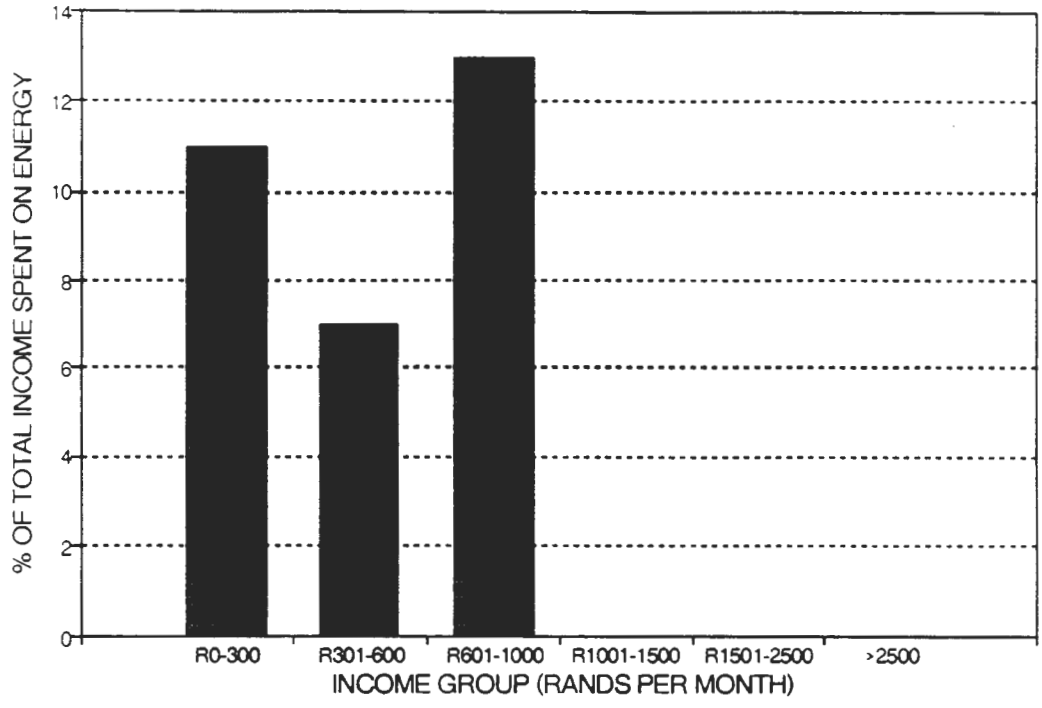

Figure 9.4 : Percentage of total income spent on energy.

9.2.4 Energy preferences

The high proportion of households indicating that they preferred Eskom power to other supply options is shown in figure 9.6.

9.2.5 Energy related problems

The majority of problems mentioned by households were related to the unavailability of Eskom power, and suggestions for improving the situation centred around obtaining grid electricity.

9.3 SUMMARY AND DISCUSSION

Onseepkans inhabitants are more dependent on wood than on other fuels. Incomes are relatively low, as is expenditure on energy due to the abundance of free wood along the Orange River. Percentage of total income spent on energy is generally only around 10% for all income groups, as opposed to the 30% common in many other settlements studied.

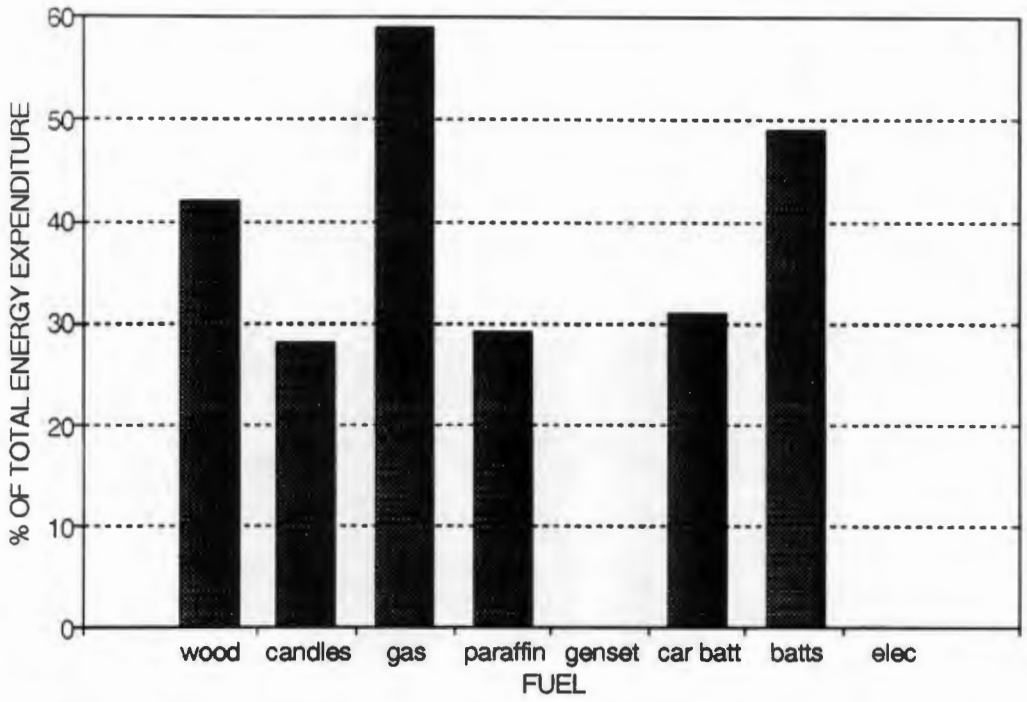

Figure 9.5 : Proportions of total energy expenditure on each fuel for those that use the fuels.

The dependence of the village on wood indicates that wood fulfils a strong social need in households. It is therefore unlikely that Eskom power will replace wood as an energy source in the short term. Eskom power is nonetheless the most sought after energy source.

9.3.1 Affordability of electricity

Present energy expenditures in the village for the lower income groups are lower than if these households were electrified. However, if we assume that lower income households would be prepared to spend 20% of their total monthly income on electricity, this would amount to around R38 per month for the lowest income group which would provide about 240kWh per month (at the current "S1" tariff), which is generally more than low income households require. It would therefore be necessary to establish whether residents realise actual payments involved in obtaining electricity, and allow them to weigh this against their preference for Eskom power. Because incomes are relatively low in the settlement, residents should also be made aware of the cost implications of basic appliance purchase.

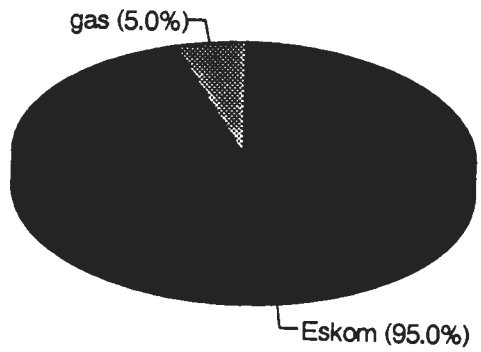

Figure 9.6 : Energy preferences.

9.4 RECOMMENDATIONS

- The viability of electrifying Onseepkans should be investigated in more detail, and information should be gathered concerning residents willingness to meet the cost of electricity, as well as basic appliances.

CHAPTER 10

NABABEEP

10.1 BACKGROUND

10.1.1 Location & infrastructure

Nababeep and Okiep have similar histories in that they were both established by the Okiep Copper Company (OCC) as settlements for their employees on the copper mines. The town is about 15km north west of Springbok, and is easily accessible by road.

10.1.2 Demography

Table 10.1: Nababeep population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	6182	85%
White	1047	15%
Black	10	0%
TOTAL	7239	100%

Note : populations based on 1985 census figures and average population growth rates.

The study found Nababeep to have 4.9 persons per household on average.

10.1.3 Settlement characteristics

The land on which the town is situated is all owned by the OCC. At present there are 284 company owned houses and 617 privately owned houses in the settlement. There are no informally settled households . Although the town is relatively spread out with informal settlements around the fringes, it is the policy of the OCC not to extend the services available in the central part of the town to

the surrounding houses, but to encourage these families to move into the serviced area.

10.1.3 Economic activity

Most employment opportunities have historically been with the OCC copper mines in the area, but due to the fluctuations in the copper industry many residents have been forced to seek employment elsewhere over the years. The OCC nonetheless remains the main employer in the area.

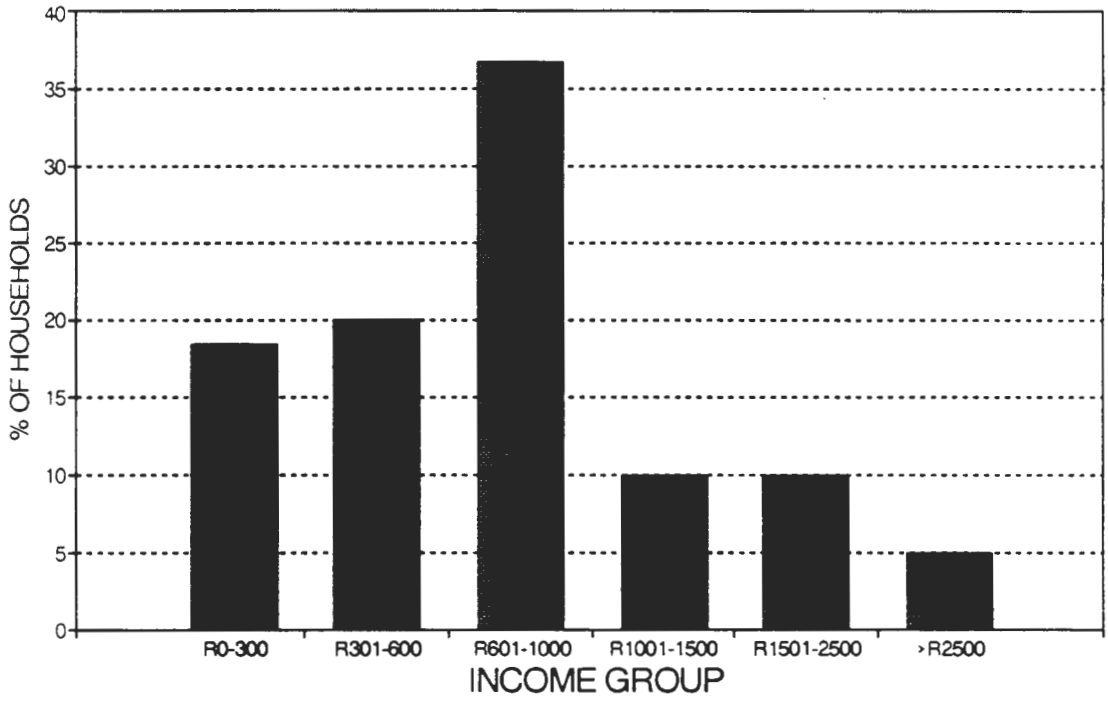

Figure 10.1 : Income distribution.

Household income distribution is shown in figure 10.1, and the median household income is R 800 p.m. It is apparent that Nababeep is a relatively wealthy settlement, with an income distribution less skewed than most of the settlements studied in this project.

10.2 ENERGY CONSUMPTION PATTERNS

10.2.1 General

All of the company owned houses in Nababeep have been connected to the mine electricity grid, as well as a small proportion (about 10%) of the private houses. The overall percentage electrification is thus about 38%. According to the OCC, their existing grid does not have the extra capacity to supply all households in the town with electricity. Electricity is sold to residents at subsidised rates - 7.5c/kWh for employees and 10.4c/kWh for non-employees.

Residents of Nababeep who still use wood are not allowed to collect on the surrounding land which is privately owned. There is a R50 fine if they are caught doing so.

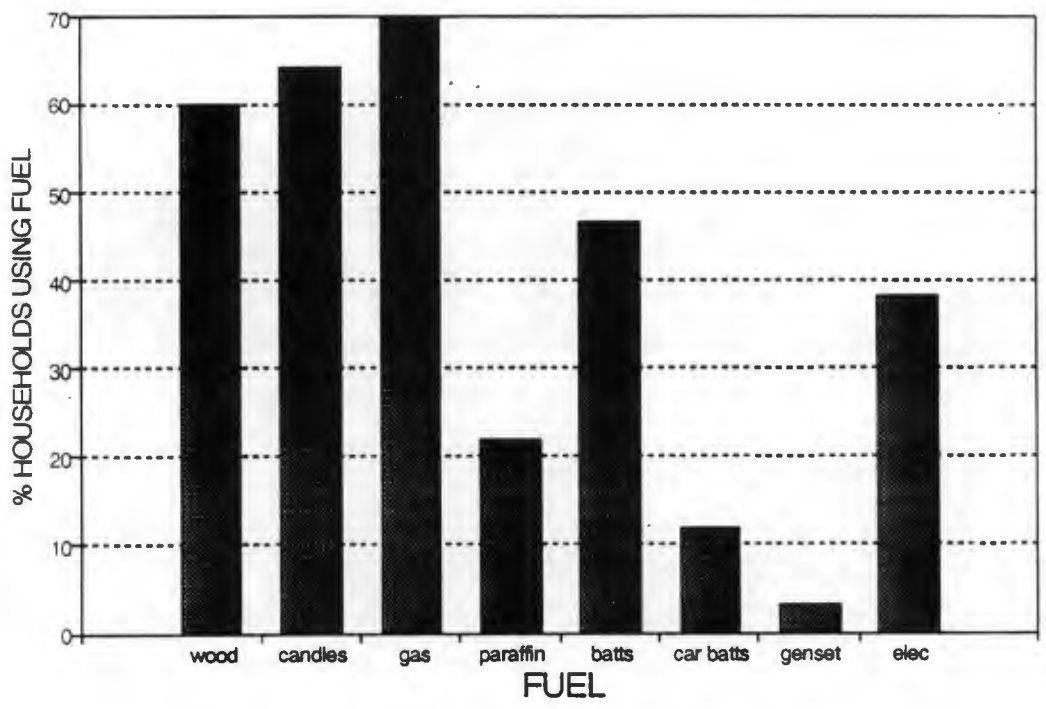

Figure 10.2 : Percentage households using different fuels.

10.2.2 Fuels used

Gas, candles, and wood are all widely used by households, with batteries and electricity used by a smaller percentage of houses (figure 10.2).

Electricity, wood, and gas all are major contributors to the total nett energy consumption in the town, although in useful energy terms, electricity and gas are the largest contributors (figure 10.3).

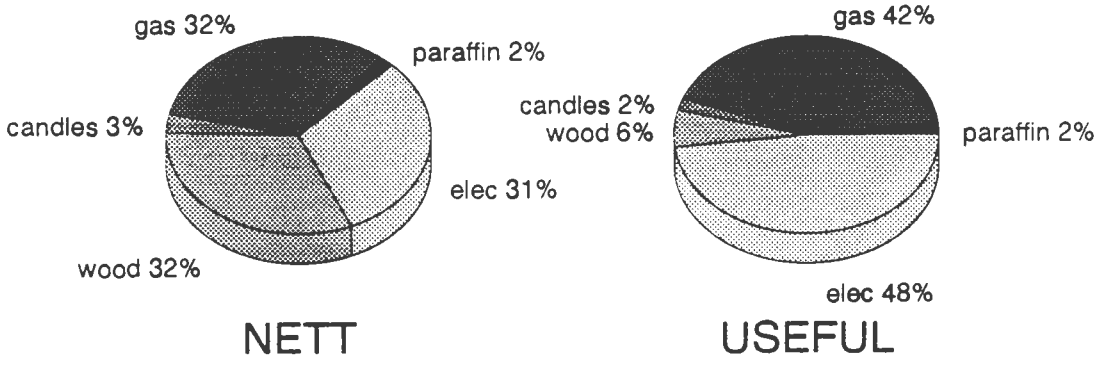

Figure 10.3 : Contribution of different fuels to total nett and useful energy consumption.

10.2.3 Expenditure on energy

Figure 10.4 shows that poorer households spend a high proportion of their income on energy requirements, while the higher income groups, typically electrified OCC employees, spend very small proportions of their total income. This is borne out by table 10.2, which shows that higher income groups actually spend less on energy than do lower income families. This is more pronounced in this settlement

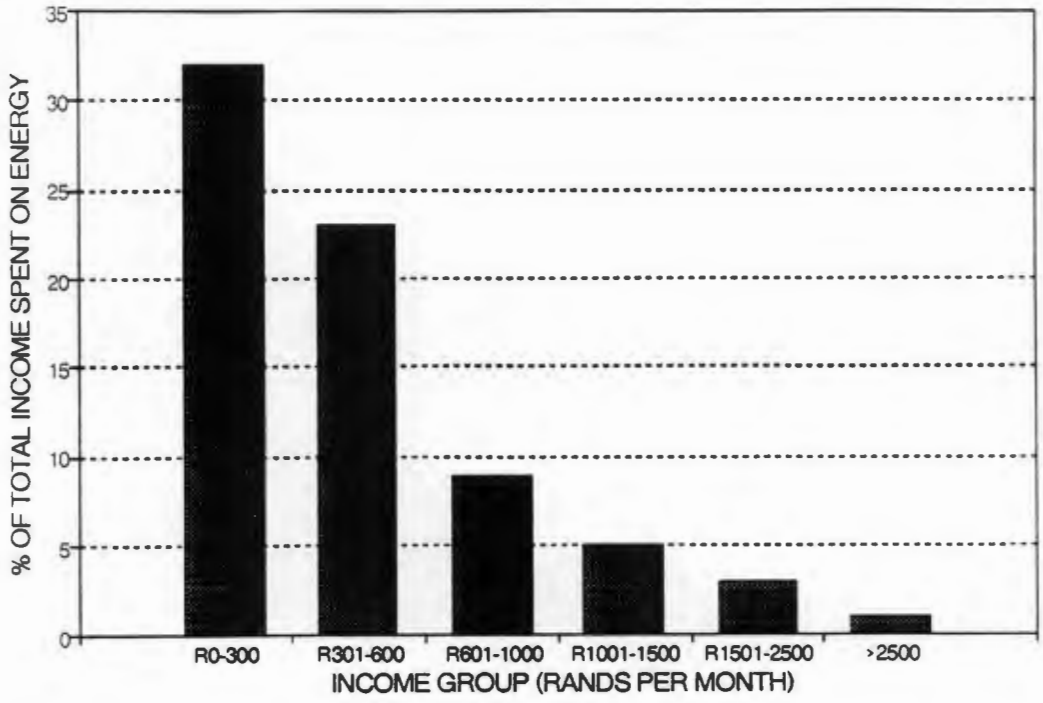

Figure 10.4 : Percentage of total income spent on energy.

because of the low cost of electricity to company employees - about 50% of the unit cost available through the present Eskom "S1" tariff system.

Table 10.2: Average monthly household energy expenditure for different income groups (Rands)

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	76	82	69	59	66	49	71

Although a large proportion of households use wood and candles (see figure 10.2), very little is spent on these fuels. Gas absorbs a large proportion of total energy expenditure where households use it, and electrified households spend almost entirely on electricity (figure 10.5).

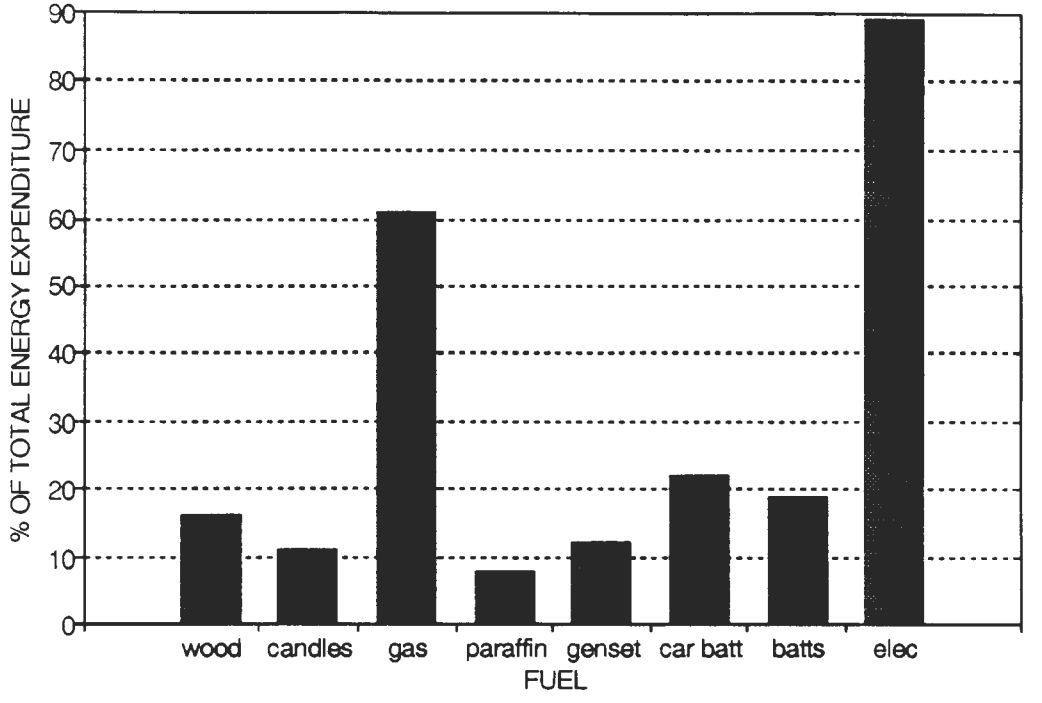

Figure 10.5 : Percentage of total energy expenditure on different fuels for households using the fuels.

10.2.4 Energy preferences

As with almost all other settlements considered, Eskom power is preferred as an energy source over other alternatives by an overwhelming majority of households, as shown in figure 10.6.

10.2.5 Energy related problems and perceived solutions

The expense of obtaining fuels was mentioned by many households as a problem, as can be seen in figure 10.7. Availability of existing fuels and the inconvenience of using them were also mentioned as problems, and electrified households indicated that the existing supply was unreliable.

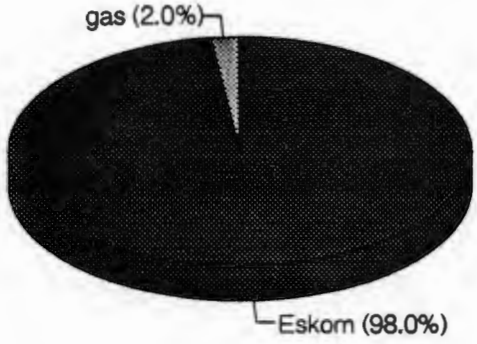

Figure 10.6 : Energy source preferences.

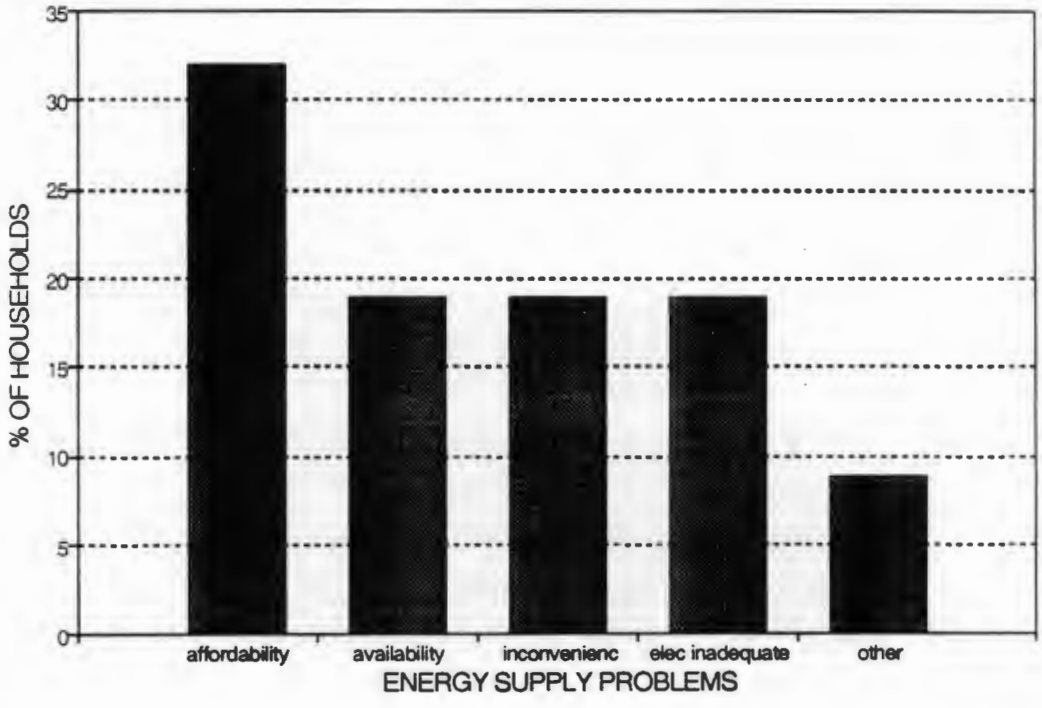

Figure 10.7 : Energy related problems.

10.3 SUMMARY AND DISCUSSION

The most important fuels used in Nababeep in terms of their contribution to total energy use in the town and the numbers of households using them are gas and electricity, with wood being also extensively used.

10.3.1 Affordability of electricity

Amounts presently being spent on energy by households indicate that they could easily afford monthly electricity payments as discussed in chapter 3. The lowest income group is presently spending about R76 on fuels, and electricity costs are likely to be close to R30 for such households if the "S1" tariff structure is implemented.

Since the OCC presently subsidises electricity to both employees and non-employees houses, any Eskom involvement in the area would have to be sensitive to perceptions regarding electricity cost.

It must also be remembered that the OCC does not consider its network to have the spare capacity to fully electrify Nababeep.

10.3.2 Other fuels

The majority of households still use wood, which is a particularly important fuel for lower income groups. The restriction on movement into the surrounding land therefore means that households may need to buy from merchants, which poor households can ill afford.

There is limited potential for reducing the gas price in the area to significantly affect household energy expenditure (Borchers et al.1990).

10.4 RECOMMENDATIONS

- Because the residents can afford electricity and have a strong preference for it, it is recommended that the town be fully electrified.

- The electrification of the town should be done with the full participation of the community.

- Special consideration needs to be given to the price of electricity in the town because of the present subsidization of electricity by the OCC.

- The OCC should give some thought to permitting woodgathering on the land surrounding the settlement.

CHAPTER 11

BERGSIG

11.1 BACKGROUND

11.1.1 Location & infrastructure

Bergsig is the largest coloured township in Namaqualand. It is situated approximately 1km north of Springbok and thus has strong ties with the town. It is on the western side of the main road leading north from Springbok.

11.1.2 Demography

Table 11.1: Bergsig population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	5830	100%
White	0	0%
Black	0	0%
TOTAL	5830	100%

Note : This population figure is based on the 1985 census projected at average growth rates.

The study found on average 5.9 persons per household in Bergsig.

11.1.3 Settlement characteristics

The Bergsig settlement has a number of clearly identifiable "suburbs", often separated by open land. The Springbok municipality has registered 1009 plots in Bergsig, not all of which are occupied. 466 houses are owned by the municipality and are rented out, the Atomic Energy Council owns 30 houses in another area called Kernkor which are occupied by its employees who work at the Vaalputs nuclear waste site. There is a owner-builder scheme available to residents, and

so far about 70 houses have been constructed using the scheme. There are also some informal settlements on the communal land.

The settlement has primary and high schools, as well as a few businesses.

11.1.4 Economic activity

Many inhabitants are employed by companies in nearby Springbok, or are migrant workers with the mines, such as at Koiingnas. Some also work in Bergsig

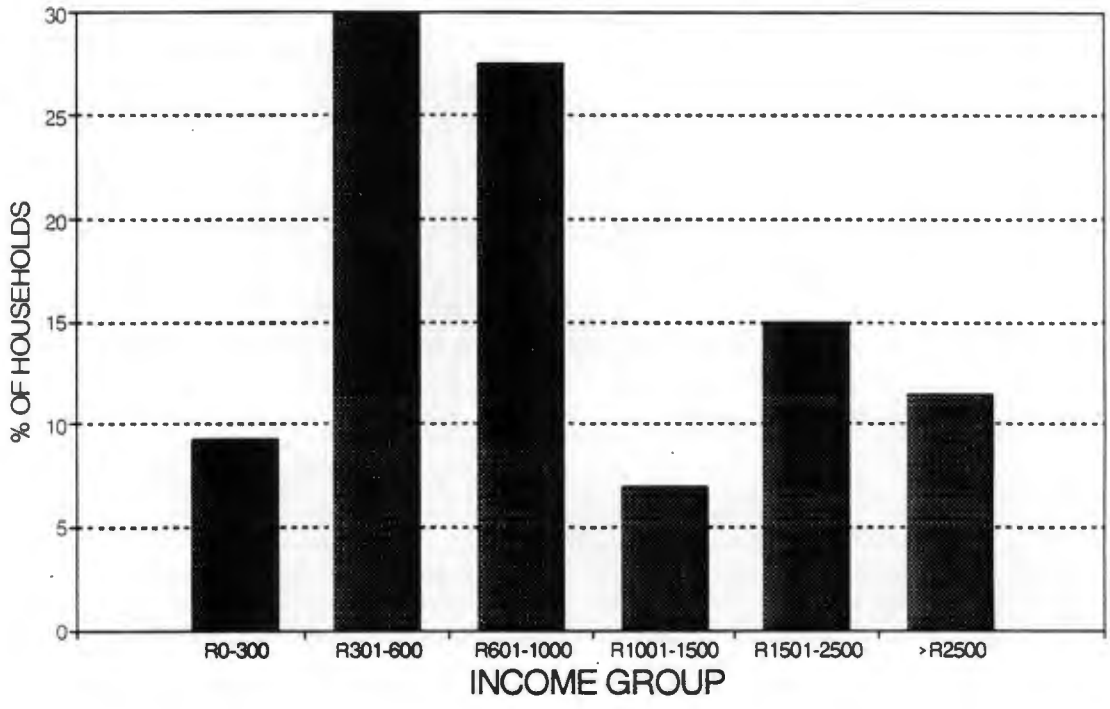

Figure 11.1 : Income distribution.

itself. Household income distribution is shown in figure 11.1, and the median household income is R720, showing that it is one of the wealthier settlements in the region.

11.2 ENERGY CONSUMPTION PATTERNS

11.2.1 General

Electricity is available throughout the settlement, although only 255 plots have been connected so far. This is due to an inability to afford the high connection fee of R660, and housewiring costs, which typically amount to R1500. The overall level of electrification is therefore around 23%. After connection, households pay a monthly service fee of R8.90 and 9.95 c/kWh energy charge. The entire settlement has street lights.

11.2.2 Fuels used

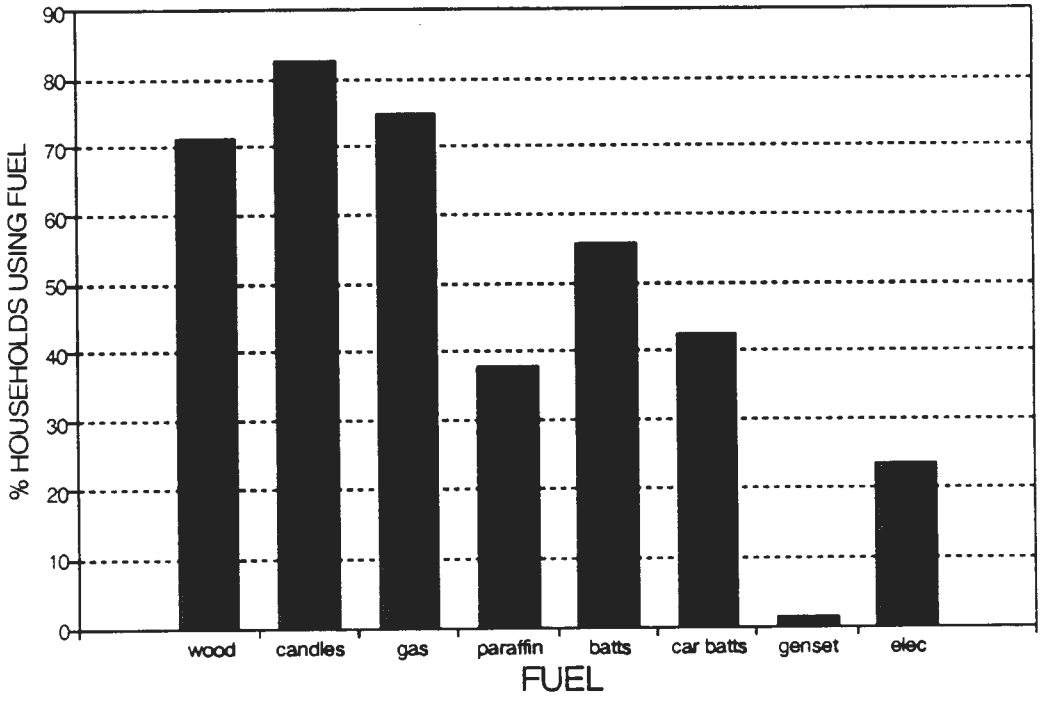

Figure 11.2 : Percentage households using the different fuels.

The most commonly used fuels are shown in figure 11.2. Candles, wood, and gas are all widely used. Figure 11.3 shows gas to be the most important fuel in terms of the total nett and useful energy consumption in Bergsig, while electricity contributes the second largest amount to the useful energy consumption in the settlement.

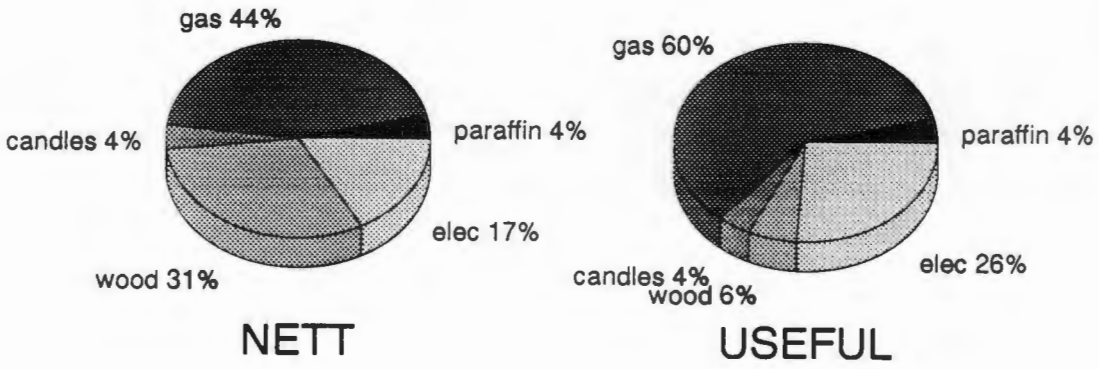

Figure 11.3 : Contribution of each fuel to total nett and useful energy consumption.

11.2.3 Expenditure on energy

The poorer families spend an unusually high proportion of their income on energy, as shown in figure 11.4, and it is interesting to note that actual amounts spent by higher income groups are the same as that for poorer families. Because the wealthier families are generally those that can afford the high connection fees and thus often have electricity, the relatively low expenditure of these households illustrates that electrification can bring energy expenditure down significantly.

Table 11.2: Average monthly energy expenditure for different income groups (Rands)

Income group	0-300	300-600	600-1000	1000-1500	1500-2500	>2500	AVRG
Rands spent	79	90	125	104	117	79	102

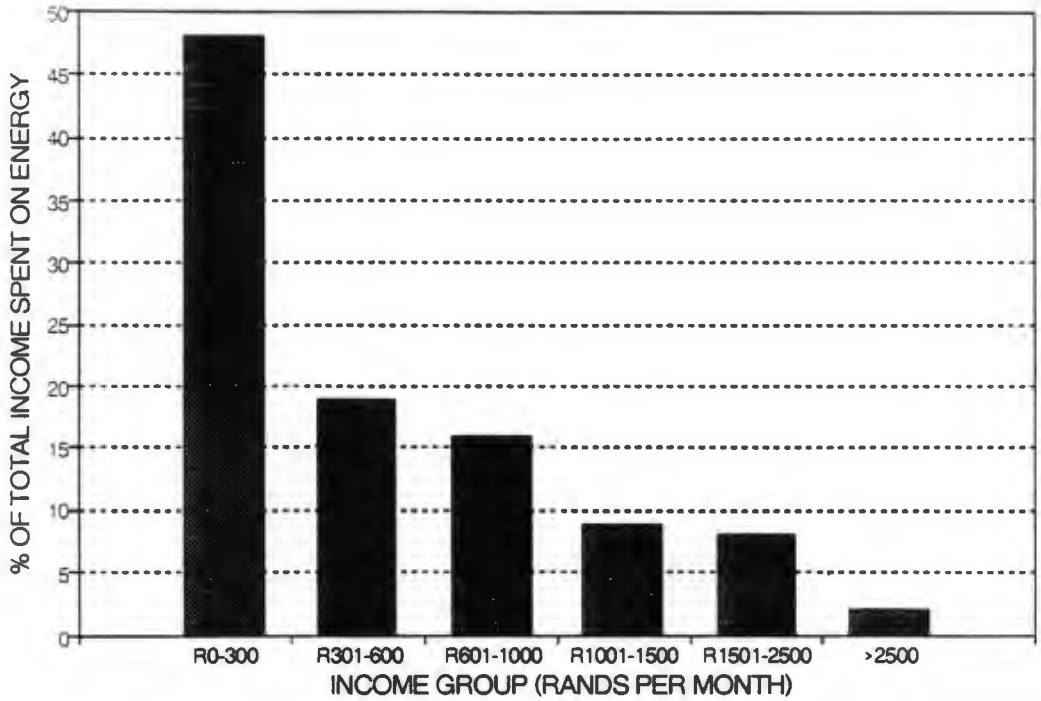

Figure 11.4 : Percentage of total income spent on energy.

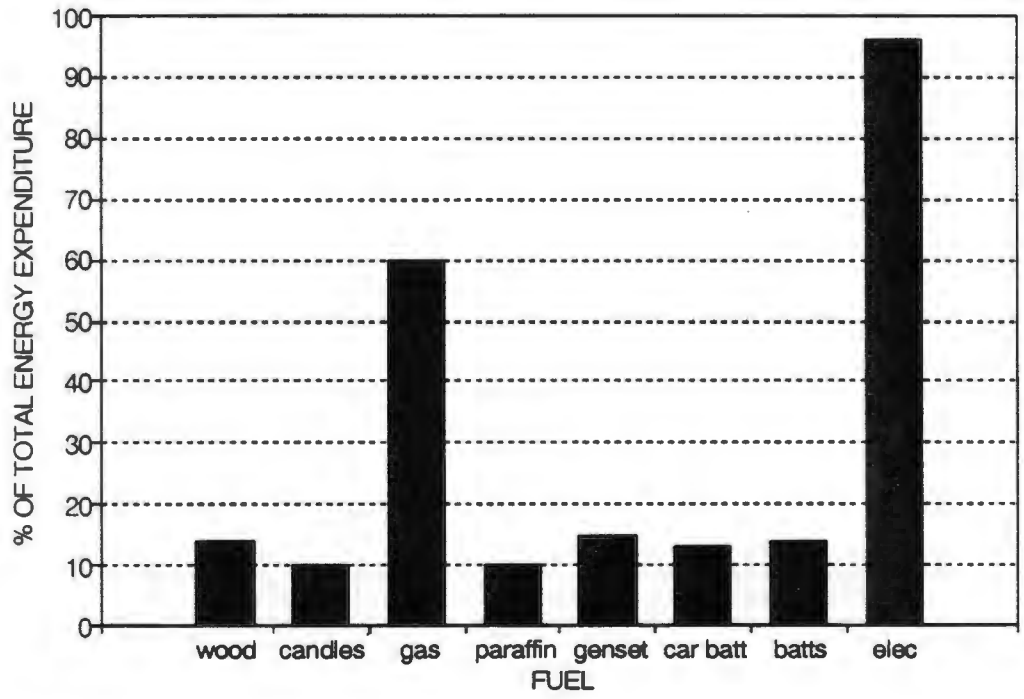

Figure 11.5 : Percentage of total energy expenditure on each fuel for those that use the fuel.

Figure 11.5 shows that the majority of energy expenditure on energy is on gas for households that use gas, and almost all is on electricity for houses connected to the grid.

11.2.4 Energy preferences

As with most other settlements in the Namaqualand area, the great majority of respondents have a preference for Eskom power over other alternatives

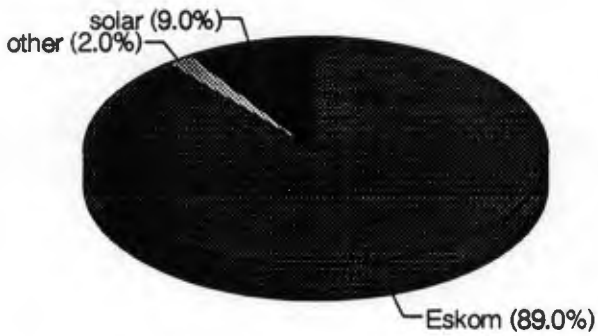

Figure 11.6 : Energy source preferences.

(figure 11.6). It is interesting to note that 9% of respondents indicated that they would prefer solar energy.

11.2.5 Energy related problems and perceived solutions

The affordability of fuels, particularly gas, and the high costs involved in connecting to electricity in Bergsig were amongst the most frequent problems, while some also mentioned that they considered safety of existing fuels problematic (Figure 11.7).

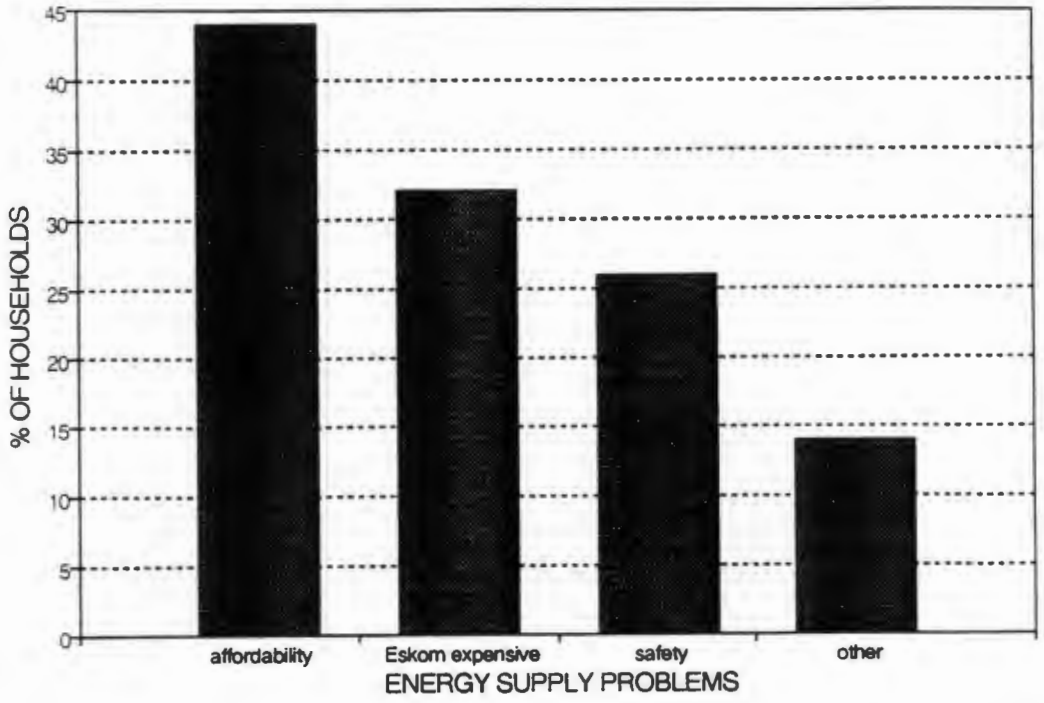

Figure 11.7 : Energy related problems.

The most commonly encountered suggestion made by residents concerning the improvement of the energy supply situation was widespread access to electricity. Many residents also stated that the candles available in the area were not able to withstand the summer heat, and suggested that they be made harder.

11.3 SUMMARY AND DISCUSSION

The most important fuels used by Bergsig residents in terms of expenditure and contribution to the total energy consumption in the settlement are gas, electricity, and to a lesser extent wood.

11.3.1 Affordability of electricity

Present energy expenditures even in the lowest income groups indicate that electricity is affordable to all in Bergsig. The present expenditure for this income group is around R79 p.m., and monthly electricity expenses can be expected to be about R30 (see chapter 3). The high connection fees have prevented the

widespread use of electricity in the area, and it is therefore important that electricity be supplied on the "S1" tariff system.

11.3.2 Other fuels

Other studies have shown that there is little potential to reduce household spending significantly by reducing the gas price (Borchers et al.1990).

11.4 RECOMMENDATIONS

- Considering the affordability and desirability of grid electricity, and the overwhelming preference for it, it is recommended that the settlement be fully electrified using the Eskom "S1" tariff system.

- The electrification of the settlement should be carried out with the full participation of the Bergsig community.

CHAPTER 12

OKIEP

12.1 BACKGROUND

12.1.1 Location & infrastructure

Okiep is situated about 10km north of Springbok, a few kilometres east of the main Cape Town - Windhoek road. The town arose because of the copper mining activities in the area, mainly by the Okiep Copper Company (OCC), historically one of South Africa's most important producers of copper ore. Springbok is easily accessible by road from Okiep.

12.1.2 Demography

Table 12.1: Okiep population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	5664	94%
White	367	6%
Black	11	0%
TOTAL	6024	100%

Note : populations are based on the 1985 census and average growth rates.

The households in the study have an average of 5.4 persons per house.

12.1.3 Settlement characteristics & development

The OCC until recently owned the town, which was established to provide accommodation for employees, who were charged a nominal rent. Over the years private houses have been built on the OCC land, and today the town is a mix of company and private houses, and the town structure is relatively informal. There

are at present 678 private houses and 171 company houses in the settlement. The houses are mainly constructed of brick, zinc, or a mixture of the two. On the outskirts of the town the settlement tends to be less formally structured, with zinc houses becoming more common. A significant proportion of the town's population lives in these areas. The town therefore has developed into a relatively low density settlement, with clusters of houses, or suburbs, clearly identifiable.

Recently the OCC has handed the town over to the Okiep community, and the local RSC in conjunction with the House of Representatives have assumed the responsibility to develop it. The provision of services and restructuring of the settlement to facilitate service installation is underway. The scheme aims to encourage the inhabitants who at present live over a large area on relatively large plots to concentrate in a central area known as "Kamp 2". According to the restructuring plans, therefore, most people living outside the development are seen as squatters. The residents, however, are unhappy with the scheme and the manner in which it is being implemented, and have begun active resistance.

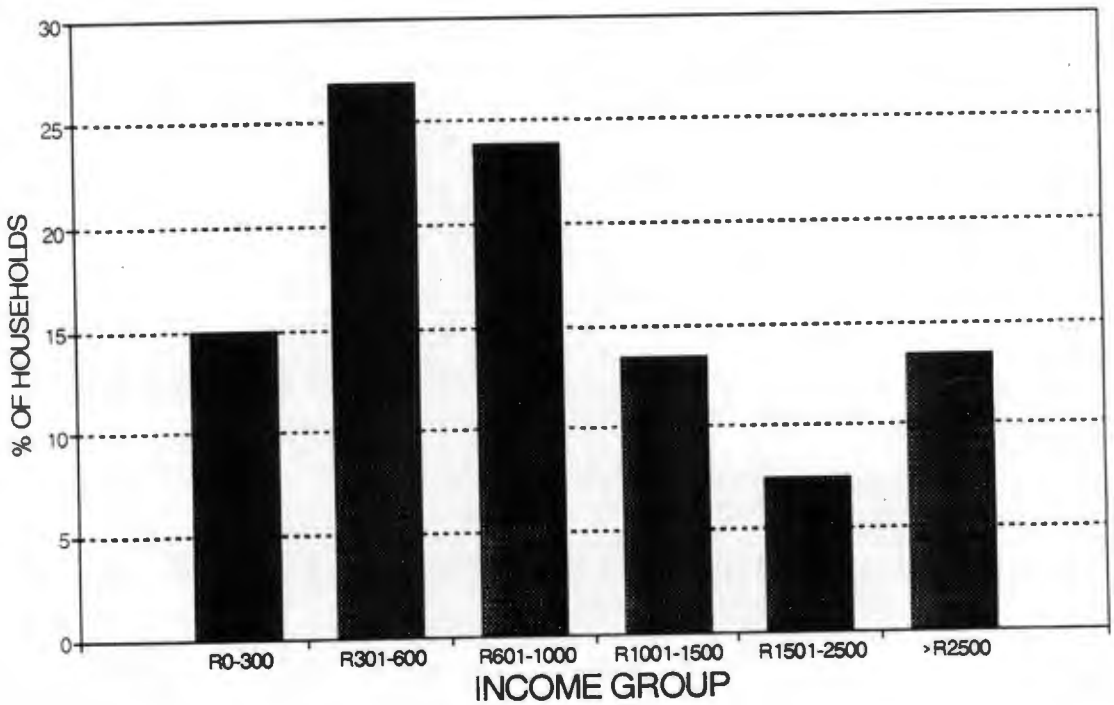

Figure 12.1 : Income distribution.

12.1.4 Economic activity

Historically most employment for Okiep residents has been on the OCC mines, which remains the major employer. Employment in the copper industry has never been secure, however, due to its sensitivity to international metal prices and exchange rate fluctuations, and residents therefore have often been forced to seek work elsewhere. Some families still keep some stock in the surrounding areas.

Household income distribution is shown in figure 12.1, and the median household income is R 673.

12.2 ENERGY CONSUMPTION PATTERNS

12.2.1 General

The houses owned by the OCC were all supplied with electricity in the past, as were a small proportion of the private houses. Electricity was sold to employees and non-employees at a subsidised rate (7.5c/kWh for employees and 10.4c/kWh non-employees). As a part of the development plans being implemented in Okiep, the area earmarked for development is being fully electrified using a ready-board/pre-pay meter scheme. This scheme is partially complete, but again, residents are unhappy with the manner in which it has been implemented.

Wood is scarce in the area.

12.2.2 Fuels used

The most widely used fuels in Okiep are gas, candles, and wood (figure 12.2), while in terms of total useful energy consumption, gas and electricity are the largest contributors (figure 12.3). Wood is a significant contributor to the nett energy consumption of Okiep.

12.2.3 Expenditure on energy

The percentage of total income spent on energy for different income groups is shown in figure 12.4. The trend common to all settlements considered is again

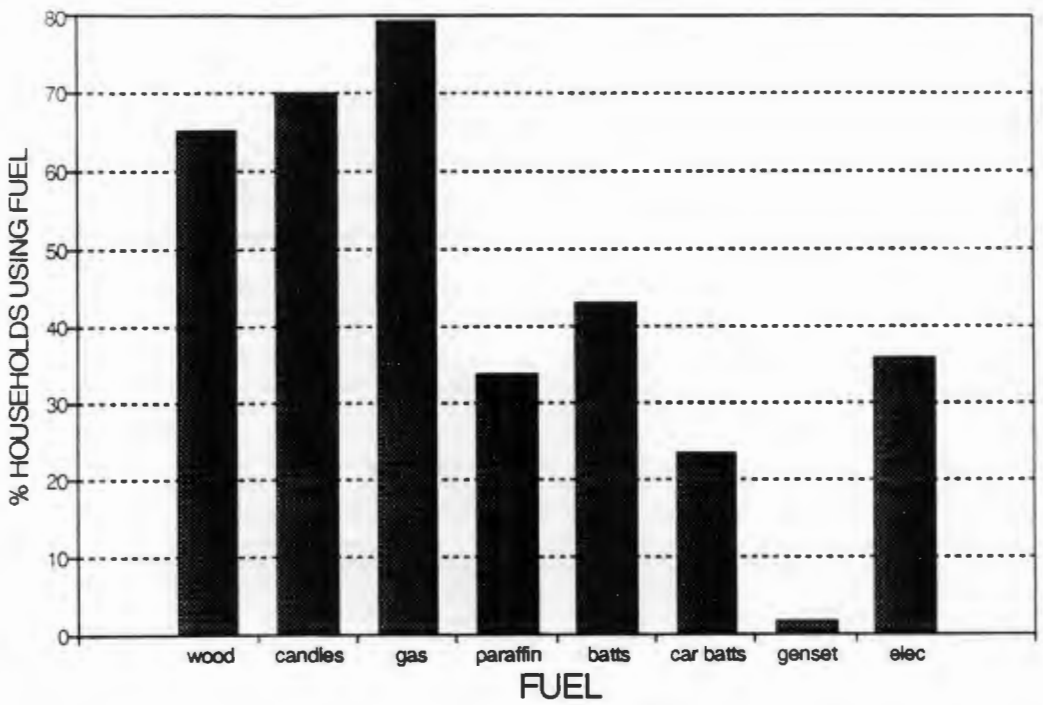

Figure 12.2 : Percentage households using the different fuels.

evident - that higher proportions of income are spent on energy amongst the lower income groups.

Table 12.2: Average monthly household energy expenditure for different income groups (Rands)

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	52	76	77	92	129	52	75

As was the case in Matjieskloof, the high income group households, which are generally electrified, spend the same actual amount as the low group (see table 12.2), indicating that electrification can produce significant reduction in energy expenditure.

Figure 12.5 shows that for those using gas or electricity, the greatest proportion of expenditure is on these fuels.

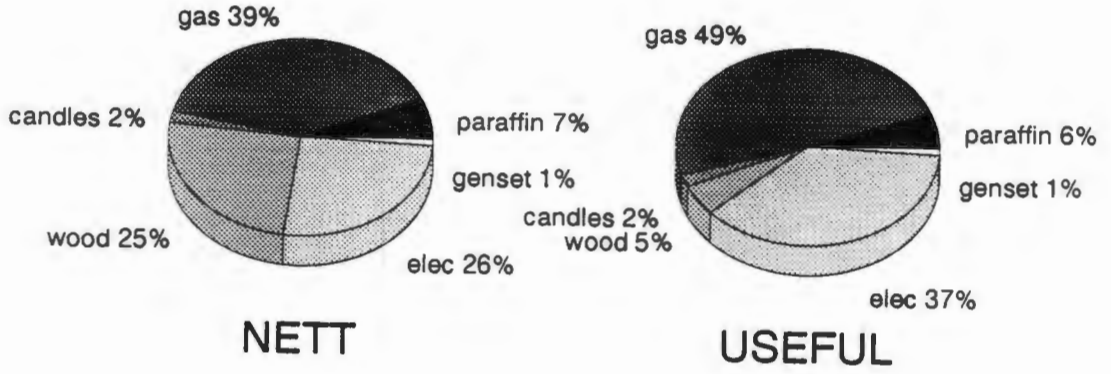

Figure 11.3 : Contribution of each fuel to the total nett and useful energy consumption.

12.2.4 Energy preferences

Eskom power is again the most widely preferred energy source amongst households, with a small proportion of residents indicating a preference for solar energy, as shown in figure 12.6.

12.2.5 Energy related problems and perceived solutions

Residents in Okiep most frequently considered the affordability of existing fuels to be a problem, as indicated in figure 12.7. Many presently electrified households were unhappy with their power supply. This is partly due to the frequent off-line periods because of work being done on the reticulation system, but also reflects the widespread dissatisfaction with the installation of the system. Many residents complained that they were not consulted as to where they wanted their ready-board installed, or that the boards were placed in awkward places, such as behind the front door. The residents feel that they were not adequately consulted with respect to the implementation of the entire project.

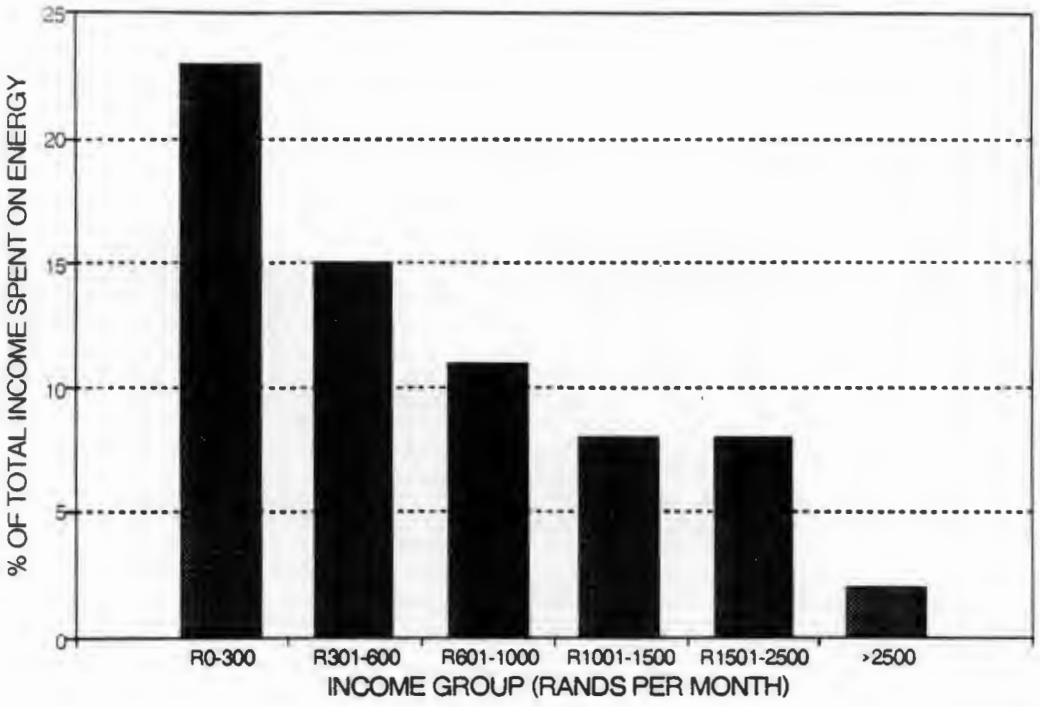

Figure 12.4 : Percentage of total income spent on energy.

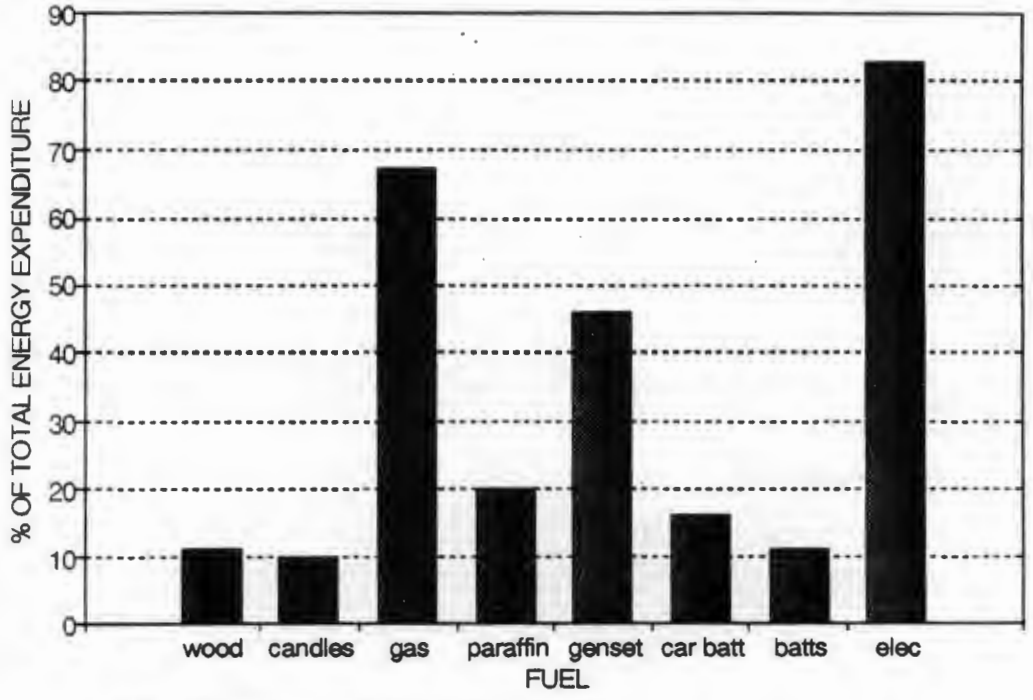

Figure 12.5 : Percentage of total energy expenditure on each fuel for those that use the fuel.

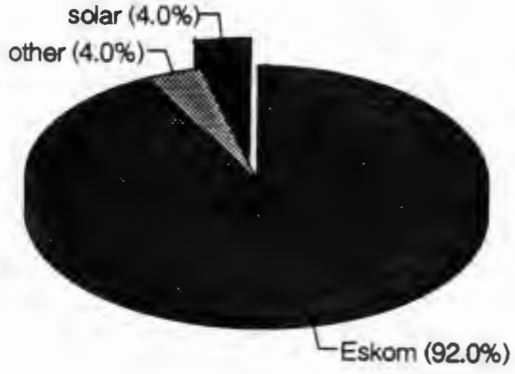

Figure 12.6 : Energy source preferences.

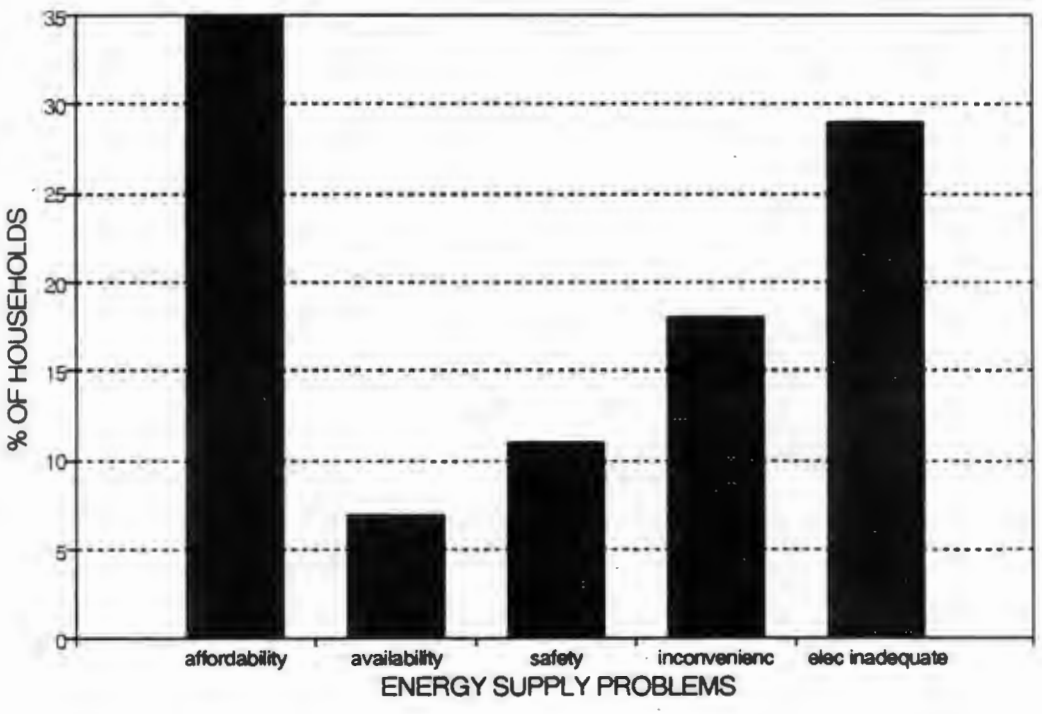

Figure 12.7 : Energy related problems.

12.3 SUMMARY AND DISCUSSION

Okiep is presently in the process of being electrified as part of a broader services supply and settlement re-structuring. However, in the project implementation, many residents on the outskirts of the settlement have not been included in the development plans. The project may therefore not meet the energy needs of the community as a whole.

Aside from electricity, gas may be regarded as the most important fuel due to the high proportions of income spent on it and its high contribution to overall energy consumption.

12.3.1 Affordability of electricity

The information in table 12.2 indicates that electricity would be affordable to all income groups. The lowest income group households presently spend around R50 on their energy requirements, and electricity expenses for such households are expected to be around R30 p.m.

12.4 RECOMMENDATIONS

- The current electrification project should be extended to include all households including those on the outskirts of the town, using the "S1" or similar tariff system. Electricity is affordable, desirable, and the preferred energy source to the community.

- The electrification should be undertaken with the full participation of the existing community organization, and must be approached with sensitivity due to the dissatisfaction of the community with the current project.

CHAPTER 13

MATJIESKLOOF

13.1 BACKGROUND

13.1.1 Location & infrastructure

Matjieskloof, which grew out of an informal settlement, is situated about 3km west of Springbok, and may be regarded as a suburb of Springbok. The settlements are linked by the road leading from Springbok to Kleinzee on the west coast.

13.1.2 Demography

Table 13.1: Matjieskloof population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	1738	99%
White	21	1%
Black	0	0%
TOTAL	1759	100%

Note : population figures are based on the 1985 census and growth rate estimates.

The study found an average of 5.3 persons per household in the settlement.

13.1.3 Settlement characteristics

The settlement is relatively nuclear in layout - i.e. does not have distinct areas within it. It was not a planned settlement due to its organic growth from an informal village, and the Springbok municipality has only recently begun the implementation of service supply. At present there are still few services available to residents, and there is widespread dissatisfaction amongst households. There

are 226 registered plots here, and according to the municipality only 152 are occupied. There are also about 100 families living informally on the outskirts of the main settlement. The settlement has a primary and a high school.

The majority of the houses are constructed from zinc, but there are also many brick houses.

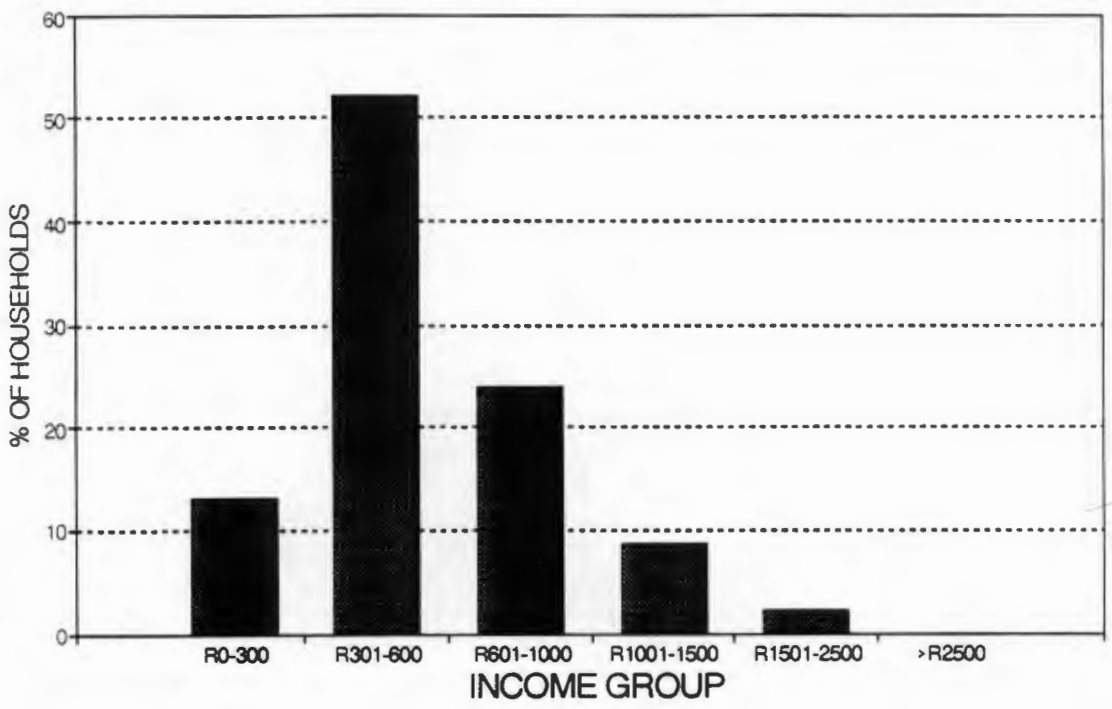

Figure 13.1 : Income distribution.

13.1.4 Economic activity

Most of the employment available to Matjieskloof residents is in Springbok or on mines in the area. Household income distribution is shown in figure 13.1, and the median household income is R 500 p.m.

13.2 ENERGY CONSUMPTION PATTERNS

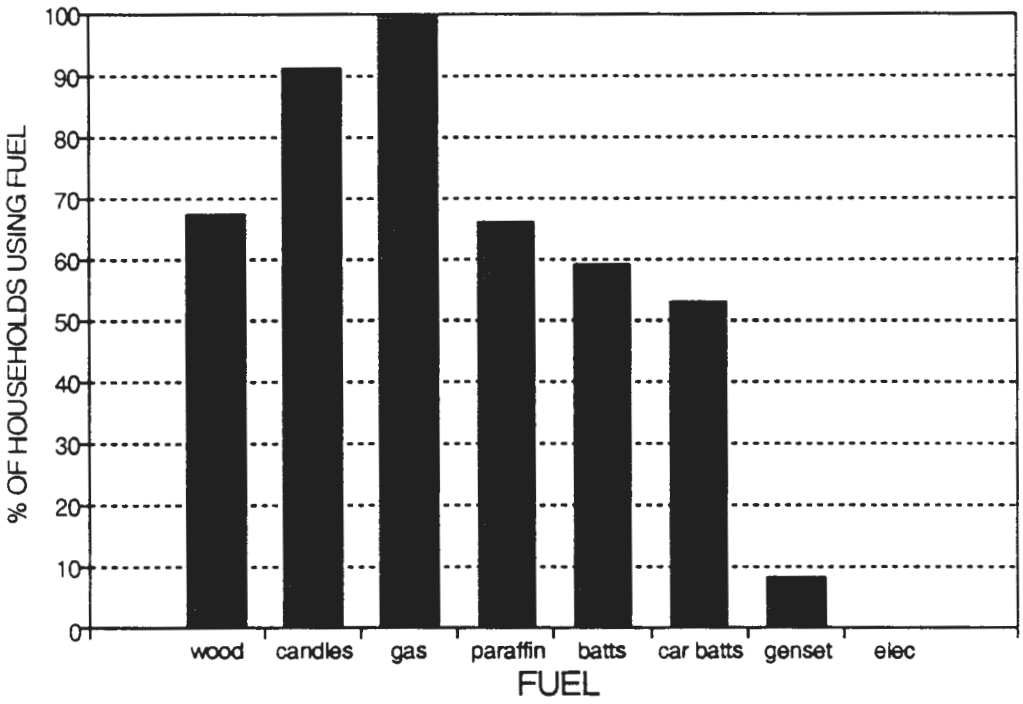

Figure 13.2 : Percentage households using different fuels.

13.2.1 General

Although a few buildings are connected to the electricity grid, they have dedicated lines, and the village itself is not reticulated.

13.2.2 Fuels used

Figure 13.2 shows that while gas is used by all households, candles, wood, and paraffin are also widely used. Wood is widely used for cooking, as illustrated by figure 13.3, which shows its high contribution to the total nett energy use in the settlement. However, gas is clearly the most important energy source overall.

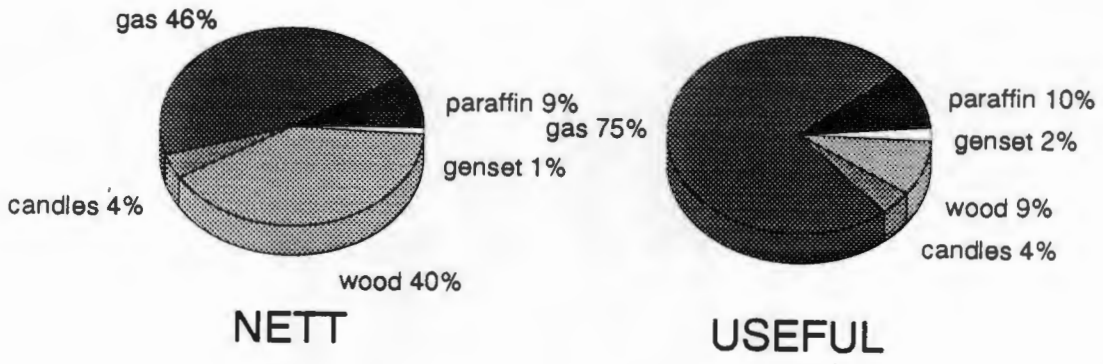

Figure 13.3 : Contribution of each fuel to total nett and useful energy consumption.

13.2.3 Expenditure on energy

As with most areas studied, the financial burden of obtaining energy is significantly heavier for lower income households, as shown in figure 13.4. It can be seen from figure 13.5 that gas generally absorbs the largest proportion of energy expenditure in all households, while table 13.2 shows actual amounts spent by different income groups.

Table 13.2: Average monthly household energy expenditure for different income groups (Rands)

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	73	77	113	127	192	-	95

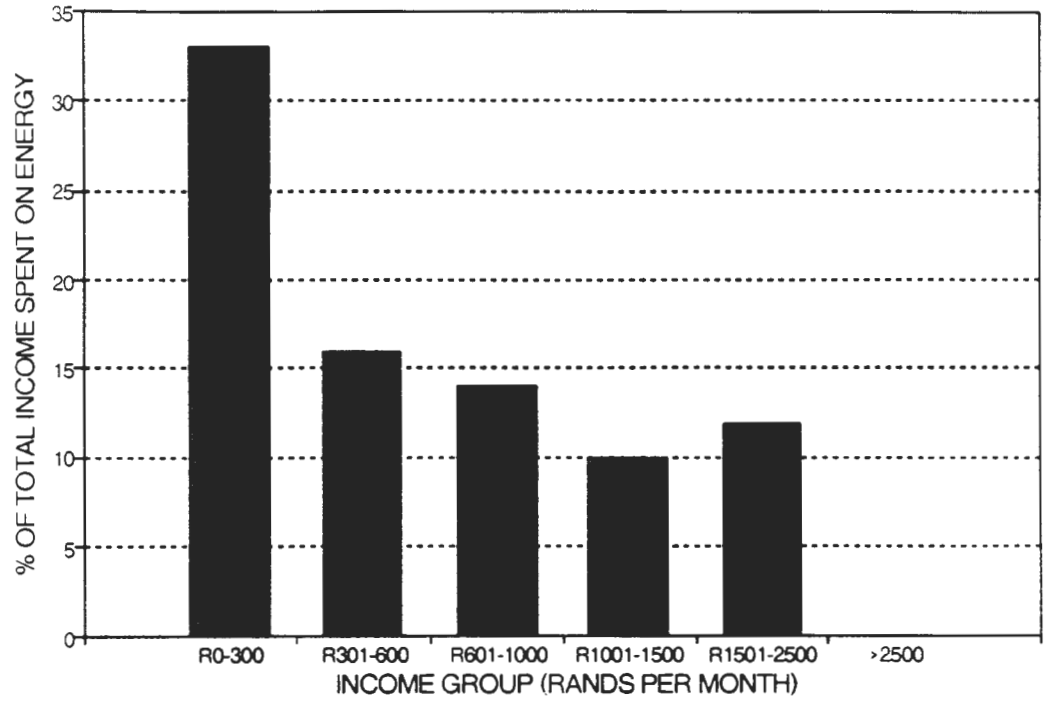

Figure 13.4 : Percentage of total income spent on energy.

13.2.4 Energy preferences

Although a very high percentage of households prefer Eskom, as is the case in all settlements dealt with, a significant proportion have indicated a preference for gas (figure 13.6).

13.2.5 Energy related problems and perceived solutions

Figure 13.7 shows that fuel affordability is regarded by most households as being a problem, which relates largely to the dependence on gas. Residents suggested that this might improve were there access to electricity.

Wood is still widely used for baking and cooking, and the poorer households are generally more dependent on wood than are those that can easily afford gas. Wood is not abundant in the area, and residents indicated that it takes about 3/4 hour to gather one batch (10-15kg) of wood.

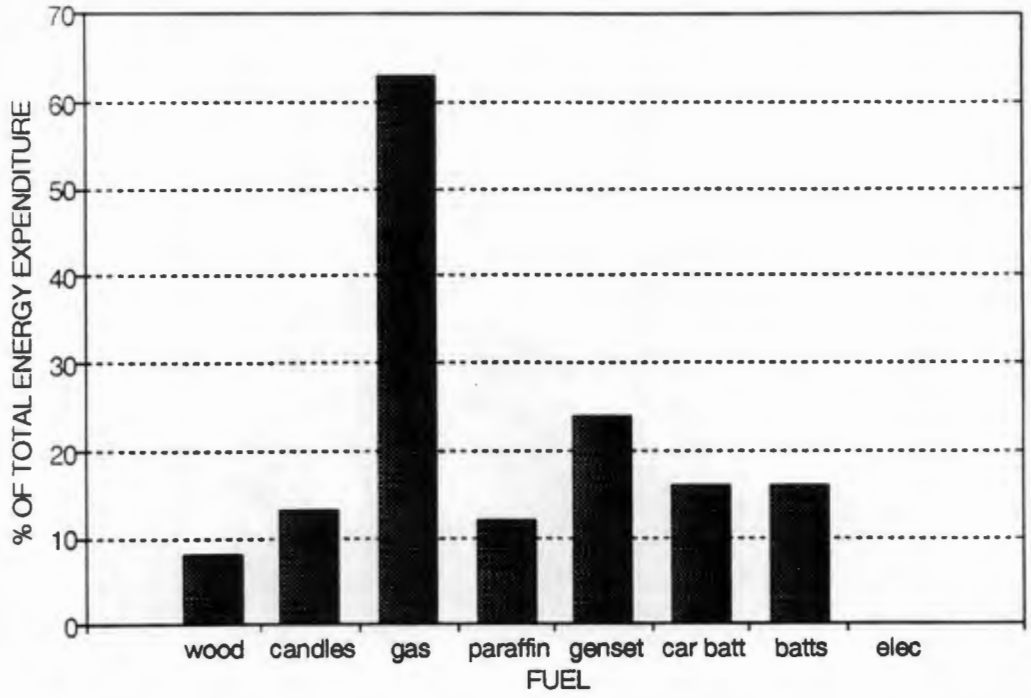

Figure 13.5 : Percentage of total energy expenditure on each fuel for those that use the fuel.

13.3 SUMMARY AND DISCUSSION

Gas is the most widely used fuel in this settlement, contributing most to the energy consumption of households and absorbing most of the expenditure on energy. Wood is also still an important fuel, particularly amongst the lower income groups.

13.3.1 Affordability of electricity

Table 13.2 shows that the lowest income group is generally spending around R70 on energy. Typical electricity accounts for low income households on the Eskom "S1" tariff are expected to be around R30, which would leave about R40 p.m. for purchase of other fuels such as gas. It must therefore be concluded that electricity is affordable to all households in Matjieskloof.

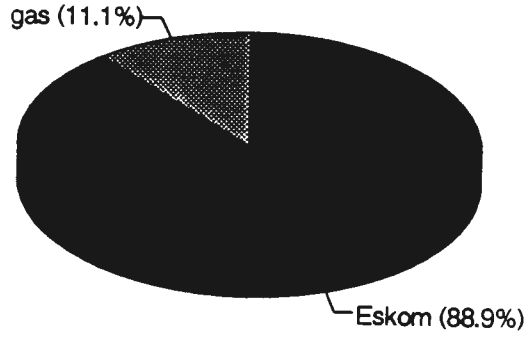

Figure 13.6 : Energy source preferences.

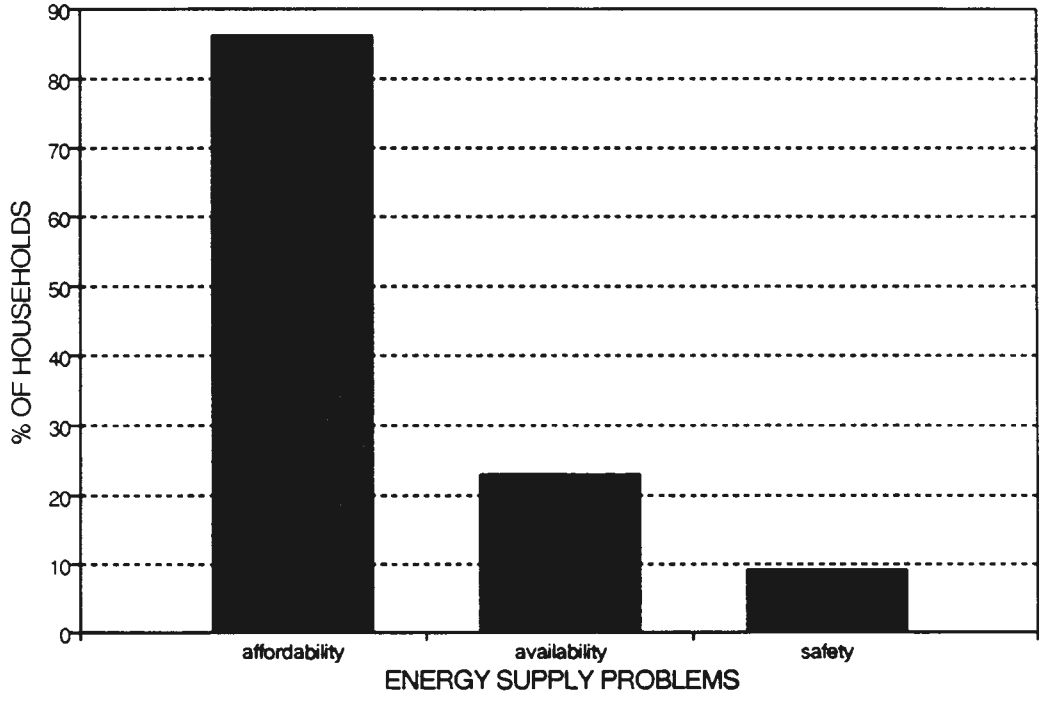

Figure 13.7 : Energy related problems.

13.3.2 Other fuels

There is limited potential for significant savings to households by the reduction in gas price (Borchers et al.1990).

13.4 RECOMMENDATIONS

- The settlement should be electrified using the Eskom "S1" tariff system, as it is affordable, preferred by most residents as an energy source, and will generally benefit the community at large.

- The electrification should be undertaken with the full participation of the community organizations.

CHAPTER 14

HONDEKLIPBAAI

14.1 BACKGROUND

14.1.1 Location & infrastructure

Hondeklipbaai is a small fishing village situated on the coast approximately 150km south east of Springbok, and is connected to the main Cape Town - Windhoek route by minor roads only. Almost all of the houses and land in the settlement belongs to the Namaqualand Canning Company - a branch of the Oceana fishing group from the Cape.

14.1.2 Demography

Table 14.1: Hondeklipbaai population distribution by race

RACE	POPULATION	% OF TOTAL
Coloured	400*	87%
White	57	12%
Black	4*	1%
TOTAL	461	100%

Note : population based on projections from 1985 census using average growth rates.
* - population figures as of 1990 obtained from Namaqualand Canning Company.

The study found an average of 5.3 persons per household in Hondeklipbaai.

14.1.3 Settlement characteristics

The settlement consists of the Namaqualand Canning Company(NCC) factory, two shops, a school, a post office, a police station and a few residential areas.

There are two white residential areas, the largest owned by the NCC and another of approximately 10 private houses.

The coloured community live in two areas, Spitsfire, consisting of 7 housing blocks divided into 10 housing units accommodating 49 people, and Blokke consisting of 31 blocks divided into 60 housing units that accommodate 339 people. In both these areas the land and the houses are owned by NCC, whose plans are to eventually demolish the Spitsfire settlement and to sell Blokke to the Namaqualand RSC. A further housing block in the private area and bordering Blokke is owned by a mining company and is divided into 3 housing units and accommodates ±15 people. The houses are all brick structures with asbestos or zinc roofing.

Many of the households interviewed in the study expressed the wish to buy their own land and to build their own houses and expressed frustration at the lack of response to their repeated petitioning of the Labour Party and NCC. Residents also felt that their present accommodation was overcrowded, with single quarters housing whole families, and felt unhappy that they were not allowed to extend the houses, and that the houses were not adequately maintained.

The canning company provides certain services to the community consisting of limited supplies of fresh drinking water, salt water from communal taps and access to a cold room at the factory.

NCC also owns a compound of single quarters (capacity 200) about 3km outside the town in which seasonal migrant workers live. All the white housing is fully serviced with electricity and hence only the coloured areas were included in the study.

14.1.4 Economic activity

Activities at Hondeklipbaai are primarily concerned with the catching and processing of crayfish. The fishing season is approximately eight months long (from November to June), and thus many inhabitants are only employed for this period. Some inhabitants are permanent employees, and are paid a subsistence wage during the off season. Other people are employed at nearby diamond mines. Household income distribution is shown in figure 14.1, with a median

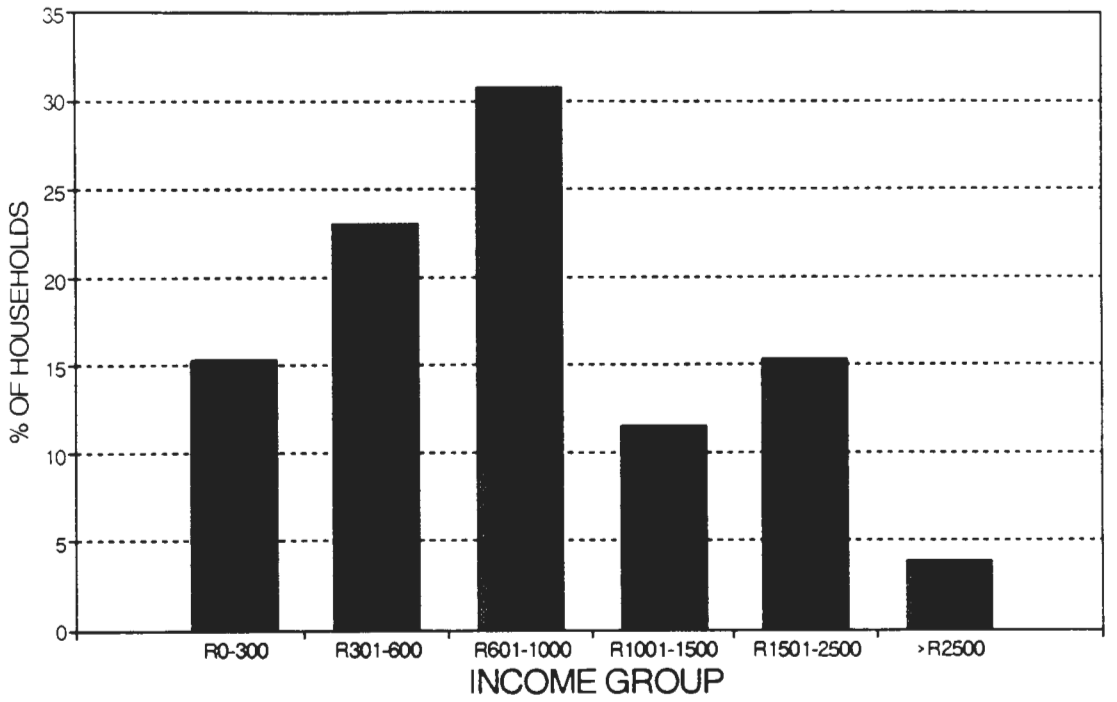

Figure 14.1 : Income distribution.

household income of R646. The settlement is therefore not amongst the poorest dealt with in this study.

14.2 ENERGY CONSUMPTION PATTERNS

14.2.1 General

All the electrical infrastructure in Hondeklipbaai is owned by NCC who purchase their electricity from De Beers Consolidated Mines, who are in turn supplied by Eskom. None of the households in the study area have access to electricity although the community have repeatedly applied to NCC to be connected. The NCC however do not feel it is their responsibility to supply the community with electricity and do not have the resources to implement and manage electrification.

Much of the land adjoining Hondeklipbaai is owned and strictly controlled by mining companies who forbid collection of wood on their land. This has resulted in a shortage of wood and the need for wood to be bought.

14.2.2 Fuels used

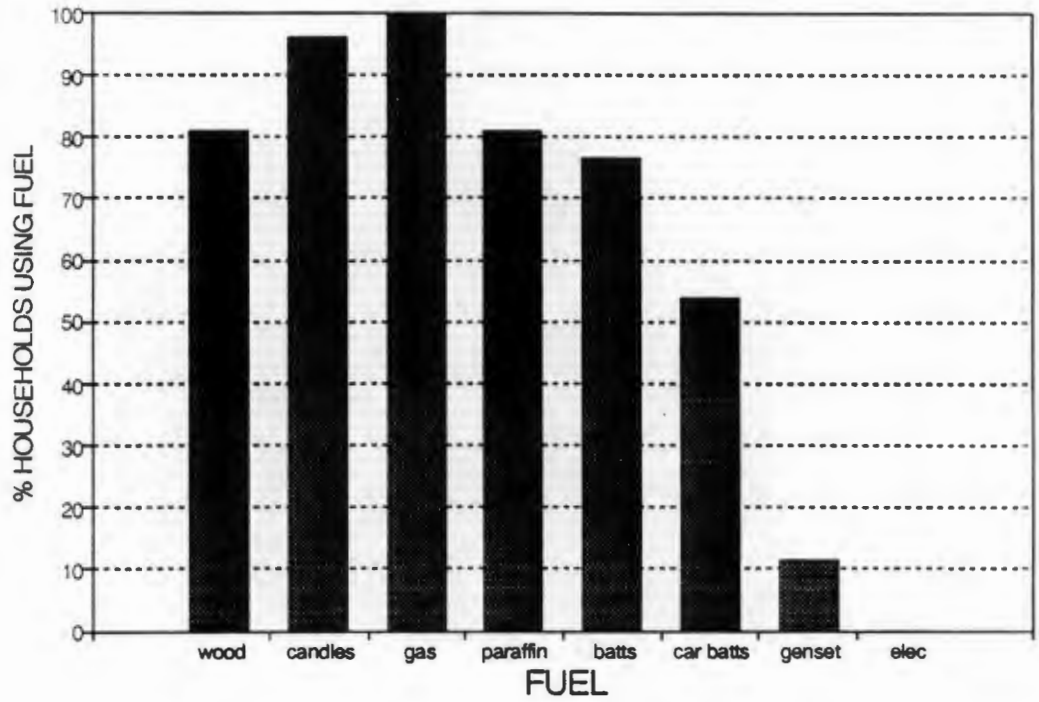

Figure 14.2 : Percentage of households using each fuel.

Figure 14.2 shows that most of households are using a wide range of fuels, generally using gas for cooking, wood for baking bread, candles and paraffin for lighting and batteries for radio and TV. Gas is the major energy source as can be seen in figure 14.3, supplying more than 80% of the useful energy. The gensets are generally used for the charging of car batteries.

14.2.3 Expenditure on energy

The high proportional cost of energy to the poorer households is clearly illustrated by figure 14.4 with the average expenditures shown in table 14.2. The expenditure on different fuels is indicated in figure 14.5 and illustrates the large proportion of total energy expenditure used for gas purchase.

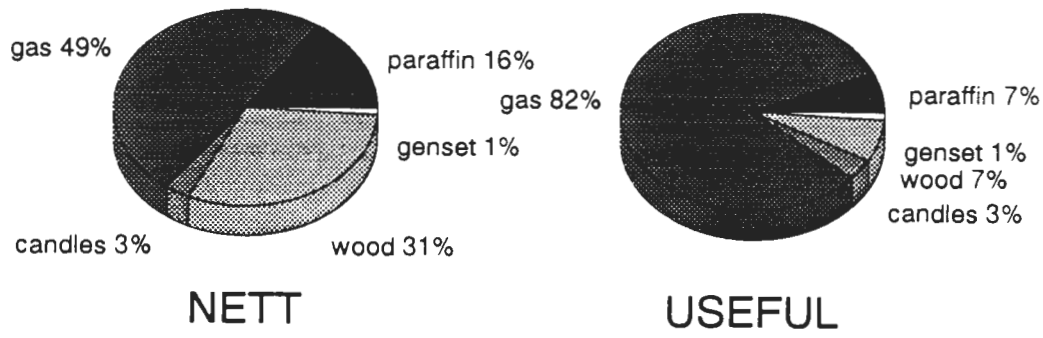

Figure 14.3 : Contribution of each fuel to total nett and useful energy consumption.

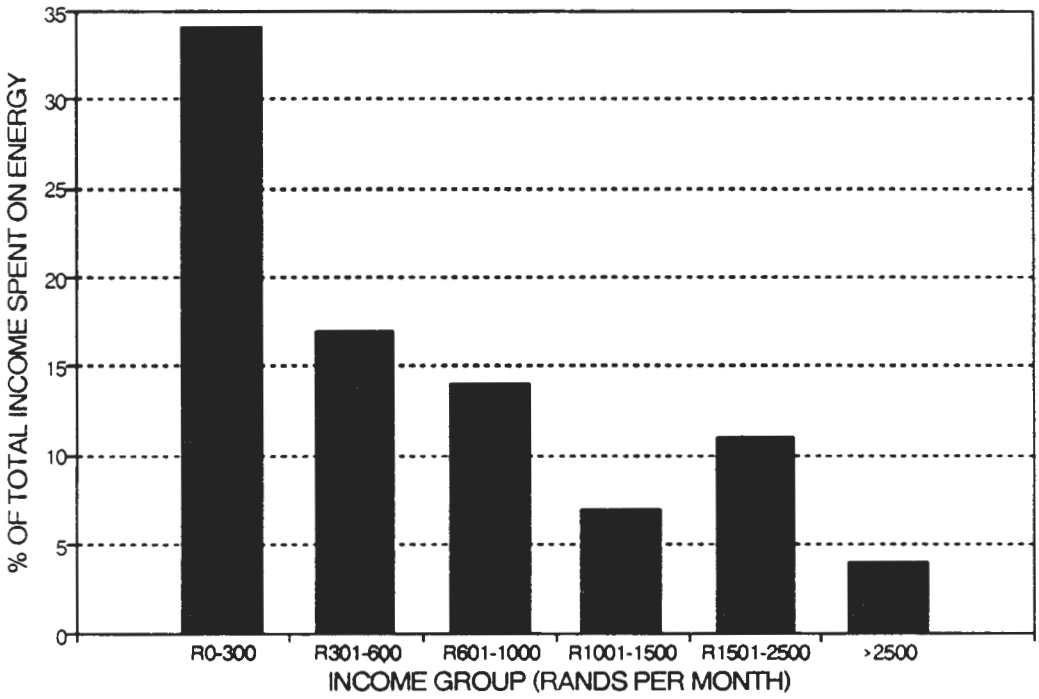

Figure 14.4 : Percentage of total income spent on energy.

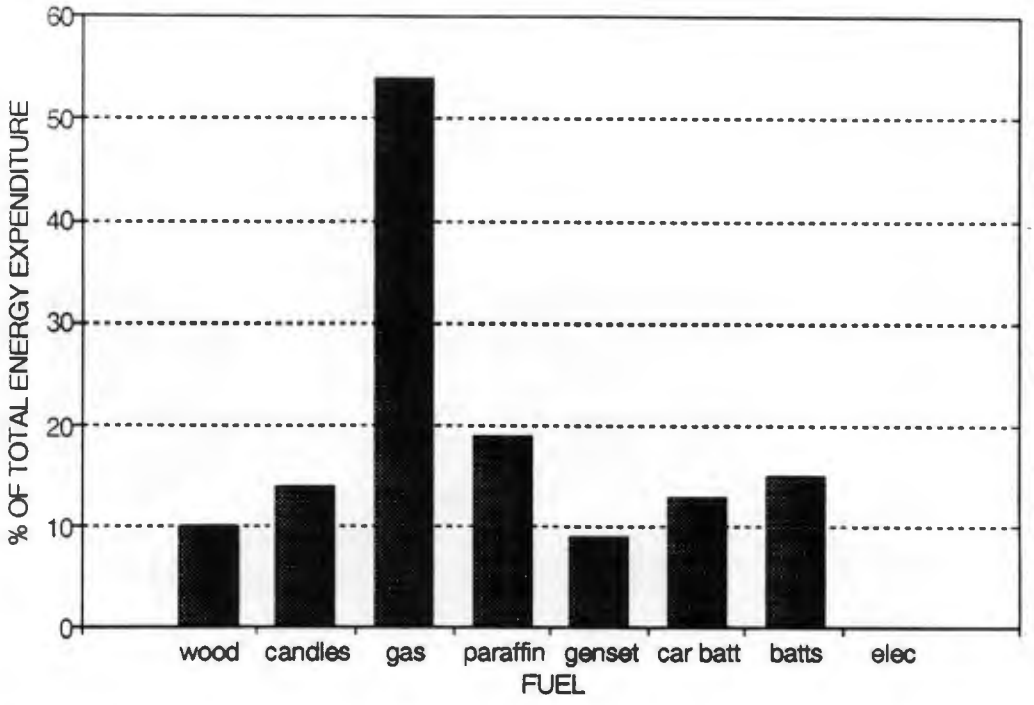

Figure 14.5 : Percentage of total energy expenditure on each fuel for those that use the fuels.

Table 14.2: Average monthly household energy expenditure for different income groups (Rands)

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Rands spent	74	87	98	77	194	122	105

14.2.4 Energy preferences

The preference of all households surveyed was Eskom power as seen in figure 14.6.

14.2.5 Energy related problems and perceived solutions

The main problems perceived by the households surveyed are shown in figure 14.7 with the majority identifying affordability, of gas in particular, as the major problem. The availability and inconvenience of fuels used were also perceived

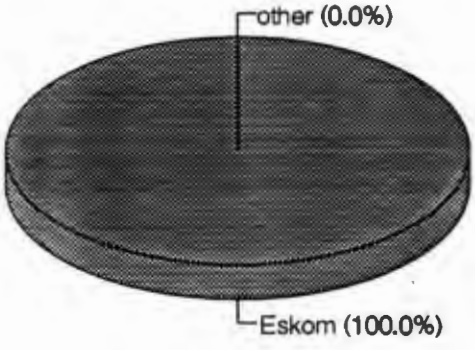

Figure 14.6 : Energy source preferences.

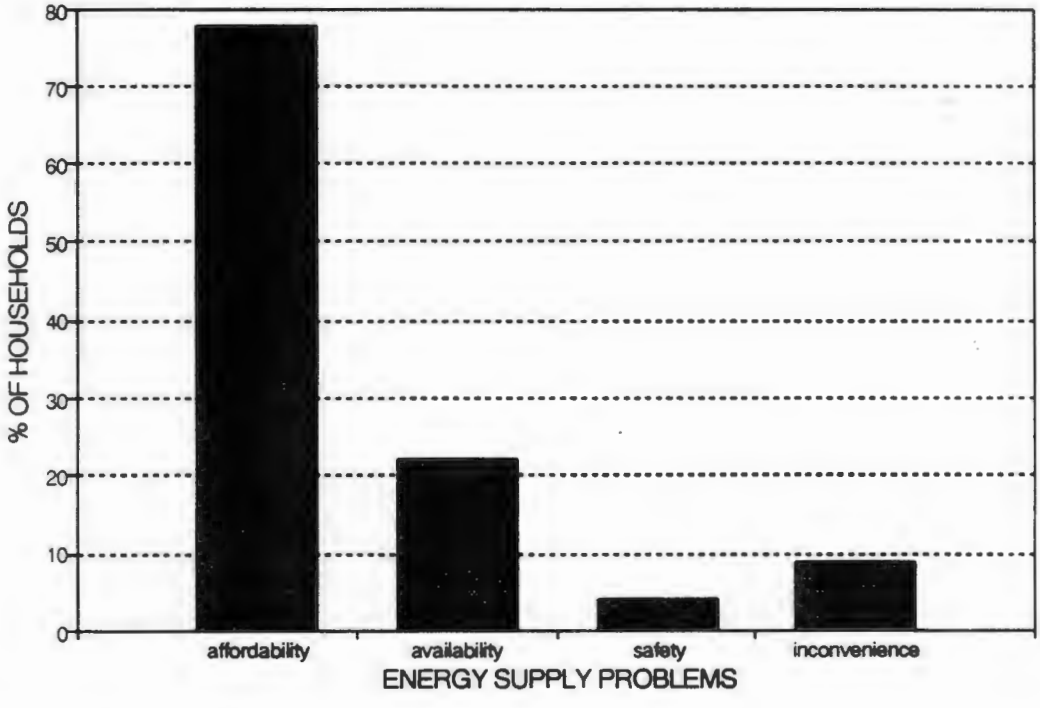

Figure 14.7 : Energy related problems.

to be problems, in particular, that gas, paraffin and candles are not always available in the shops. Of the households that made suggestions to address these problems, 100% suggested that electricity should be supplied.

14.3 SUMMARY AND DISCUSSION

The Hondeklipbaai residents utilise a broad mix of energy sources but their major energy expenditure is on gas. Wood, although scarce, is a popular energy source for baking.

14.3.1 Affordability of electricity

From the actual energy expenditures shown in table 14.2 it can be seen that the residents of Hondeklipbaai could probably all afford electricity using the Eskom "S1" tariff system. The lowest income group spends R74 p.m. on energy at present, which would easily cover R25 p.m. for a low demand electricity bill, leaving R49 p.m. to cover other fuels and transitional costs.

14.3.2 Other fuels

There is little potential for reduced household energy expenditure by supplying cheaper gas, as has been shown in a previous study (Borchers et al.1990).

Because of the continuing demand for firewood in Hondeklipbaai, there is a need for the mining companies to develop a more flexible approach to the question of land control and firewood collection.

14.2 RECOMMENDATIONS

- Considering that electricity is affordable and wanted by the residents, it is recommended that the area be supplied with electricity using the Eskom "S1" tariff system.

- The electrification should be undertaken by Eskom rather than NCC and should involve full participation of the community.

- The mining companies should permit the collection of wood on the land owned by them around Hondeklipbaai.

CHAPTER 15

OVERALL ENERGY USE CHARACTERISTICS

15.1 GENERAL ENERGY USE PATTERNS

Differences in energy use between the various settlements dealt with in this project have been found to be great, and generalisations should therefore be regarded with caution. Nonetheless, noteworthy trends have been found which merit some discussion.

15.1.1 Fuels used

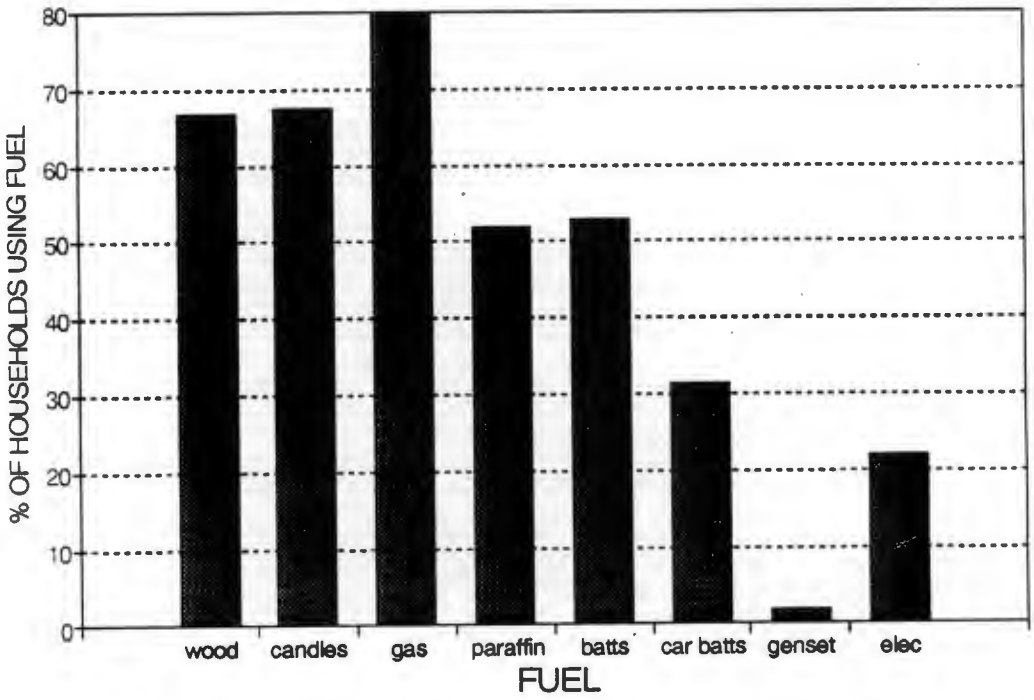

Figure 15.1 : Percentage of households using each fuel - all areas.

In most settlements, gas is the most commonly used fuel (figure 15.1), as well as contributing the most to total energy consumption in both nett and useful energy terms (figure 15.2). Wood and candles are used by the majority of households, while about 50% of the total population surveyed use batteries and paraffin. The

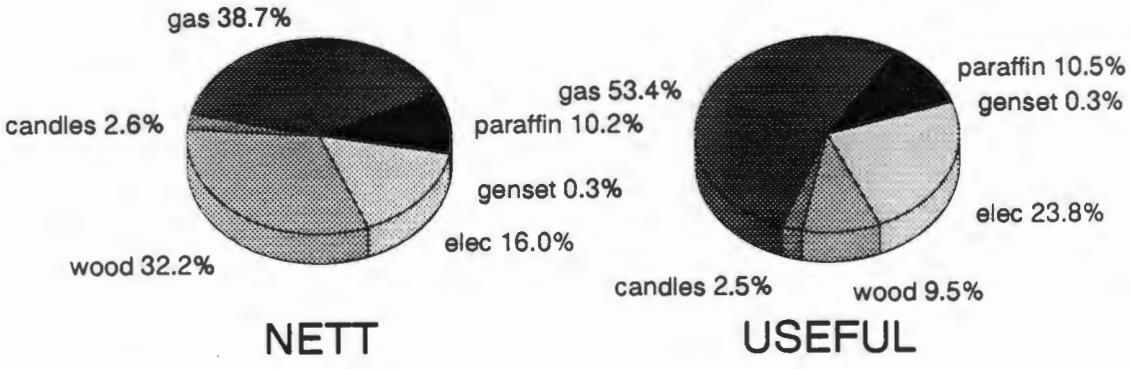

Figure 15.2 : Nett and useful energy contributions of different fuels - all areas.

two settlements along the Orange River, Onseepkans and Vioolsdrif, have significantly different energy use patterns, with wood being the most important energy source. The informal settlement in Port Nolloth is another exception - here paraffin is more widely used than gas.

15.1.2 Expenditure on energy

As shown in figure 15.3, lower income groups generally spend around 30% of their total income on energy requirements. This proportion reduces sharply for wealthier households. There are notable differences Vioolsdrif and Onseepkans, where the abundance of free wood allows residents to spend less on energy (lower income households spend around 15% of their total income on energy).

In all settlements examined it was found that gas constituted the largest proportion of energy expenditure where households use gas (figure 15.4).

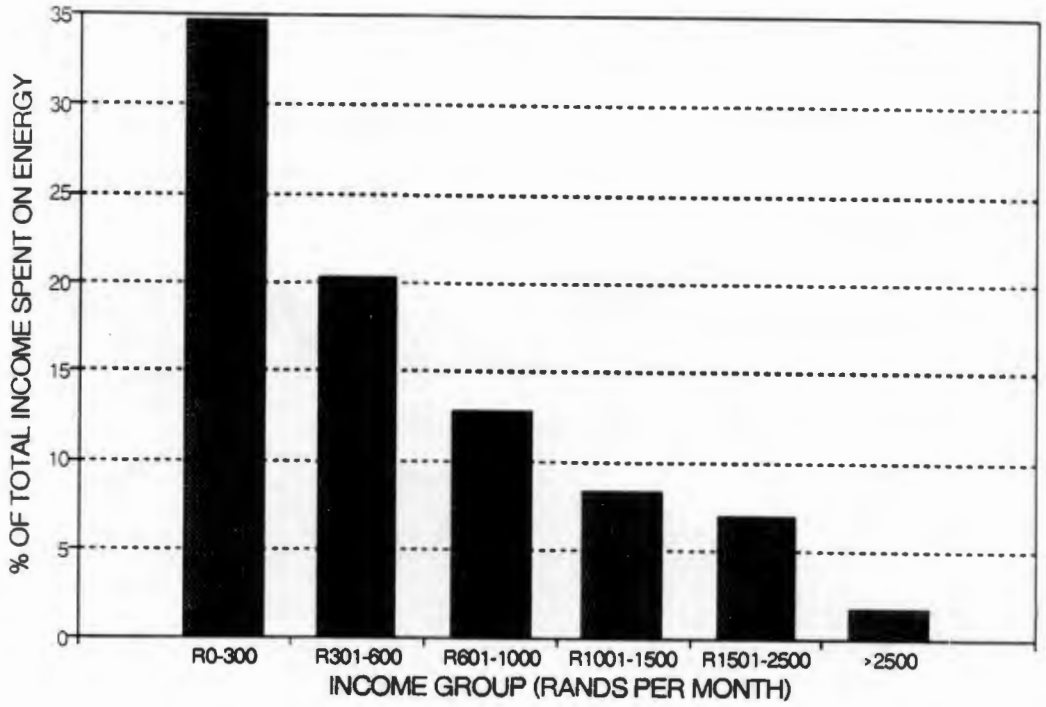

Figure 15.3 : Percentage of total income spent on energy - all areas.

15.1.2.1 Expenditure of electrified and non-electrified households

Table 15.1 shows the differences in total energy expenditure between electrified and non-electrified households over the range of income groups. The electrified houses in Nababeep and Okiep were not included in the table as electricity is subsidised by the OCC in these areas and expenditures are therefore unrealistically low. Over 50% of electrified households in the settlements considered still use gas for cooking, and the expenditure shown in the table therefore includes gas purchase. It can be seen that expenditures of electrified houses are generally significantly lower than houses without grid power, except for the lower income households. It must be remembered that electrified households generally pay a monthly service charge for electricity (typically over R 20), which constitutes a large proportion of energy expenditure for low income houses. With the "S1" tariff system there is no such charge, and energy costs of low demand households (which are generally the low income houses) would therefore be reduced. The table therefore indicates that electrification can result in substantial savings to households.

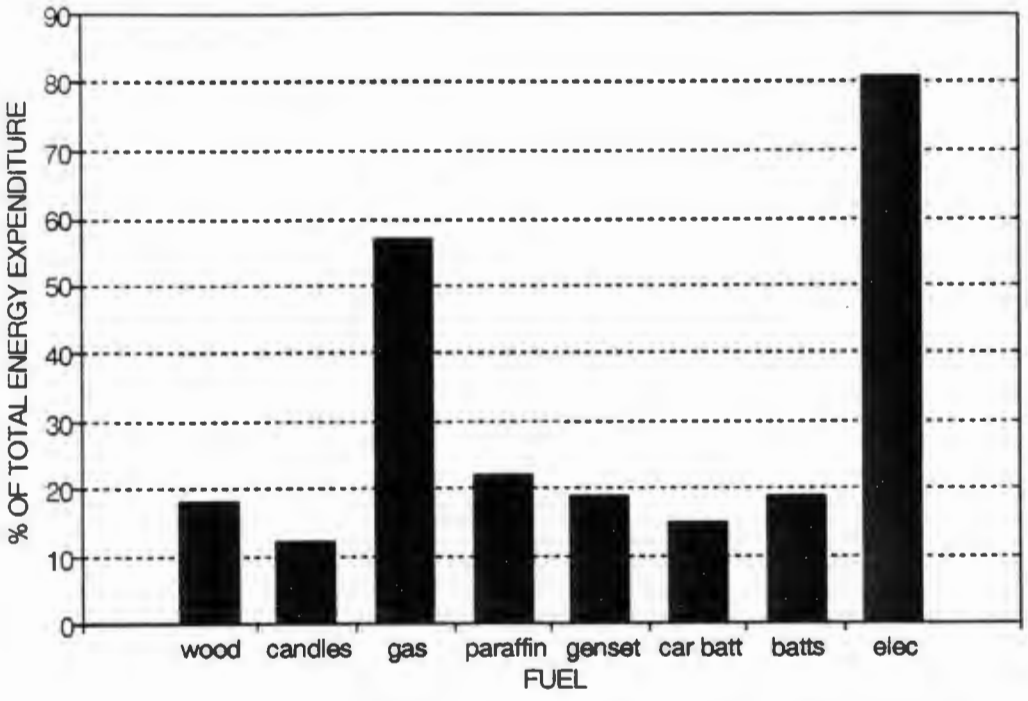

Figure 15.4 : Percentage of total energy expenditure spent on different fuels - all areas.

Table 15.1 : Monthly energy expenditure of electrified and non-electrified houses.

Income group	0-300	3-600	6-1000	10-1500	15-2500	>2500	AVRG
Elec	R 87.09	R 89.94	R 70.78	R 69.49	R 77.58	R 88.58	R 81.93
No elec	R 68.26	R 92.68	R 106.77	R 122.87	R 169.33	R100.09	R 97.04

Note : electrified households in Okiep and Nababeep excluded from the table as electricity is subsidised by the OCC in these settlements.

15.1.3 Energy Preferences

In all areas there was an overwhelming preference for Eskom as an energy source. Figure 15.5 shows the overall energy preferences for all settlements surveyed.

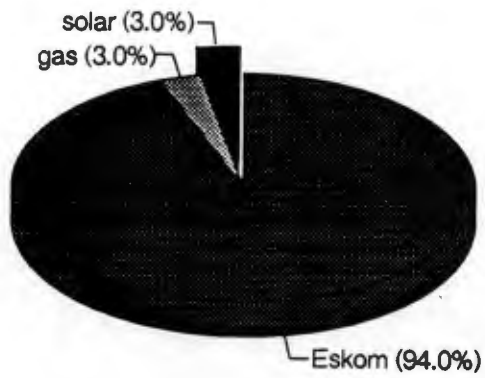

Figure 15.5 : Energy sources preferred - all areas.

15.1.4 Energy related problems and perceived solutions

The majority of problems mentioned by households related to the affordability of fuels, generally referring to the expense involved in gas purchase. This is illustrated in figure 15.6. In Vioolsdrif, where houses are largely made from reeds, the safety of available fuels was considered problematic. In settlements where electricity is available such as Okiep and Bergsig, residents often complained that connection costs were excessive. Residents in many settlements also indicated that they found available fuels inconvenient.

The great majority of households that made suggestions concerning the improvement of energy supply indicated that settlements should be electrified.

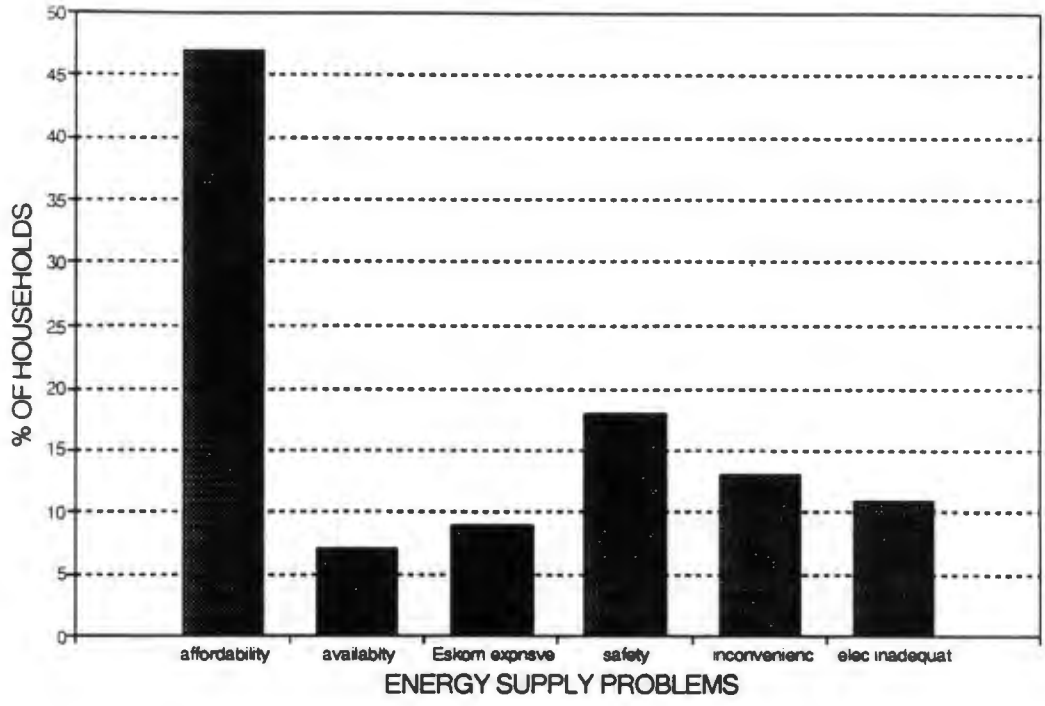

Figure 15.6 : Energy related problems mentioned by households - all areas.

15.2 DISCUSSION

15.2.1 Affordability of electricity

Many settlements where residents have access to electricity have low take-up rates. This may be attributed to the excessive expense involved in connecting to the network and installing housewiring (typically >R1500 in total), which places it out of the reach of most residents. This project has evaluated the affordability of electricity using the "S1 tariff system, which requires a small connection fee (about R30), and, if combined with a ready-board, does not require housewiring.

Based on actual amounts currently spent on energy, it is considered that all income groups in all but two of the settlements can afford electricity if supplied using the Eskom "S1" tariff system. The two possible exceptions are Onseepkans and Vioolsdrif, where incomes are low and energy expenditures proportionately lower than in other places. The low amounts spent on energy in these two settlements is a result of the abundance of free wood along the Orange River. It

is possible that residents in these places would be prepared to spend larger proportions of their incomes on electricity to enjoy its benefits, and this must be explored before decisions regarding its affordability are made. It is the experience of the project fieldworkers that these communities would be prepared to pay more for the convenience of electricity.

Electricity supply is expected to have a positive effect on communities both in terms of household energy use and in expanding productive opportunities in commercial areas. However, projects should be sensitively implemented and must adequately consider the needs and aspirations of community members if they are to be effective. Development projects in Namaqualand which have been insensitively implemented have typically aroused community resistance, thus wasting resources, promoting poor relations between communities and authorities, and limiting the effect of the project on the development of the community. It is therefore important that communities be involved in the planning and implementation of a project if they are to successfully address the needs of communities.

15.2.2 Gas use

It is expected that gas use for cooking will continue in the settlements examined, even if far reaching electrification projects are implemented. Although dependence on gas is widespread throughout the area, there appears to be little potential for significant reduction in household energy expenditure by reducing the price of gas. The gas market is relatively competitive and price reductions would therefore not be great.

15.2.3 Wood use

Lower income groups typically depend more on wood than wealthier households. In many areas it is widely used for baking, and in settlements such as Onseepkans and Vioolsdrif it is also the principal cooking fuel.

In Port Nolloth, Hondeklipbaai, and Nababeep residents are not permitted to gather wood in the surrounding company owned area, thus forcing residents to spend more on energy. This has particular impact on energy expenditure by poorer households.

Table 15.1 : Summary of settlement characteristics and recommendations

SETTLEMENT	Populatn surveyed	Persons/hs	Median monthly income	Most important fuels	Energy expenditure range (monthly) low - high	Percentage electrified	Main energy preference	Eskom "S1" affordable?	Recommendations
Port Nolloth (formal)	3728	6.6	R 800	gas	R 56 - R 136	36%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation ■ Free land for wood collection
Port Nolloth (informal)	1800	6.4	R 430	gas paraffin	R 109 - R 240	0%	Eskom	Yes	■ Electrify after land allocated ■ Engage community participation
Pofadder	4221	5.9	R 500	gas	R 87 - R 215	5%	Eskom	Yes	■ Electrify with S1 system ■ Eskom preferable to municipal ■ Engage community participation
Garies	792	5.9	R 430	gas	R 70 - R 116	23%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation
Vioolsdrif	400	5.3	R 320	wood	R 24 - R 59	0%	Eskom	borderline	■ Study in further detail
Kamieskroon	900	5.6	R 500	gas	R 53 - R 153	0%	Eskom	Yes	■ Electrify with S1 system ■ Eskom preferable to municipal ■ Engage community participation
Onseepkans	1041	6.9	R 260	wood	R 19 - R 83	0%	Eskom	borderline	■ Study in further detail
Nababeep	6192	4.9	R 800	electricity gas	R 76 - R 82	38%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation ■ Free land for wood collection
Bergsig	5830	5.9	R 720	gas	R 79 - R 125	24%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation
Okiep	5675	5.4	R 673	gas electricity	R 52 - R 129	37%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation
Matjieskloof	1738	5.3	R 500	gas	R 73 - R 192	0%	Eskom	Yes	■ Electrify with S1 system ■ Engage community participation
Hondeklipbaai	400	5.5	R 646	gas	R 74 - R 194	0%	Eskom	Yes	■ Electrify with S1 system ■ Eskom prefered developer ■ Free land for wood collection
OVERALL	32727	5.7	R 629	gas	R 19 - R 240	22%	Eskom	Yes	■ Electrify using Eskom S1 system

15.3 RECOMMENDATIONS

The recommendations made concerning each settlement are summarised in table 15.1. Due to the overwhelming preference for grid electricity, its widespread affordability and potential positive effect on communities, it is recommended that most communities be electrified. Before implementing any electrification plans in Onseepkans and Vioolsdrif, however, it is necessary to examine in more detail the willingness of residents to pay for grid power.

It must also be stressed that communities need to be fully involved in electrification projects from the planning phase if the project is to be successful in addressing community needs and aspirations and stimulating the development of the area.

REFERENCES

Borchers ML, Archer FM, & Eberhard AA, 1990. Namaqualand Household Energy Survey. National Energy Council report, Energy for Development Research Centre, Energy Research Institute, University of Cape Town.

Dunne J, 1988. Towards a Regional Development Strategy for Namaqualand. Working Paper No.75, South African Labour and Development Unit, University of Cape Town.

APPENDICES

APPENDIX A

QUESTIONNAIRE USED IN THE SURVEY

VRAELYS VIR NAMAKWALAND Ondervraer.....

(Maak 'n kruis op dit wat van toepassing is) (los die blokkies oop.

1 Van van huisgesin..... Erf nommer | No..... | weet nie | geen |

2a Hoeveel persone woon hier (almal wat 1X per maand of meer huis toe kom ingetel)?.....

2b Wat is die totale inkomste van die huishouding? (pensione, onderhoude en salarisse ingesluit.)
1.....+2.....+3.....+4.....
+5.....+6.....+7.....+8.....

= TOTAAL : .....

TOTAAL	0-230	231-440	441-800	801-1000	1001-1500
	1501-2000	2001-2500	2501-3000	3001-3500	3501+

3a Watter tipe huis het u? | muur | sink | hout | seil | ander |

3b Behoort die huis aan u? | YA | NEE |

3c Is u tevrede waar u woon of wil u elders woon ?

tevrede hier	
wil in 'n ander area van dié dorp woon:	waar?.....
wil op 'n ander plek woon:	waar?.....

Indien u op'n ander plek wil woon :

3d Hoekom wil u daar woon ? | het grond daar | daar gebore | wil daar werk | ander : | verduidelik.....

4 Waar was die hoof van die huis gebore? | plaaslik | elders: | waar?.....

5 Gebruik u nog hout (selfs vir bakoond)? | JA | NEE |

5a Hoe dikwels?

elke dag	elke 2de dag	2Xp week	1Xp week	minder

5b 1. Maak u self die hout bymekaar? | JA | NEE |

2. Koop u die hout? | JA | NEE |

5c Hoe dikwels kry/koop u hout?

2Xp week	1Xp week	1Xp maand	minder

5d Hoeveel kos die drag hout? .....

6 Gebruik u kerse? | JA | NEE |

6a Hoeveel pakke p. maand?

minder as een	een	twee	drie	vier	meer

6b Hoeveel spandeer u aan kerse p. maand? .....

7 Gebruik u gas? JA | NEE Indien ja,

7a Gebruik u 'n gasstoof JA | NEE

7b Gebruik u die gasstoof elke dag | elke 2e dag | 1Xp week | minder

7c Gebruik u gaslampe? JA | NEE

7d Gebruik u gasyskas? JA | NEE

7e Hoeveel gas koop u p. maand (kg) .....(R).....

8 Gebruik u paraffien? JA | NEE Indien ja,

8a Gebruik u paraffien lampe? JA | NEE

8b Gebruik u paraffien yskas? JA | NEE

8c Gebruik u paraffien stoof? JA | NEE

8d Hoeveel paraffien koop u elke maand (l).....(R).....

9 Gebruik u 'n kragopwekker (bv vir TV)? JA | NEE

9a Hoeveel petrol/diesel p. maand? (R).....

10 Gebruik u 'n motorbattery in u huis (bv vir TV) JA | NEE

11 Gebruik u enige ander batterye (bv PM9, PM10, flits)? JA | NEE

a. Hoeveel PM9?..... b. Hoeveel PM10?.....

c. Hoeveel flits?.....

12 Het u elektrisiteit? JA | NEE

Indien JA :

12a Wat was u vorige rekening ?.....

Indien NEE :

13a Wil u elektrisiteit hê? JA | NEE

14 Besit u enige elektriese toestelle (bv yster, ketel, stoof...) besit u alreeds?
Lys.....

15 Watter soort krag wil u hê?

EVKOM	gas	paraffien	hout	sonkrag	kragopwekkers

16 Enige probleme in verband met energie/energiemiddels wat u graag wil noem, of enige voorstelle wat u wil maak i.v.m. energie?.....

.....

.....

APPENDIX B

CALORIFIC VALUES & CONVERSION EFFICIENCIES

CALORIFIC VALUES USED

Gas		- 49.8 MJ/kg
Paraffin		- 38.0 MJ/litre
Candles		- 3.45 MJ/candle
Wood		- 17.0 MJ/kg
Batteries :	PM-9	- 0.081 MJ ea
	PM-10	- 0.297 MJ ea
	Torch	- 0.0198 MJ ea

USEFUL ENERGY CONVERSION EFFICIENCIES OF DIFFERENT FUELS

Gas		- 70%
Paraffin		- 50%
Candles		- 50% (based on light emitted)
Wood		- 10%
Batteries		- 80%
Genset	- fuel efficiency	- 15%
	- elec use efficiency	- 80%
Electricity		- 80%

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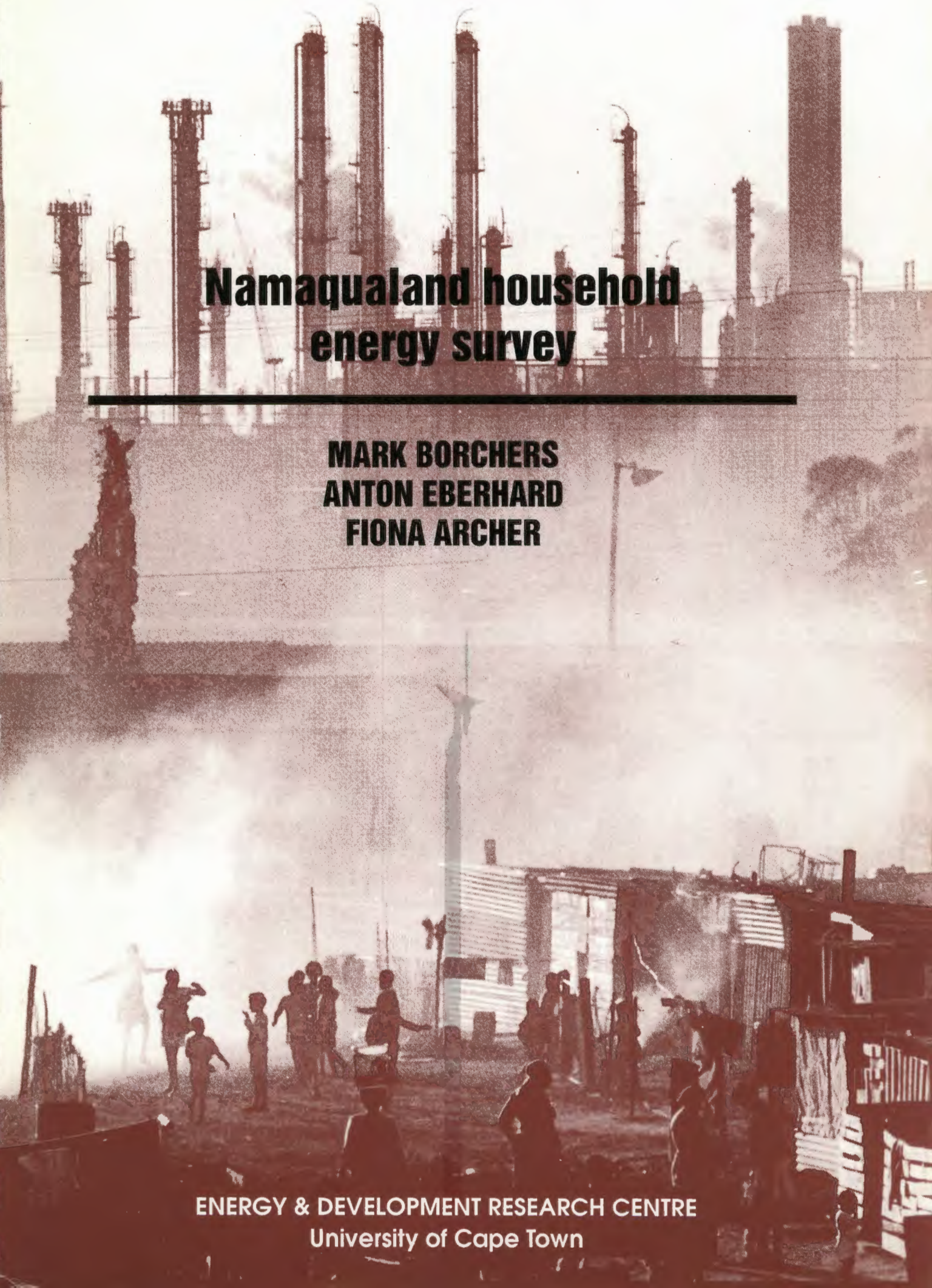

Namaqualand household energy survey

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