

Analysis of new electrification schemes in the Western Cape (Phase 2)

Steve Thorne and Paul Theron

**Energy for Development Research Centre
Energy Research Institute
University of Cape Town
Private Bag
Rondebosch 7700**

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EXECUTIVE SUMMARY

Project objective

The objective of this project is to examine electricity use in newly-electrified, poor urban settlements in the Western Cape, by monitoring and analysing household energy-consumption data and relevant socio-economic information. An important aim is to understand factors which affect the movement from multiple fuel use to greater electricity consumption. The intention is also to provide useful information for electrification planners.

Project methodology

The poor, mainly black townships of greater Cape Town provide an interesting opportunity to contrast electricity consumption in recently electrified areas, such as Khayelitsha, with more established townships, such as Langa and Guguletu which have had electricity for over 20 years. Both areas are going through significant changes in patterns of energy consumption.

There were two main sources of data:

- Firstly, all available information was collected on electricity accounts of households in Langa and Guguletu (there are currently about 9 975), and in Khayelitsha (currently about 5 414). This information was obtained from the distribution authorities serving these areas (the City of Cape Town and the LWCC respectively.)
- Secondly, a survey of 116 electrified households was carried out. 80 households in Khayelitsha were surveyed, as well as 36 households in the older electrified areas of Langa and Guguletu. Households were selected on the basis of having high, medium and low monthly electricity-consumption levels. In addition, the sample in Khayelitsha was distributed between Towns 1 and 2 (the initial 'core' housing area) and the newer up-market formal housing areas of Jonkersdam, and Bongweni, to cover different housing types and income levels. The households surveyed were essentially the same as those interviewed the previous year in phase 1 of this project. Because of the movement of households and a limited number who preferred not to continue with the survey, 5% of the sample in Khayelitsha and 10% in Langa and Guguletu are new additions.

After phase 1, there was consultation with key institutes and individuals who were asked to assist in the shaping of the second phase of this project.

Background and electricity use

In Khayelitsha the areas surveyed were constructed between 1986 and 1991 and progressively electrified. Average electricity consumption levels for all consumers in Khayelitsha increased between 1991 and 1992 from 154 to 210 kWh/month (summer means) and 248 to 290 kWh/month (winter means). The annual means were 200 and 244 kWh/month for 1991 and 1992 respectively. These increases occurred despite the significant number of new electricity connections in 1992. The number of domestic electricity consumers in Khayelitsha has grown by 190% from December 1990 to June 1992 and is now 5 414.

There are substantial variations in average consumption levels in different areas. For example, winter levels in Bongweni were up to 80% higher than the average for Khayelitsha. Consumers with credit meters use the most electricity, while those in Town 2 Village 3 use the least electricity. Those with credit meters in Khayelitsha are mostly in the up-market areas. It is Council policy that credit meters should be replaced by pre-payment meters when a household goes into arrears.

Langa and Guguletu are representative of the older, more established poor areas in the Western Cape. Langa was proclaimed in 1922, Guguletu in 1948. Some houses in both areas were electrified in the 1960s. Levels of domestic electrification in formal households is currently 73% in Langa and 89% in Guguletu. Households in Langa and Guguletu are large, partly because of the prevalence of backyard shacks there.

Average consumption levels of all households in Langa are 411 kWh/month (summer mean), 508 kWh/month (winter mean) and 497 kWh/month (annual mean). In Guguletu figures for the summer, winter and annual means are 453kWh, 538kWh and 523 kWh respectively. 85% of all consumers in both of these areas are not keeping up with their electricity payments. The average size of arrears, has grown from R1 200 to R1 700 between 1991 and 1992.

Appliances

In all areas there is an increase in the ownership of larger appliances, such as stoves, geysers, fridges, and television sets, while the survey indicates a trend for households to dispose of small appliances.

Between 1991 and 1992 there has been a move to greater dependence on electricity in the Khayelitsha sample. In the Langa and Guguletu sample there was slight movement away from electricity to a reliance on a mix of fuels. This is a result of deterioration in the quality of the electricity supply in Langa and Guguletu. The threat of disconnection as a result of arrears is ever-present and may influence decisions on the purchase of appliances. Paraffin appliances are more prevalent than gas ones in Langa and Guguletu. The reverse is true for Khayelitsha.

Of the sample in Langa and Guguletu 83% own electric stoves, as do 53% of the sample in Khayelitsha – an increase in Khayelitsha and a decrease in Langa and Guguletu, from 1991 to 1992. The number of television sets has increased in Khayelitsha. 37% of the households surveyed bought television sets as their most recent electrical appliance. Geysers are owned by 64% of the Khayelitsha sample and by 10% of the Langa and Guguletu sample. The study shows a marked correlation between the total number of electrical appliances and household income, with higher-income households buying more electricity.

Analysis of fuel use

Between 1991 and 1992 there was an increase from about two-thirds to three-quarters of the sample using electricity on a daily basis. Fewer households use a fuel mix. In Khayelitsha the move has been towards greater reliance on electricity as the only fuel used on a daily basis, from 61% to 80%. In Langa and Guguletu the opposite has been observed, with a decrease from 72% to 66%.

With the increased daily use of electricity there has been a corresponding increase in the use of candles as a backup for lighting in case of electricity failure. There is some evidence that households also retain paraffin and gas appliances because of electricity supply problems. Wood and coal are not normally used, except for cooking traditional meals and braais.

Useful energy consumption (ie, the actual energy utilised in powering the appliance) is higher for households with higher incomes.

Cost of energy services

Hire purchase (HP) payments on electrical appliances contributed significantly to household energy-service costs, particularly in the newly electrified areas in phase 1 of the study. In Khayelitsha, the HP cost of R71 made up 45% of the average monthly energy bill. In 1992 this had fallen dramatically to an average of R17 per month or to between 10% and 20% of monthly energy bills.

The lowest income category showed the lowest dependence on electricity, and tended to use a wider mixture of fuels.

Transport bills amount to roughly the same as the sum of fuel expenditure and HP costs for electrical appliances. If transport costs are included in the total energy service cost to households, then these amount to between 18% and 36% of total household incomes for the different areas.

Households with electricity spend less on fuels than households without access to electricity. A recent study of un-electrified areas of Khayelitsha found that the amount spent on fuel was R127 per month (Macroplan), which compares with R68 spent on fuel in electrified households in surrounding areas.

On a *useful* energy basis, the prices of gas and paraffin are lower than that for electricity in all areas surveyed. In 1991, electricity was the cheapest fuel.

The affordability of electricity

Consumers with credit meters are more likely to perceive electricity to be unaffordable, perhaps because so many of them are in arrears. Most households would like to use more electricity, but suggest that they are limited by the number of appliances they own and can afford.

Attitudes towards electricity

Attitudes towards credit and pre-payment meters are very mixed. Pre-payment meters are mostly well-liked, in spite of the poor reliability experienced with early models installed in Khayelitsha. About 10% of the households with credit meters would prefer pre-payment metering.

Township residents generally prefer high-mast lights to standard street lights, primarily because they create a brighter, safer night environment.

The household environment has improved significantly since gaining access to electricity, with better air-quality, an improvement of safety, and houses better illuminated. Most households perceive their houses to be cooler, and respondents felt that the occupants' health had improved.

All households would like some education on how to use electricity more effectively.

The quality of the electricity service provided

Electricity supply in the areas studied is unreliable. Service has improved considerably in Khayelitsha, however, while it has deteriorated in Langa and Guguletu to the point where people consider it unsafe. The perceived duration of blackouts was in excess of four hours per blackout. The perceived frequency of blackouts in Khayelitsha has decreased while in Langa and Guguletu it had increased. Poor reliability prevents full dependence on electricity for daily activities such as

cooking. This is evident in the move from electricity to a mixture of fuels in Langa and Guguletu, where the service has deteriorated.

- Reliability of services may well be a function of the political and economic marginalisation of the poor (mainly black) townships in South Africa. Few mechanisms exist whereby residents can protest at the poor quality of services that they routinely receive. These issues will need to be addressed in restructuring the electricity industry and local government on a non-racial basis.

Key determinants of increased electricity consumption levels

A number of variables affect electricity consumption, some of which were considered in this study.

Where the R-squared tool was employed to measure statistical correlations on the discrete data, these were found to be weak. On grouping the information in a method similar to that used in phase 1, some trends were apparent – these were reported and compared, but not statistically measured.

The study examined the aggregated electricity consumption data as set against a number of suspected determinants, including size of the household, years of access to electricity, total number of electrical appliances (lights are considered as one appliance), incidence of large appliances (like electric stoves, fridges and geysers), seasonal trends and the perceived duration of blackouts. Lack of access to water inside the house affected the electricity consumption of the sample in Khayelitsha Town 1.

In the Khayelitsha sample, the number of electrical appliances owned and the total electricity consumption yields a clear trend. The number of appliances owned by a household is related to the household income.

Areas for further research

The information from these two phases of the study will facilitate better understanding of household energy-usage patterns and can be used to inform the planning and implementation stages of the process of electrification. An understanding of the initial period after gaining access to electricity seems to be the most critical and can assist in maximising the benefits to all parties concerned in the process. For example, an understanding of the determinants of electricity consumption can inform the type of interventions that will achieve desired goals, such as increasing electricity consumption, the design of demand-side management interventions, and the type of metering.

Specific areas that emerged in phases 1 and 2 of this study that require greater understanding are, firstly, the factors affecting changing appliance-ownership. This is particularly relevant, as the number of appliances owned appears to be one of the most important determinants of electricity-consumption levels.

From the consumer's perspective, there is a demand for particular energy services, which then imply various fuel/appliance combinations. The most energy-intensive of these services are: cooking, space- and water-heating and, to a lesser extent, refrigeration. The research outline proposes that phase 3 of this study to investigate individual household load monitoring, to add to the understanding of individual electricity loads within households.

An important motivation for continuing a longitudinal study such as this is that it monitors changes in energy-use patterns over time, and thus informs the appropriate energy service interventions. It provides the quantitative information on electricity consumption that will, in turn, inform the rate of return on investments in the electrification of similar areas. It provides data on the impact

on the quality of life, environmental and other socio-economic issues. This information is useful because it gives an indication of the sustainability of providing electricity to poorer areas.

This study is well placed to inform the process of electrification in Khayelitsha, where Eskom has undertaken to electrify 60 000 households over the next three years (Eskom).

Finally, a study such as this will refine the methodologies for monitoring the electrification process.

Relevance of findings for the electrification of poor areas

This study has revealed a number of important issues which have general bearing on the electrification of poor areas. A central question affecting electrification planning relates to expected electricity-consumption levels. The study has provided clear quantitative evidence that consumption levels in newly-electrified areas will rise over time. Further tracking of this trend is necessary, but the much higher levels of consumption in Langa and Guguletu (despite the limited use of geysers) suggest that it will continue. A key question is the rate at which electricity consumption will increase, as this impacts decisively on the economic viability of electrification.

The variable associated with higher electricity consumption is the number and size of electrical appliances owned. The study examined the impact of ownership of stoves, geysers, and refrigerators on electricity consumption, finding that higher consumption levels will result from the acquisition of more and larger electrical appliances. An intervention to increase ownership of such appliances would benefit all sides: households would enjoy greater convenience and lower useful energy costs, and the distribution authority would sell more electricity – thus getting a better return on its capital investment. The purchase of appliances may cause total household energy costs (including the cost of paying for them) to rise for a period. Yet the longer-term benefits for the household and the electricity distributor are clear. The HP payments for electrical appliances in Khayelitsha are evidence that the purchase of appliances is already a priority for newly electrified households.

What steps can be taken to increase market penetration of large electrical appliances? Both appliance manufacturers and electricity distribution authorities stand to gain from producing and marketing lower-cost electric stoves. Non-profit schemes to market and distribute appliances have been used with much success around the world (including white municipal areas in the past), and need to be actively explored for use in areas such as Langa, Guguletu and Khayelitsha.

Alternatively, access to credit facilities for the poor being limited, it may well be in the interest of distribution authorities to consider innovative financing methods to allow easier access to these appliances. Comparison between the amounts being spent on fuels in non-electrified and in electrified areas reveals a compelling argument for credit facilities to assist in the acquisition of electrical appliances. This may present an opportunity for appliance manufacturers and retailers, electricity distributors and consumers, to the benefit of all.

Improving the reliability of the electricity service provided in poor areas should be a priority. Besides being necessary for reasons of equity — consumers have a right to equal standards of service in all areas — consumption levels will probably rise if quality improves. Many households retain, and continue to use, non-electrical appliances because of the frequency of blackouts. Dependence on electricity will rise if the service is dependable.

However, introducing innovative appliance-marketing schemes and improving the quality of supply in poor areas can only be undertaken by professionally-run, service-oriented distribution authorities. Very few township areas – and certainly not Khayelitsha, Langa or Guguletu – have such authorities. The distribution sector of the South African electricity supply industry has evolved within the paradigm of apartheid. Fundamental restructuring will be necessary to create a more workable situation.

Electrification in South Africa has reached a stage where it is seen as a necessary strategy for increasing living standards and promoting economic growth and equity. It is to be hoped that the information gained from micro-level studies such as this one will help to maximise the benefits of the electrification process for all concerned.

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— *Steve Thorne*

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Chapter One INTRODUCTION

1.1 Project objective

The project entails the examination of electricity use in newly-electrified, poor urban settlements in the Western Cape by monitoring and analysing energy-consumption data and relevant socio-economic information. A primary aim is to understand factors which affect the movement from multiple fuel use to greater electricity consumption. The intention is to provide detailed information which would be of use to those involved with electrification.

The project involves a longitudinal study of changing energy-use patterns over time. The first phase of the project began in 1991. This report covers phase 2 of the project, conducted in 1992.

1.2 Context of the project

This study intends to inform current debates on the viability and effect of electrification on poor areas. Levels of electrification are on the increase in South Africa and a priority of those involved in this process is electrification of urban townships, such as Khayelitsha.

Electricity distribution authorities need information on the effects of electrification, in particular, on trends in electricity consumption and their determinants. High levels of consumption imply better returns on the capital invested in the development of electrical infrastructure and affect the viability of these schemes.

Phase 2 of this study hopes to meet these information needs by providing data based on the perspectives of energy end-users, in an effort to maximise the benefits to all concerned in the electrification process. Phase 2 continues longitudinal tracking of electricity consumption, while providing a second snapshot cross-sectional analysis of energy usage in households sampled. As in phase 1, it attempts to uncover socio-economic and other determinants of electricity use.

It is important to note that the study examines electrified households only, and presents data from the time of gaining access to electricity onwards. As will be discussed in later sections of this report, the sample households are a small but typical section of formal houses in a poor area. The results of the study are relevant to only a small, more affluent section of township residents, and it excludes unplanned informal (shack) and planned informal (site-and-service) settlements.

This study draws on similar studies carried out previously by the Energy for Development Research Centre. In particular, the work of Viljoen (1989) indicates the importance of looking at multiple fuel use, including amongst households with access to electricity. The detailed household survey looked at total energy use. A comparison of this work to other relevant work in the electrification process is attempted in the literature survey included as Appendix 1.

In collating and discussing the material below, no particular attempt has been made to develop a general model to explain electricity consumption in newly-electrified areas. As will be seen, fuel use in these households depends on a range

of interrelated determinants. Data from this project will contribute to the development of a general model.

In the two areas surveyed, the electrification process is going through two quite different stages. In the case of the older areas the electricity infrastructure is decaying; and residents are not paying electricity accounts. In the new area of Khayelitsha the crisis is around access to an electricity service. The political transition imminent at local and national government levels, and the future rationalising of the electricity distribution industry, add further ingredients to the heated debate around electricity.

At present, provision of electricity in Langa and Guguletu is in crisis as a result of poor service and high arrears. Addressing the problem of arrears, the City of Cape Town Electricity Department has changed its strategy three times since October 1992. There appears to be no constructive long-term view on how to resolve the situation under present local government arrangements in which the residents of Langa and Guguletu have no formal control over the provision of electricity.

In Khayelitsha the Lingeletu West City Council (LWCC) Electrical Engineers Department has increased the number of electricity connections. This expansion of electricity provision has taken place in a climate of inadequate access to funds and low credibility of the Council. The transfer of the electricity distribution rights from LWCC to Eskom for the entire area of Khayelitsha is currently being negotiated. Eskom plans to electrify the entire area, considered to be in the order of 60 000 new connections (Eskom correspondence, 19 February 1993).

1.3 Project methodology

The poor, mainly black townships of greater Cape Town provide an interesting opportunity to contrast electricity consumption in recently electrified areas such as Khayelitsha with established townships such as Langa and Guguletu, which have been electrified for more than 20 years.

There were two main data sources. Firstly, all available information was collected on electricity accounts of households in Langa and Guguletu (there are currently about 9 975), and in Khayelitsha (currently about 5 414). This information was obtained from the distribution authorities serving these areas (the City of Cape Town and the LWCC respectively.)

Secondly, a survey of 116 electrified households was carried out. 80 households in Khayelitsha were surveyed, as well as 36 households in the older electrified areas of Langa and Guguletu. Households were selected on the basis of having high, medium and low monthly electricity-consumption levels. In addition, the sample in Khayelitsha was distributed between Towns 1 and 2 (the initial 'core' housing area) and the newer up-market formal housing areas of Jonkersdam, and Bongweni, to cover different housing types and income levels. The households surveyed were essentially the same as those interviewed the previous year in phase 1 of this project. Because of the movement of households and a limited number who preferred not to continue with the survey, 5% of the sample in Khayelitsha and 10% in Langa and Guguletu are new additions.

The questionnaire for the second phase was compiled after a process of consultation: key persons and institutions in the electrification process were identified and asked to comment on the findings of the first phase of the study and make any additions thought necessary for complementing their understanding of the electrification process. The revised questionnaire includes contributions from these institutions and individuals. Those responding are listed in Appendix 2.

The survey questionnaire was piloted by the interviewers as part of the training exercise and to test its practicality and the need for changes. The households piloted were not those included in the sample. A copy of the final questionnaire is included in Appendix 3.

The interviews were conducted by experienced interviewers – all first-language Xhosa speakers. Interviewers were paid on a pro rata basis for completed questionnaires, and transport costs reimbursed. The interviewers returned questionnaires on a regular basis, after a certain number of days or after completing a certain number of questionnaires. Where the questionnaires were found to be incomplete, or where information contradicted or was very different from that obtained in phase 1, interviewers were asked to return and repeat the relevant parts of the interview. Respondents received a report of the phase 1 findings and a compact fluorescent energy-efficient light bulb. The interviewers were instructed to brief respondents thoroughly on the benefits of energy efficiency. An overview of the survey was submitted by Mr Lizo Ntloko, who conducted the interviews in Khayelitsha. This report is included as Appendix 4.

The information was collated in a Quattro Pro spreadsheet. All figures and graphs presented were generated through Quattro Pro.

Data from phase 2 (1992) was compared with that from phase 1 (1991) to determine trends.

1.4 Structure of the report

The report of the work done in phase 2 is presented as an update of the phase 1 report, with an attempt to closely follow its structure.

- In Chapter Two, following this introduction, poor areas in the Western Cape, in particular Khayelitsha, Langa and Guguletu, are described, including details of the extent and operation of electricity supply systems.
- In Chapter Three, electricity consumption information for the two areas is presented. Consumption levels of all consumers in selected areas are shown, and contrasted with consumption by the households surveyed.
- In Chapter Four, basic socio-economic information on Langa and Guguletu and Khayelitsha is presented and discussed.
- In Chapter Five, appliance ownership and appliance use for some of the more energy intensive household activities are analysed.
- In Chapter Six, the use of all fuels in the households surveyed is examined.
- Chapter Seven analyses the key determinants of electricity consumption levels.
- Chapter Eight explores the attitudes and perceptions of households to their electricity service.
- Finally, Chapter Nine draws together the findings of the project, and discusses implications for the electrification of poor areas.

Chapter Two

LOW-INCOME AREAS IN THE WESTERN CAPE

2.1 Introduction

This chapter describes the character and origins of poor areas in the Western Cape, and details the provision of electricity in Langa, Guguletu, and Khayelitsha.

2.2 The character and origins of low income areas

For the purposes of this project, low-income areas in the Western Cape are defined as those areas in which black African people have lived, commonly referred to as 'townships'. These include the formal townships of Langa, Guguletu, Nyanga, Crossroads and Khayelitsha, as well as a number of informal housing areas; some of these are shown in Figure 2.1.

The development of black African townships in the Western Cape has been through a number of stages. Black people living in various parts of Cape Town were forcibly removed to Ndabeni (in 1901) and, later, Langa (in 1922). Population growth led to severe overcrowding and, eventually, the construction of new housing in Nyanga and Guguletu by the Cape Town City Council between 1948 and 1972.

The Coloured Labour Preference Policy, applied increasingly after 1964, led to an end to construction of family housing for black Africans after 1972. The repeal of this policy and of the system of influx control in 1986 has led to a more tolerant attitude. New land for formal settlement by black Africans was made available in Khayelitsha in 1983.

Statistical information on the population of these areas is notoriously unreliable. One estimate is that the population of the Western Cape (including Atlantis and Malmesbury) in 1990/91 was 2 966 000 people, of which about 850 000 (28.7%) were black African (Bridgeman et al., 1992:28).

The slow pace and high cost of housing construction have led to severe housing shortages in all areas. Shacks have been constructed on the properties of most formal houses in townships, as well as in a large number of unplanned informal-housing areas.

The project is concerned with the use of electricity in low-income formal housing areas. (Few of the informal areas have electricity.) The focus is therefore on three areas where households have access to electricity: Khayelitsha, Langa and Guguletu. In this study Langa and Guguletu are usually dealt with together, as an example of townships that have had access to electricity for a long time.

2.2.1 Langa and Guguletu

Langa and Guguletu are representative of the 'older generation' of poor areas in the Western Cape. Langa grew rapidly, particularly with the construction of single-sex hostels and small box-like housing units. These units were available on a rental basis only, with no permanent forms of tenure permitted. Guguletu was founded to house an overflow of people from Langa and an emergency camp

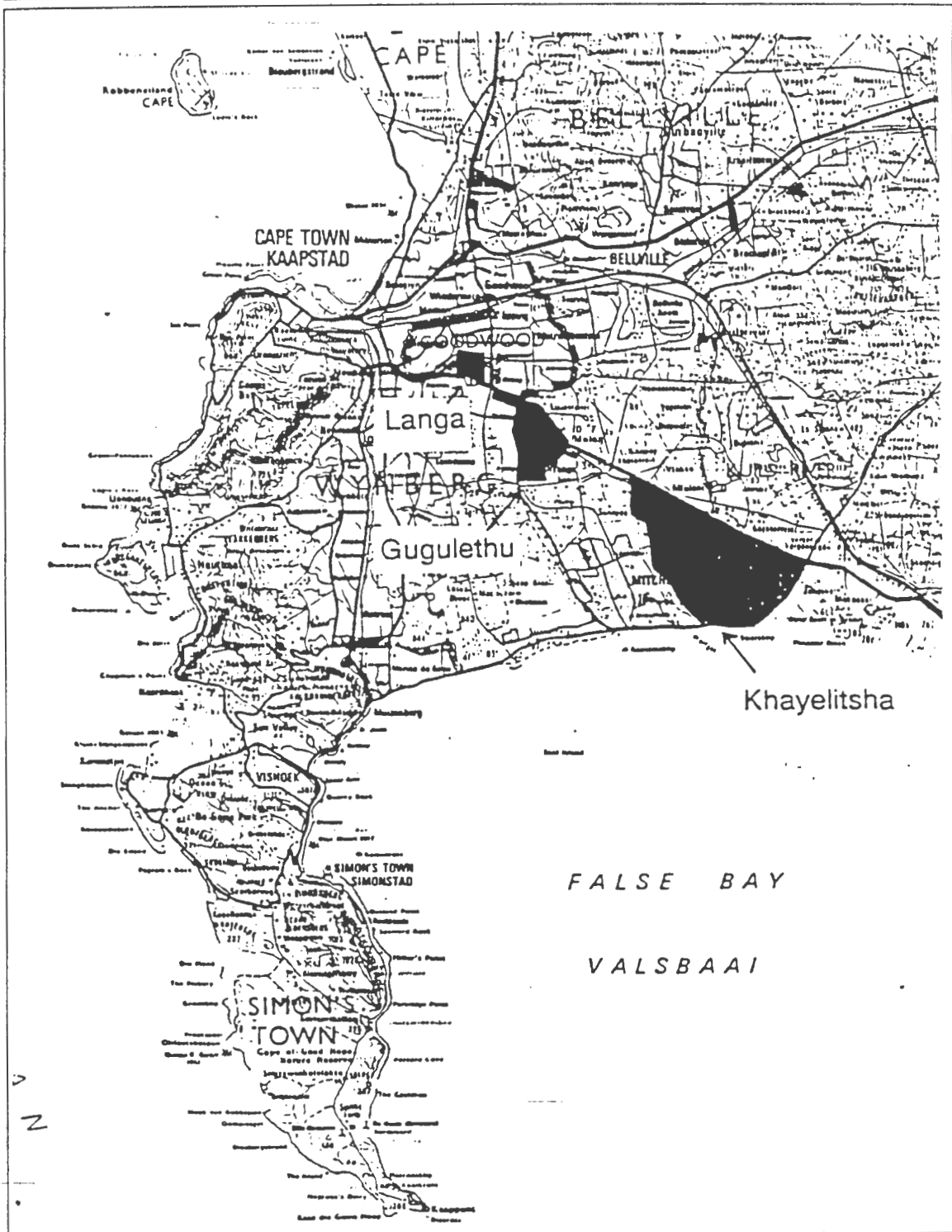


FIGURE 2.1: Low-income areas studied

in Nyanga. Small family units were constructed by the council for rental. A standard design, 'NE 51/6' was used: three-roomed, with cold running water, no ceilings, no internal doors, no internal plastering, and no kitchen sink.

From the outset, the available formal housing was inadequate. By 1977 there were an estimated 51 000 people living in informal shelters in the Gugulethu area. 'Squatter' communities were subject to frequent demolition. In the 1980s more 'squatter' camps grew in Nyanga Bush and KTC. In the formal housing areas, overcrowding has reached very high levels. Most properties in the older housing

areas have a number of backyard shacks. Migrant hostels are also severely overcrowded.

2.2.2 Khayelitsha

By 1983 it was clear to the state that allocation of additional land for Black African settlement was unavoidable. Khayelitsha was created on a 3 200 hectare site at the periphery of the city. Residents of informal areas were pressured to move to the new area. In 1985 the first 5 000 'core' housing units were constructed in Town 1, Villages 1 to 4. Thereafter settlement was permitted on serviced sites: sites B and C. Formal housing was developed in Town 2, Villages 1, 3 and 4, between 1986 and 1990 by private developers. These houses range from four-roomed units to larger family homes.

The areas of Jonkersdam, Bongweni and Tembani in Khayelitsha were more upmarket developments. Private developers constructed housing there between 1989 and 1991. A number of site and service schemes are currently being developed in Town 2, Villages 2a and 2b, as well as new areas in Town 3 and 4. There is no provision for electricity in these serviced sites, although plans for Town 5 include the provision of electricity.

The total population of Khayelitsha is difficult to estimate, since there is a continuous influx of people to the area, with estimates range from 350 000 (by the Lingeletu West City Council) upwards. This study uses a population figure of 400 000 people.

2.3 Electricity supply

The areas supplied by different electricity distribution authorities in the Western Cape are shown in Figure 2.2. The City of Cape Town is by far the largest electricity distribution authority in the area. Figure 2.3 shows the number of consumers served by each authority. Estimates of the extent of electricity provision in different areas are shown in Table 2.1.

Access to electricity - the extent of provision.					
Area		Formal	Shacks	With Access	% Access
Khayelitsha	Town 1	5000	0	1473	29
Khayelitsha	Town 2 Village 1	3477	0	1025	29
Khayelitsha	Town 2 Village 2	0	3900	0	0
Khayelitsha	Town 2 Village 3	4465	0	2405	54
Khayelitsha	Town 2 Village 4A	219	0	219	100
Khayelitsha	Town 2 Village 4B	94	0	94	100
Khayelitsha	Town 2 Village 4C	0	500	0	0
Khayelitsha	Jonkersdam	382	0	382	100
Khayelitsha	Bongweni	300	0	300	100
Khayelitsha	Tembani	183	0	181	99
Khayelitsha	Site C	0	7060	0	0
Khayelitsha	Site B	0	18500	0	0
Khayelitsha	Greenpoint	0	2000	-	0
Langa		3500	-	2570	73
Guguletu		8300	-	7405	89

TABLE 2.1: Extent of electricity provision

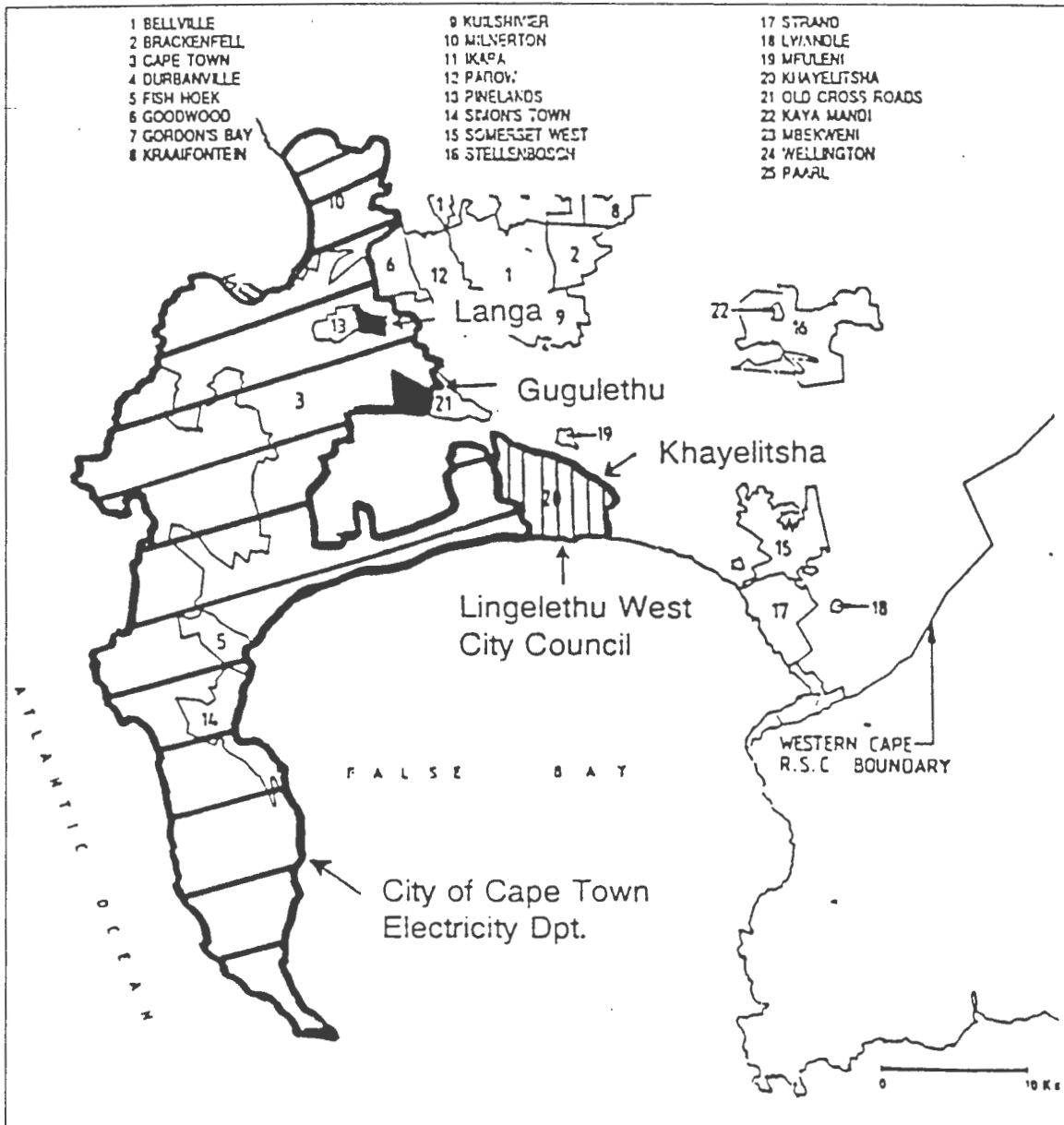


FIGURE 2.2: Areas of distribution authorities.

2.3.1 Electricity provision in Langa and Guguletu

Electricity in Langa and Guguletu is provided by the City of Cape Town Electricity Department, which is the licensed supplier of electricity to these areas, although they fall within the area of the Ikapa Town Council, a Black Local Authority (BLA). Ikapa is supposed to provide the rest of the services in these areas. The area of supply of the Department is much larger than the municipal area of the City of Cape Town. It includes the areas of jurisdiction of a number of smaller white municipalities, such as Milnerton, Fish Hoek and Simonstown.

The Department owns generating stations, but these are very seldom operated and it buys most of its electricity in bulk from Eskom. It also has a pumped storage facility at Steenbras which is in regular use. It sent on average 316 million kWh per month in 1991, with its maximum demand during that year being about 844MW. The surplus (profit) generated by the Electricity Department in 1991/1992 was R63.4 million, representing a surplus on trading of 10.86% (City Electrical Engineer, Annual Report).

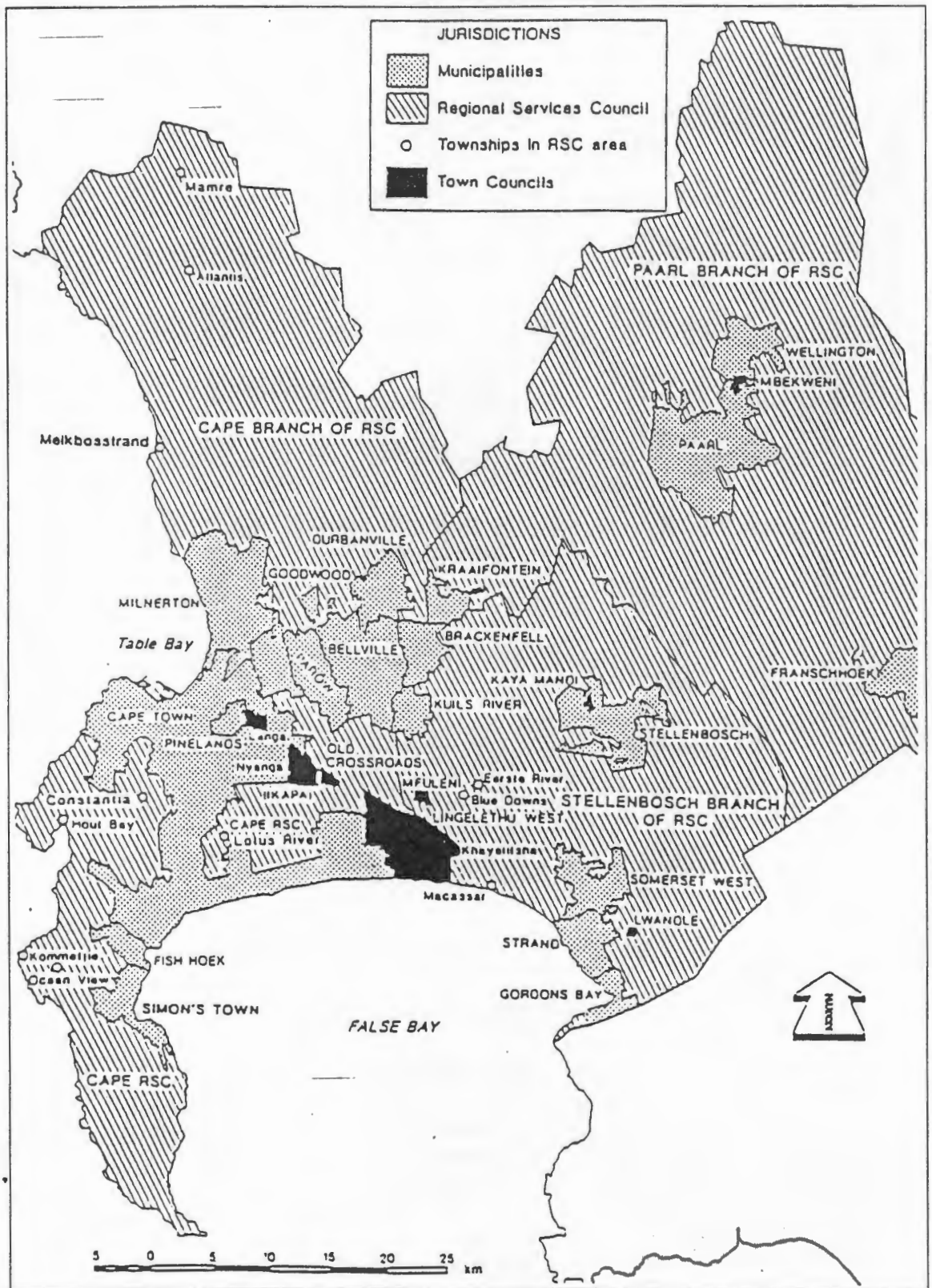


FIGURE 2.3: Supply authorities

The Department is one of the largest distribution authorities in the country, with 2509 staff members servicing 247 674 consumers by the end of 1991/1992 (a staff to customer ratio of 1:99). Of these consumers, 92.8% were domestic, with an average consumption of 662 kWh per month (up from 643 kWh per month in 1990/1991). Of the total electrical energy sold, 46.4% was consumed by domestic users. The rate of new connections in 1991/92 was 4 859, which represents an

increase of about 2% per annum in the consumer base. The number of disconnections for late payments was 8 000 prior to October 1992, when it increased to 1 220 000.

Langa

In Langa there are currently approximately 2 570 electricity consumers – about 73% of the 3 500 formal houses in the area. Some houses are without electricity because they were disconnected after running up arrears. In other cases electricity is not available because the supply network has not been extended into the area. Electrified houses are fully wired and have credit meters. The infrastructure is old, unreliable and in some cases, appeared dangerous – all those interviewed in Langa suggested that the overhead wiring was unsafe. (One respondent requested the inspection of her mother's house, which had recently burned down as a result of a fire which started at the metering board.)

Guguletu

About 7 405 (89%) of the 8 300 formal houses in Guguletu are electrified. Levels of arrears on the payment of electricity accounts in Langa and Guguletu (discussed in Chapter 3) are high and growing. Disconnection policies have not been consistent. The installation of pre-payment meters, which would avoid the problem of increasing arrears, has not yet implemented. This is, however, being planned for Tambo Square (in Guguletu). A decision was made at the February 1993 Cape Town City Council meeting, that the way to proceed is to install pre-payment meters for those with excessive arrears.

2.3.2 Electricity provision in Khayelitsha

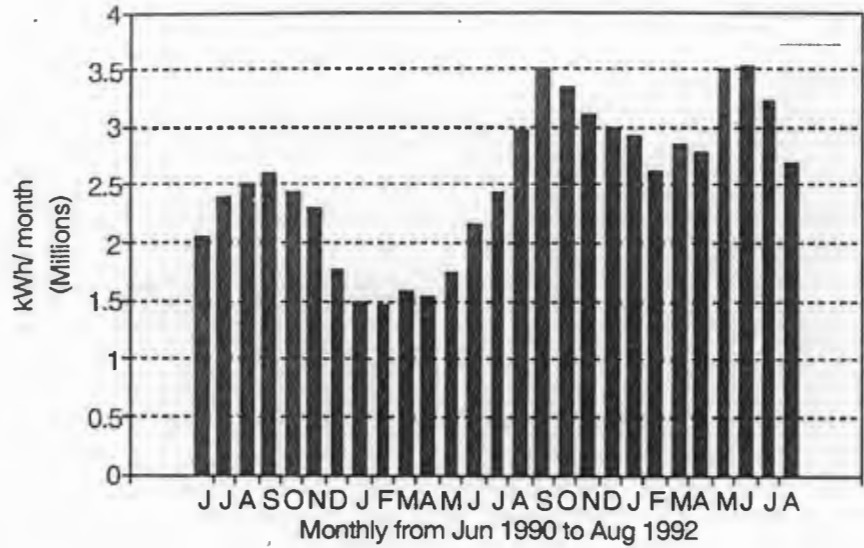
Electricity provision is managed in Khayelitsha by the Lingeletu West City Council (LWCC) Electricity Department under an agency agreement with the Cape Provincial Administration (CPA). The Development Coordination directorate of the CPA is responsible for the internal (medium- and low-voltage) network in all areas.

New connections are carried out by LWCC or their nominated subcontractors (eg, FROG and De Villiers and Moore). Capital is usually provided by the National Housing Commission for street lighting and some of the reticulation required for the lighting, and by the IDT for the service connection. The bulk electrical network built thus far in Khayelitsha has cost approximately R26.8 million (for high and medium voltage) and R2.2 million (for the low voltage systems for 1 100 houses) (personal communication with BKS). This amount is supposedly repayable by the Council.

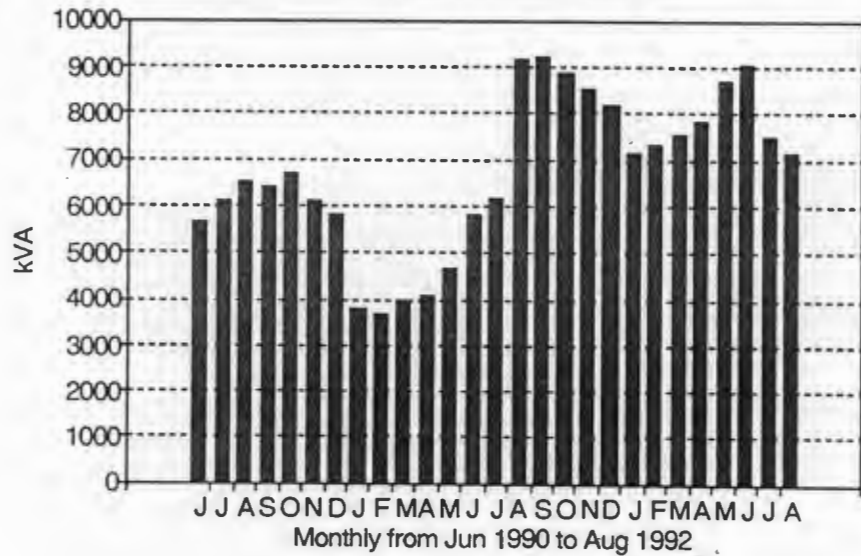
The LWCC is responsible for the ongoing maintenance and operation of the electrical networks. The LWCC Electrical Department was established in 1988, prior to which there was only street lighting in place. In 1989 electrification of houses began. The total staff complement of the Electricity Department at the end of 1992 was 36 (a staff to customer ratio of 1:150). The Department is understaffed and under-equipped, so that very little attention is given to planning and organisational development. The post of City Electrical Engineer, vacant for a number of years, was finally filled in April 1992.

The council buys all of its electricity from Eskom, which feeds the supply through two points. Trends in bulk supply are shown in Figure 2.4. In 1991/92, energy consumed was about 3 million kWh per month (about 0.9% of Cape Town's consumption), with a maximum demand of about 9 MVA (about 1.1% of Cape Town's); the load factor was between 0.42 and 0.6 and appeared to be increasing slowly.

Energy consumption



Maximum demand



Monthly Load Factors (calculated from Eskom's sales figures)

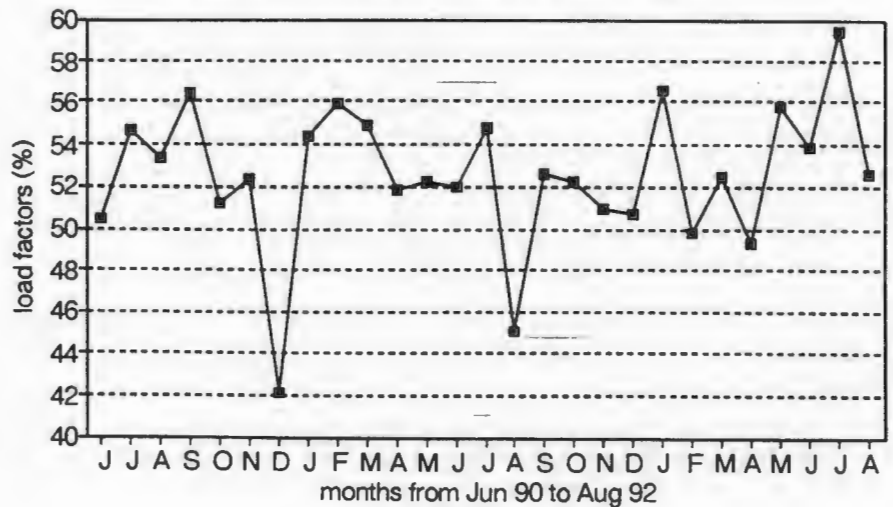


FIGURE 2.4: Bulk electricity supply to Khayelitsha

At the end of May 1992, there were about 5 414 domestic consumers, of whom about 422 have conventional credit meters. Twenty-six are non-domestic consumers – mostly schools, clinics and churches in the areas where domestic electricity is not supplied. The consumer base in the area is growing very rapidly in absolute terms but, with an estimated 60 000 connections to go, the level of domestic electrification is still very low.

Based on the assumption (from Chapter 4) that 3.8 people live in each electrified household, some 20 535 people live in electrified homes. Using a population estimate for the area of 400 000, this implies that about 5% have access to electricity.

Khayelitsha Town 1

Most houses in Town 1 were not electrified at the time of their construction in 1985. By June 1992, 811 of the 5 000 houses (about 16.2%) in the area had been electrified. By November 1992, 'oil fund' money channelled through the National Housing Fund paid for further reticulation. By November 1992, there were 120473 electrified households in Town 1 (about 29%). Houses are generally fully wired, and have 60 amp supplies with pre-payment meters.

An attempt was made to establish the Khayelitsha Electricity Supply Branch (KESB) to electrify the remaining 4 112 households in Towns 1 and 2. A project team made up of the LWCC, The South African National Civics Organisation (SANCO), the Development Bank of Southern Africa (DBSA), the community services branch of the Cape Provincial Administration (CPA), Eskom, and the Western Cape Regional Services Council (WCRSC), commissioned consultants to draw up a proposal that covered technical, institutional, socio-economic and financial aspects of the electrification process. The proposal was drafted by the consultants De Villiers and Moore, who suggested that this project would not be viable. The proposal was based on consumption reaching 350 kWh per month for the area and assuming that a loan of between R6million and R7million would be forthcoming from the DBSA via the WCRSC, which had agreed to guarantee the loan.

The failure of the KESB has left the way open for Eskom to gain access to Khayelitsha and the promised DBSA loan. Eskom has suggested that it would be in a position to electrify all of Khayelitsha in three years.

Khayelitsha Town 2 (Villages 1, 3 and 4a,b&c)

Houses in these areas were electrified at the time of construction. By November 1992, 1 025 of 3 477 households in Town 2 Village 1 used electricity, 2405 of the 4465 in Village 3, and all of the 219 in Village 4a. Household supplies are from 10 amps upwards. Individual homes were fully wired with points in each room and light fixtures in the ceilings, but only some have geysers and stove points. Most houses have pre-payment meters, but some of those in Village 1 have credit meters. All of the 94 formal households of Village 4b had access to electricity by November 1992; none of the 500 shacks in Village 4c nor the 3900 shacks in Village 2 did.

Originally, in 1989, Larry Barnett International (LBI) meters were installed. Repeated meter failures led to all these being replaced with Angcontech (now AEG) minicon pre-payment meters.

Jonkerdam, Bongweni and Tembani

Houses in these areas were also electrified at the time of their construction. Some 400 have credit meters; 483 have pre-payment meters (216 in Jonkersdam, 95 in Bongweni, and 172 in Tembani). All houses have geysers.

2.3 Conclusion

These descriptions of Langa, Guguletu and Khayelitsha provide the context for the chapters which follow. The emphasis of this project is on understanding electricity consumption in newly-electrified poor areas in the Western Cape. Attention is also given to the problems connected with electricity use in Langa and Guguletu.

Chapter Three

ELECTRICITY CONSUMPTION IN LOW-INCOME AREAS OF THE WESTERN CAPE

3.1 Introduction

In this chapter information is provided on monthly electricity-consumption levels in households in the areas surveyed. Seasonal variations and summer and winter means are shown for the different areas. Information from phases 1 and 2 of the study are given for purposes of comparison.

Information is presented on consumption by *all* pre-payment and credit-meter domestic consumers in Khayelitsha. Next, consumption levels of households actually surveyed (the sample) are compared with domestic consumption levels from all consumers in each area. The same methodology is employed for Langa and Guguletu. Information was obtained from records of the Cape Town City Council (CTCC) (for Langa and Guguletu), and from the Lingeletu West City Council (LWCC) (for Khayelitsha).

3.2 Khayelitsha

Information on electricity consumption in Khayelitsha is readily available and the most recent backups of the pre-payment card sales database was obtained. These records were complete up to June 1992 for pre-payment meters. At LWCC monthly sales of cards are recorded and computed automatically by the operating system. The records of the credit-meter transactions for Jonkersdam, Bongweni, Town 2 Village 1 and Tembani, for the period from January to September 1992, were also obtained. Information on electricity consumption levels in each of the areas in which households were surveyed is provided below. *This information is for all those using pre-payment and conventional credit meters.* The following information is provided for each area:

- Monthly means for the period between November 1990 and June 1992 are shown. The number of consumers in all of these areas was rising over the study period. The mean in each month is therefore the average monthly consumption of only those connected prior to the month for which the mean is calculated. The scale of all the graphs is kept uniform, for easy comparison.
- The frequency distribution, mean and median of monthly household consumption is presented for the summer months (November and December 1991, and January 1992). The average consumption of each consumer over the three months (or as many of the three for which data was available) were used to calculate these frequency distributions. These frequencies are compared to those generated in phase 1 (the average over November and December 1990 and January 1991). The scale in the graphs presenting the frequencies is maintained throughout.
- The frequency distribution, mean and median of monthly household consumption in winter (the average of April, May, and June 1992, or as many of these months for which data is available). This is compared with those generated in phase 1 (the average of May, June and July 1991). The number of consumers in each sample in winter is higher than that in summer. This reflects the increase in the number of consumers over time. Only consumers who were

connected a month prior to the winter or summer months were included in this exercise. Once again, the scale for these graphs is kept uniform for purposes of comparison.

- In order to present comparable annual means, these are calculated over the most recent 12-month period (or 6-month period, should 12 months of data not be available) for which electricity consumption data is available. For example, in phase 2 the annual average is calculated over the period from July 1991 to June 1992.

3.2.1 Town 1

Figure 3.1 provides information on monthly consumption levels in Town 1. The seasonal effect on consumption is large but decreasing in its influence. For the two phases, the summer means were 147 and 212 kWh/month (an increase of 65 kWh/month). The winter means were 222 and 260 kWh/month (an increase of 38 kWh/month). The differences between the winter and summer means for phases 1 and 2 were 75 and 48 kWh/month respectively. In November 1990 there were approximately 512 consumers; by August 1991 there were approximately 661; and by June 1992 the number had increased to 811. This is a 58% increase from November 1990 to June 1992. Based on the summer and winter means, consumption levels in Town 1 are close to the average for all Khayelitsha. The annual average for all Town 1 has increased from 194 to 229 kWh/month from phase 1 to phase 2.

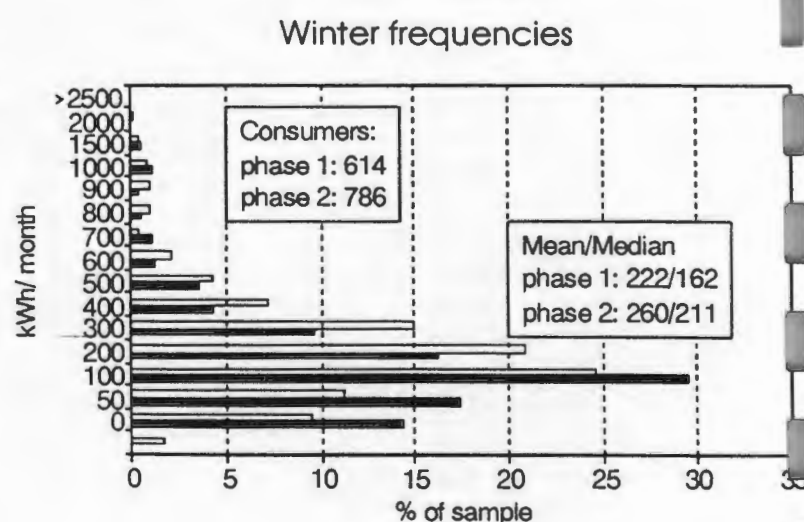
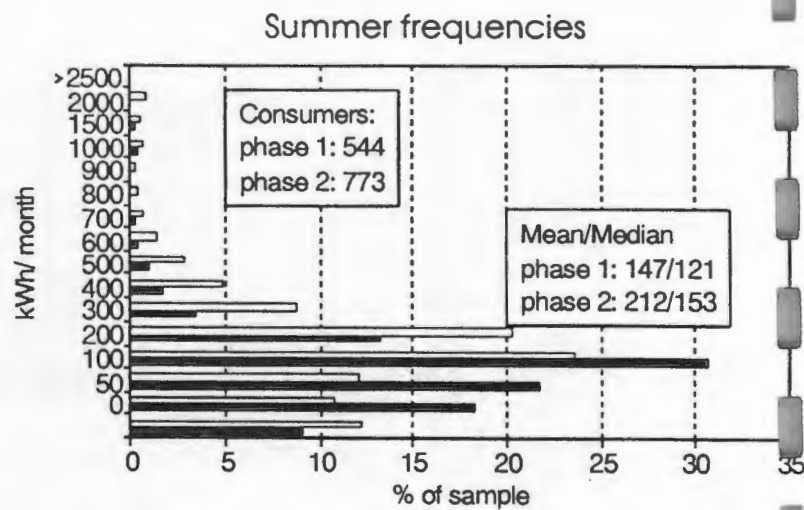
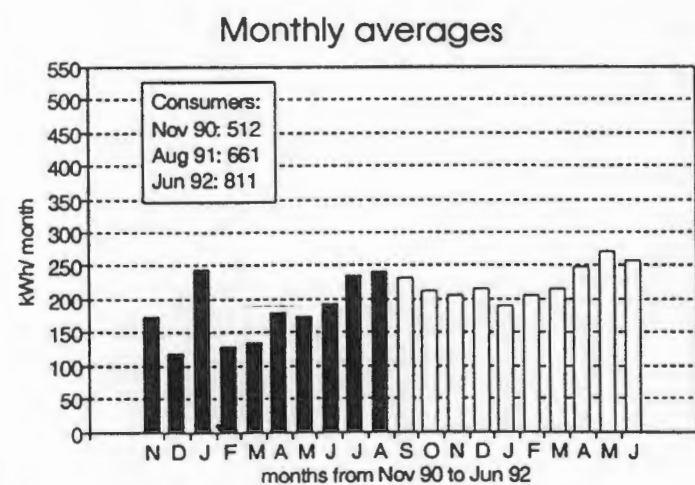


FIGURE 3.1: Town 1

3.2.2 Town 2 Village 1

Figure 3.2 reflects monthly consumption levels in Town 2 Village 1. The seasonal effect on consumption is pronounced. The summer means in the two phases were 246 and 197 kWh/month (a decrease of 49 kWh/month). The winter means were 351 and 271 kWh/month (a decrease of 80 kWh/month). The differences between the winter and summer means for phase 1 and 2 were 105 and 74 kWh/month respectively.

In December 1990 there were approximately 341 consumers; by August 1991 there were approximately 785, which rose to 1 025 by the end of June 1992 – representing an increase of 200% between December 1990 and June 1992. This large growth in new consumers in the area could account for the observed decrease in the monthly averages.

Based on the summer and winter means, consumption levels in Town 2 Village 1 are close to the average for the whole of Khayelitsha. The annual average for Town 2 Village 1 has increased slightly from 248 to 252 kWh/month despite the large increase in the number of new consumers.

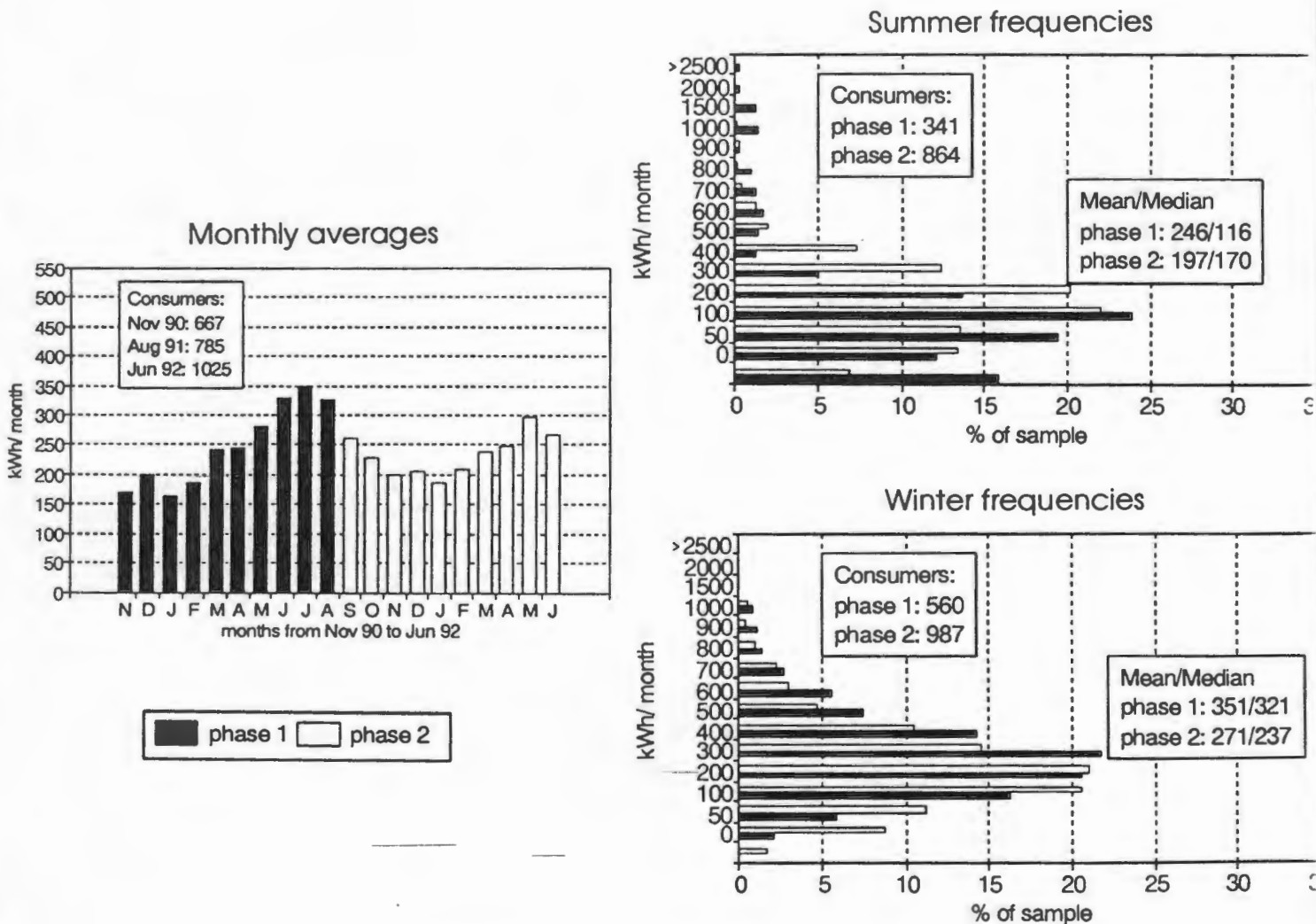


FIGURE 3.2: Town 2 Village 1

3.2.3 Town 2 Village 3

Figure 3.2 provides information on monthly consumption levels in Town 2 Village 3. The seasonal effect on consumption is noticeable but not very significant. The summer means were 124 and 162 kWh/month (an increase of 3820kWh/month). The winter means were 194 and 212 kWh/month (an increase of 18 kWh/month). The difference between the winter and summer means for the two phases were 70 and 50 kWh/month respectively.

Like Town 2 Village 1, Town 2 Village 3 has seen a large increase in the number of consumers over the last eighteen months. In December 1990 there were approximately 749 consumers; by August 1991 there were approximately 1533; by June 1992 the number had reached 2340. This is an increase of 212% since the end of 1990. Based on the summer and winter means, consumption levels in Town 2 Village 3 are the lowest in Khayelitsha. Annual averages for Town 2 Village 3 have increased from 157 to 185 kWh/month despite the large increase in new consumers.

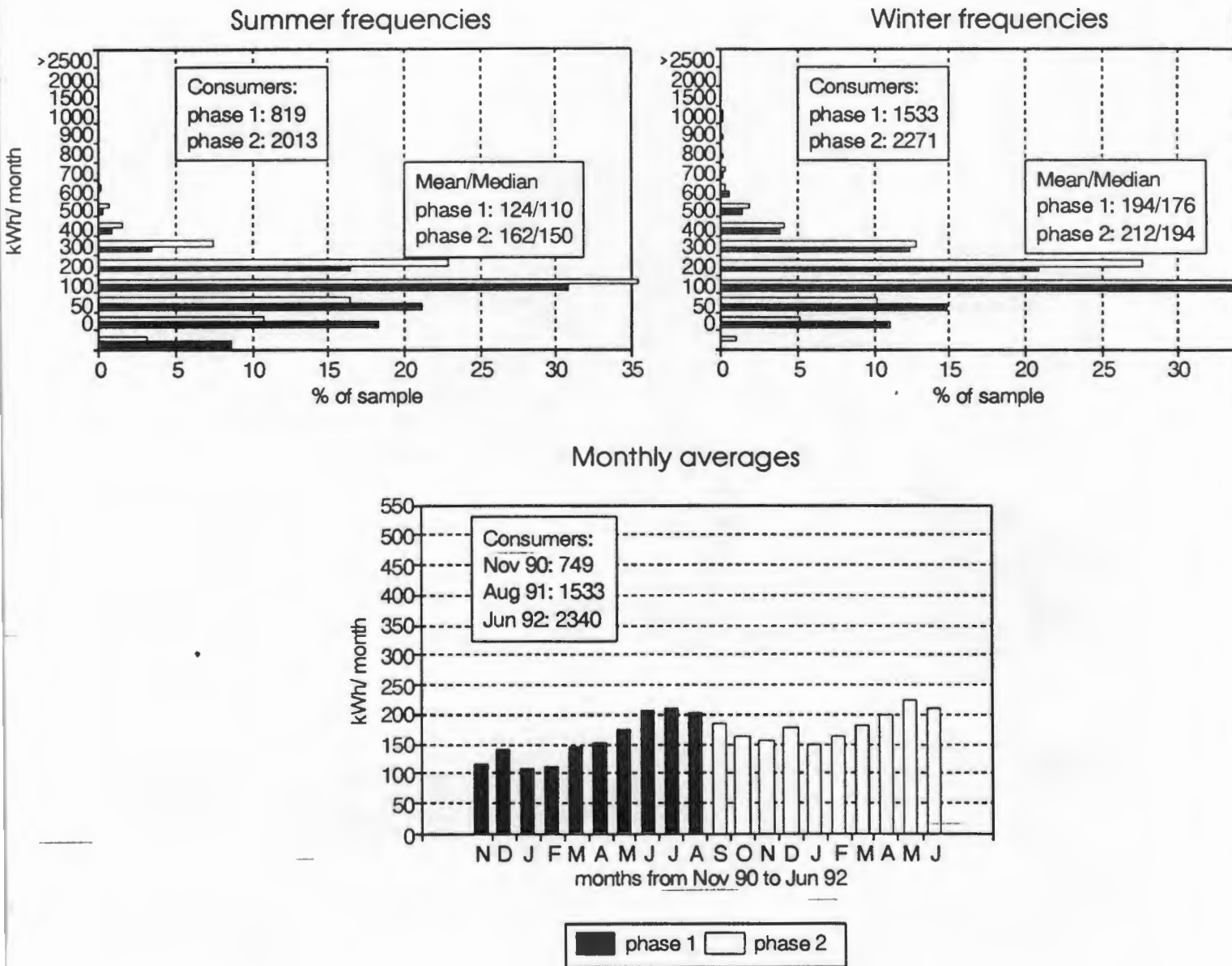


FIGURE 3.3: Town 2 Village 3

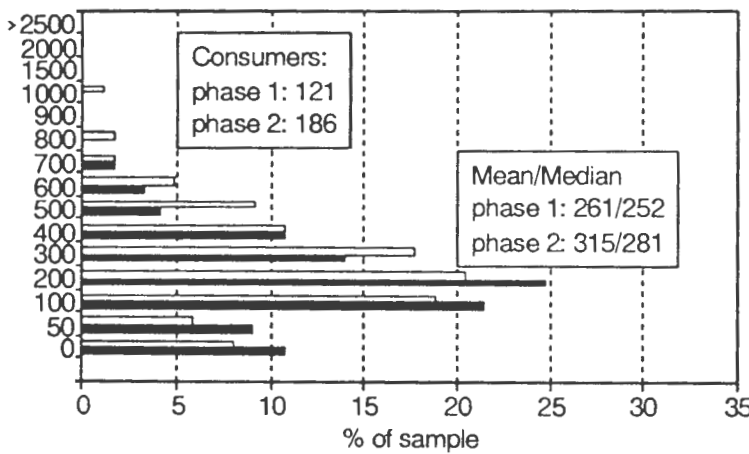
3.2.4 Town 2 Village 4a

Figure 3.4 provides information on monthly consumption levels in Town 2 Village 4a. Town 2 Village 4a is a wealthier area of Khayelitsha, so that households in this area have more appliances. The seasonal effect on consumption is marked, but decreasing. The summer means were 261 and 315 kWh/month (an increase of 54 kWh/month). The winter means were 399 and 387 kWh/month (a decrease of 12 kWh/month). The difference between the winter and summer means for the two phases were 138 and 62 kWh/month.

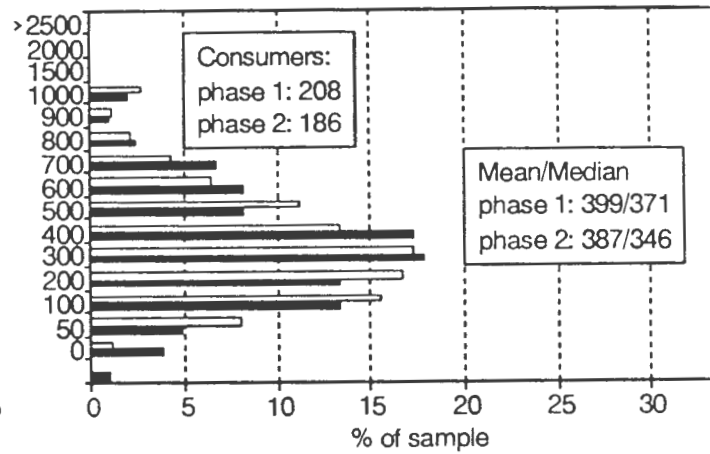
In November 1990 there were approximately 121 consumers; by August 1991 there were approximately 215, and by June 1992 the number had reached 216 (an increase of 79% between November 1990 and June 1992).

Based on the summer and winter means, consumption levels in Town 2 Village 4a are the third highest in Khayelitsha (behind Bongweni and consumers with credit meters). The annual average for this area has increased from 280 to 304 kWh/month.

Summer frequencies



Winter frequencies



Monthly averages

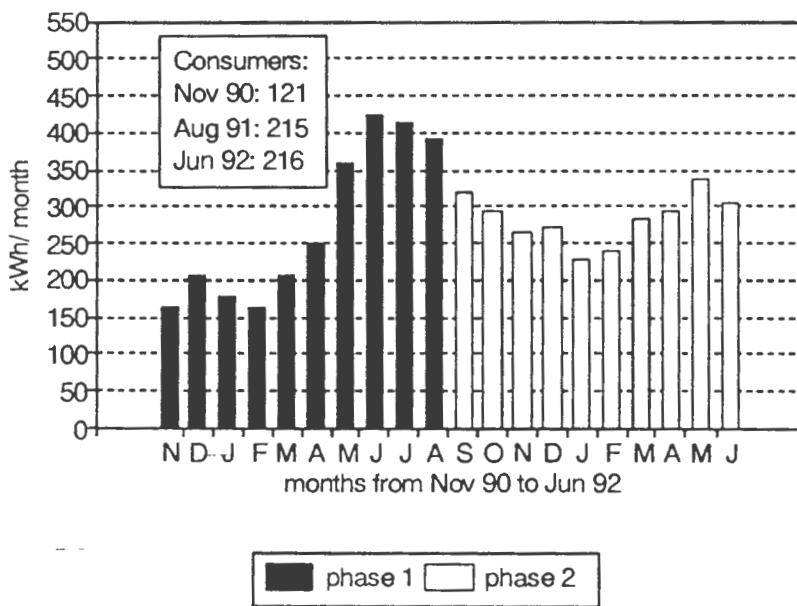


FIGURE 3.4: Town 2 Village 4a

3.2.5 Jonkersdam

Figure 3.5 provides information on monthly consumption levels in Jonkersdam. The summer means were 196 and 205 kWh/month (an increase of 920kWh/month). The winter means were 279 and 276 kWh/month (a decrease of 3 kWh/month). The differences between the winter and summer means for the two phases were 83 and 71 kWh/month, respectively.

The number of consumers in Jonkersdam has increased rapidly from a low base. In November 1990 there were approximately 52 pre-payment meter consumers; by August 1991 there were 118, by June 1992 the number had reached 216. This is an increase of 315%. In Jonkersdam, Bongweni and Tembani many of the consumers with conventional credit meters who have defaulted on payments for electricity have had pre-payment meters installed. Therefore to read the large increase of pre-payment as an increase of new consumers may be misleading.

Based on the summer and winter means, consumption levels in Jonkersdam are mid-range for Khayelitsha. Jonkersdam has seen an increase in the annual consumption amongst consumers there from 216 to 247 kWh/month.

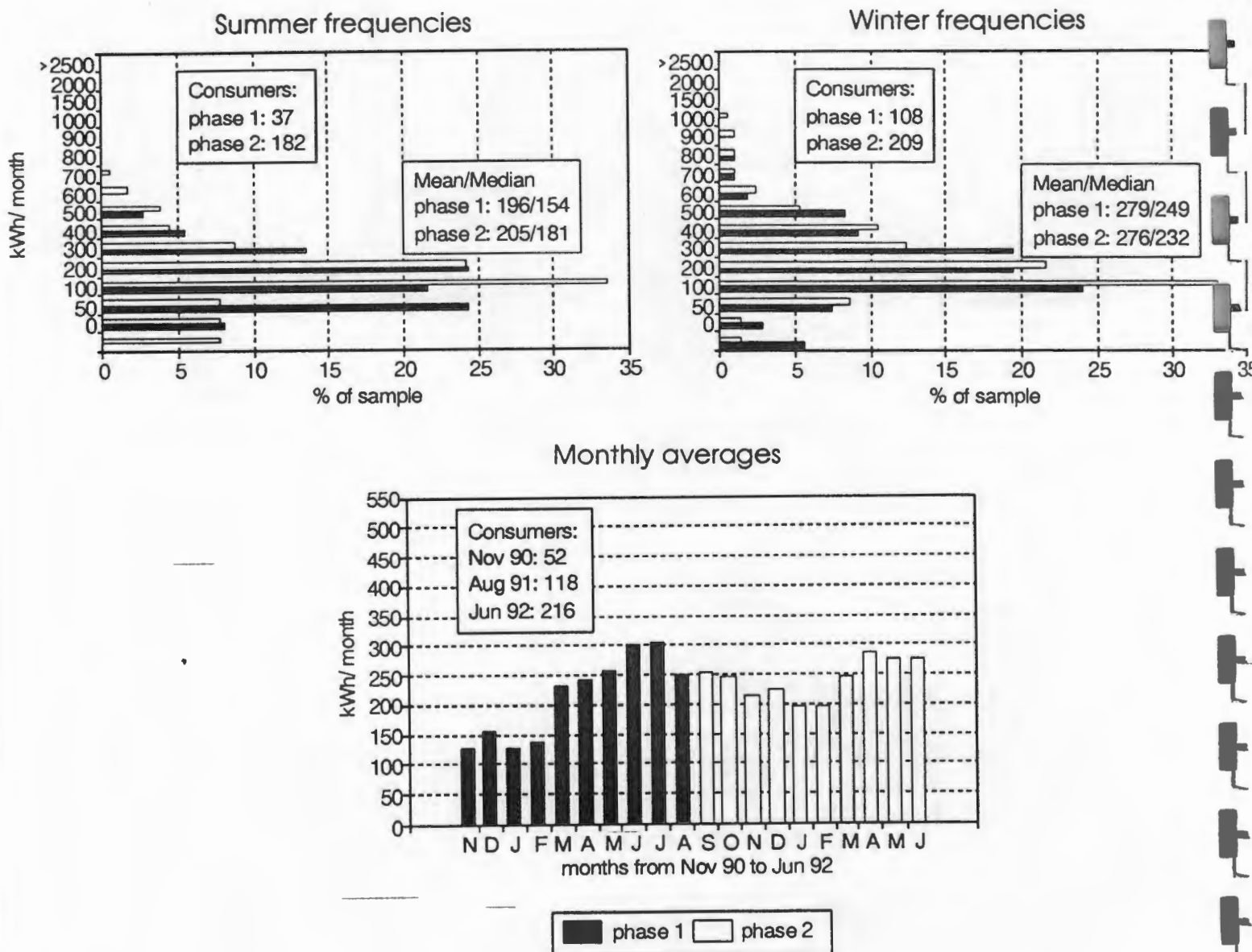


FIGURE 3.5: Jonkersdam

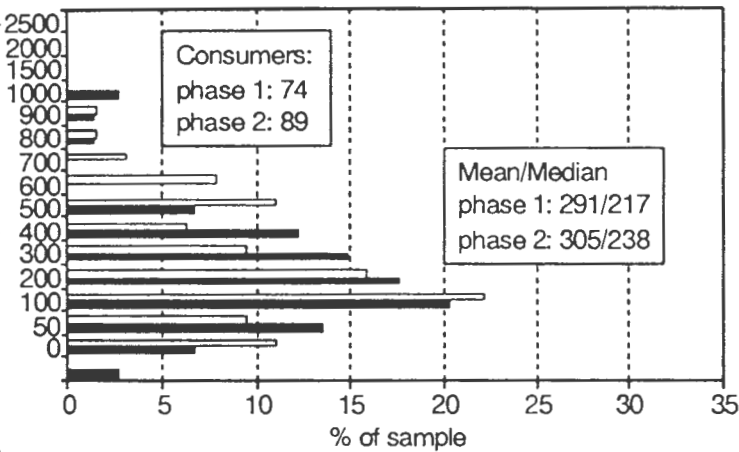
3.2.6 Bongweni

Figure 3.6 provides information on monthly consumption levels in Bongweni. Seasonal effects remain marked and increasing. The summer means were 291 and 306 kWh/month (an increase of 15 kWh/month). The winter means were 424 and 463 kWh/month (an increase of 39 kWh/month). The difference between the winter and summer means for the two phases were 133 and 157 kWh/month.

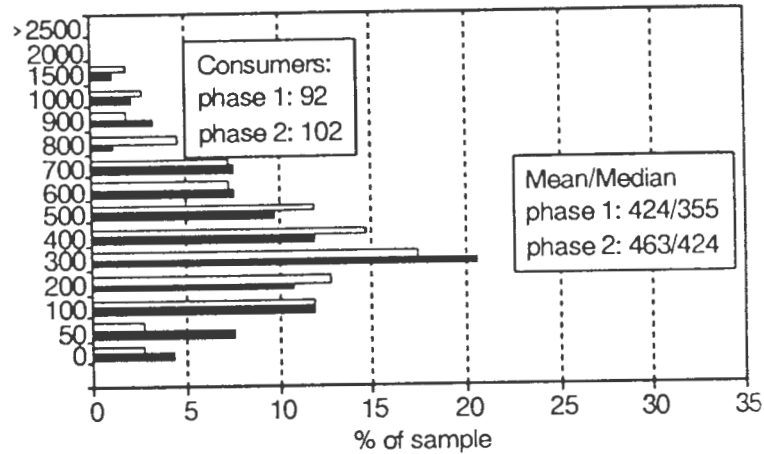
In December 1990 there were approximately 74 consumers; by June 1991 there were approximately 94, and by June 1992 there were 118, indicating an increase of 37% since December 1990. This increase may be as a result of consumers serviced with credit meters gaining access to pre-payment meters.

Bongweni has the highest levels of consumption after the credit-meter customers in Khayelitsha, and there has been an increase from 342 to 396 kWh/month in the annual average.

Summer frequencies



Winter frequencies



Monthly averages

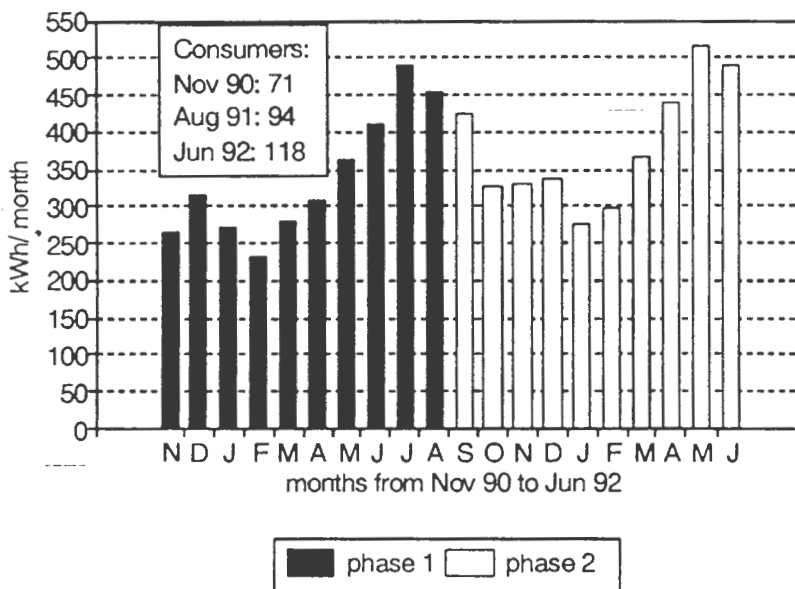


FIGURE 3.6: Bongweni

3.2.7 Other areas of Khayelitsha—

Figure 3.7 provides an indication of the consumption patterns of domestic consumers using pre-payment meters in areas not mentioned above. These areas include Tembani, Town 2, Village 4b and 4c. The figure presents information covering the period from September 1991 to June 1992. The summer and winter means were 350 and 467 kWh/month. The difference between the summer and winter means were 117 kWh/month. These figures are the second highest in Khayelitsha.

In this period there was an increase from 210 to 266 consumers. This is an increase of 27%. The annual average consumption for this area over the months for which data is available was 403 kWh/month.

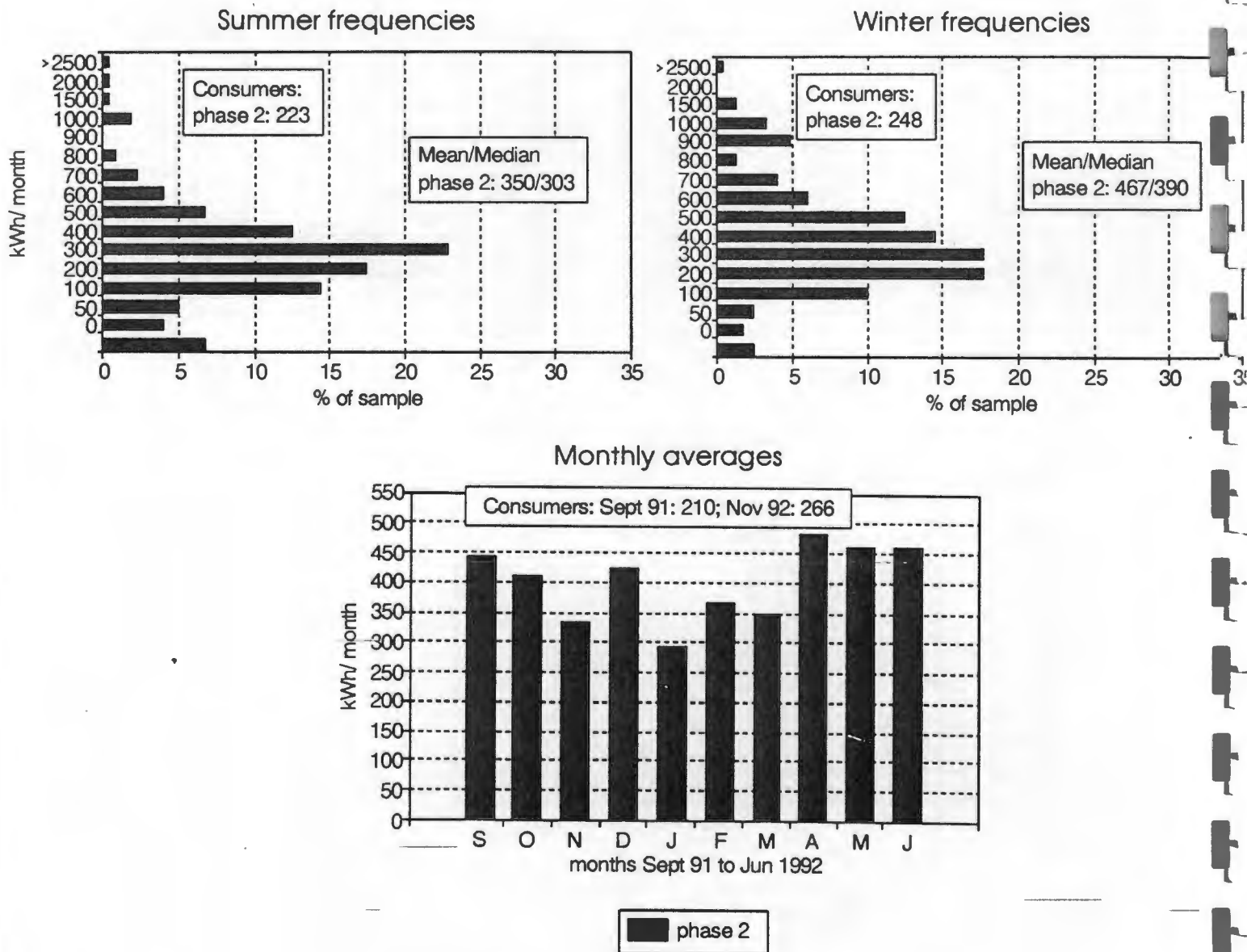


FIGURE 3.7: Other areas of Khayelitsha

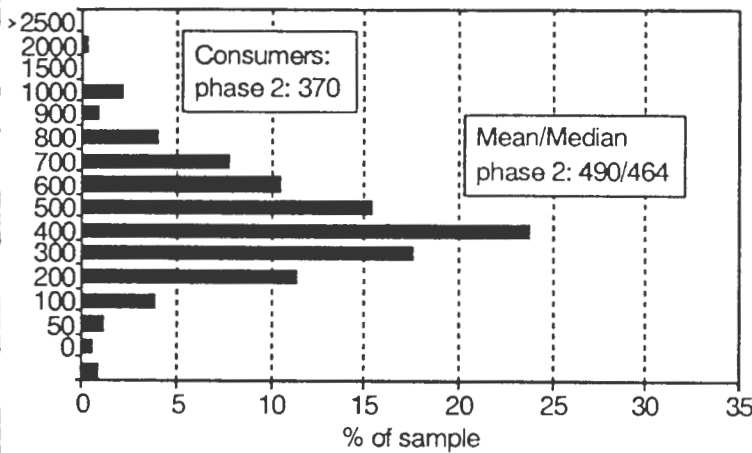
3.2.8 Consumers in Khayelitsha with credit meters

Figure 3.8 provides information on the consumption patterns of domestic electricity consumers with credit meters. In January 1992 there were 370 consumers; by October this figure had reached 422, despite LWCC's policy of replacing credit meters with pre-payment meters if consumers default on their payments. The figures displayed as monthly averages should be treated with caution, as meter-reading and billing is not regular, according to residents.

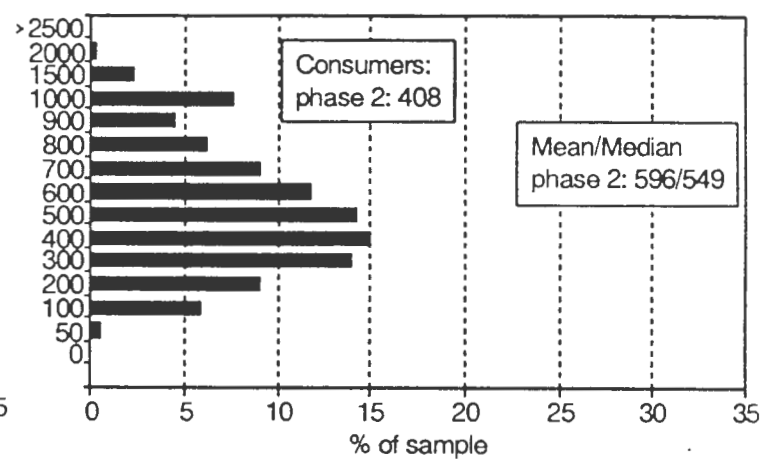
Domestic credit-meter consumers are scattered through Tembani, Jonkersdam, Bongweni, and Town 2 Village 1. There are 26 non-domestic consumers comprising churches, clinics, garages, shops, council properties, electricity substations, and street- and high-mast-lighting accounts. The latter non-domestic consumers are not included in the information presented.

The averages are presented for the period January to October 1992. Summer and winter averages were 490 and 596 kWh/month (a difference of 106 kWh/month). Based on the summer and winter means, consumption levels of those using credit meters are the highest in Khayelitsha. The annual average is 599 kWh/month for this group of consumers.

Summer frequencies



Winter frequencies



Monthly averages

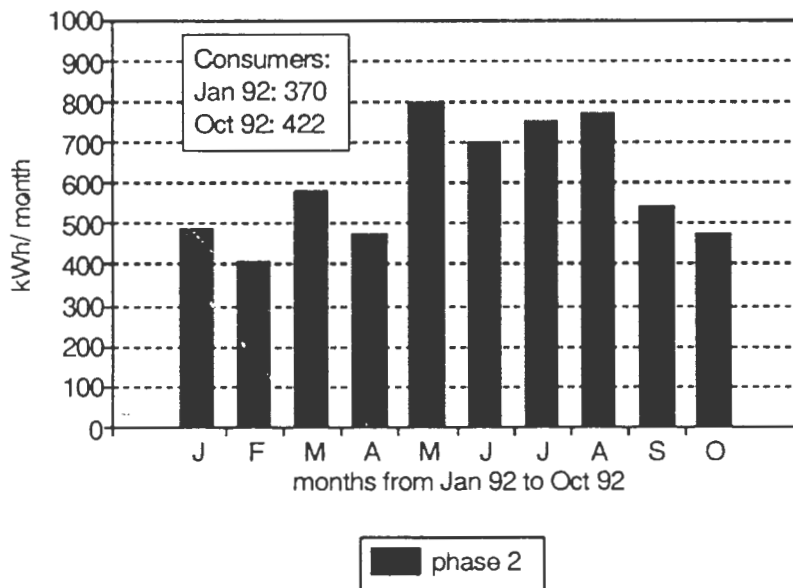


FIGURE 3.8: Credit-meter consumers

3.2.9 All areas in Khayelitsha

Figure 3.9 provides the averages and summer and winter frequency distributions for the entire database of domestic electricity consumers. This includes all those areas with pre-payment meters covered, as well as those with credit meters. This is referred to below as 'all consumers' or the 'larger group' in Khayelitsha. The number of consumers in this group stood at 1 865 in November 1990, 3 115 in August 1991, and 5 414 by June 1992. This is an increase of 190% since November 1990. In phase 1 the summer and winter means were 154 and 248 kWh/month respectively (a difference of 94 kWh/month). In phase 2 the summer and winter means were 210 and 290 kWh/month (a difference of 80 kWh/month). This indicates an increase of consumption between phases 1 and 2 of 56 and 42 kWh/month for the summer and winter means.

The *annual* mean for all domestic consumers in Khayelitsha for which data is available was 200 kWh/month in phase 1, and 244 kWh/month in phase 2. This indicates an increase in consumption of 44 kWh/month between the two phases.

It should be noted that the credit-meter averages are included only from January 1992 onwards. Tembani, Town 2 Villages 4b and 4c are included from the beginning of September 1991 onwards.

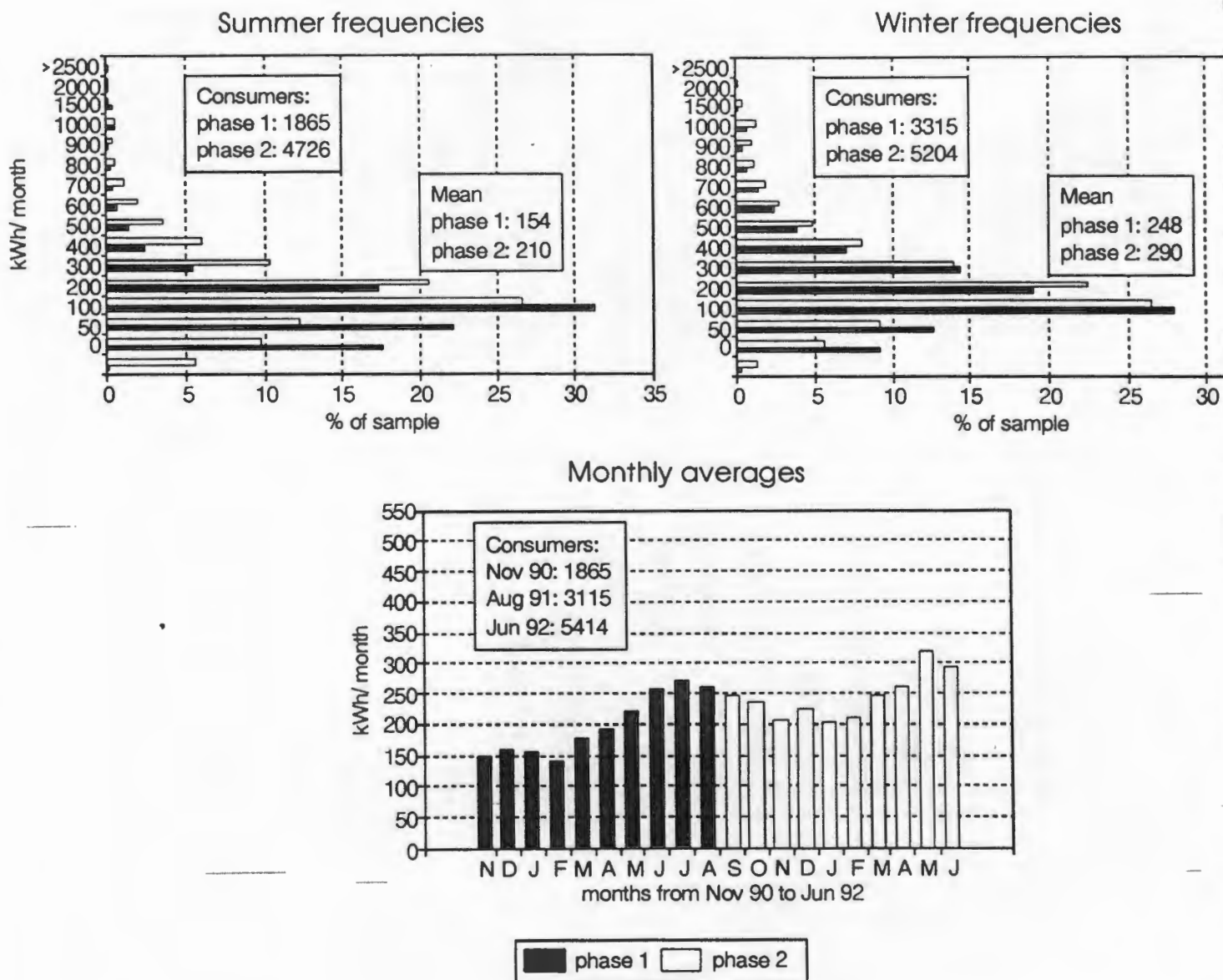


FIGURE 3.9: All Khayelitsha

3.3 Langa and Guguletu

Gathering information on electricity use in Langa and Guguletu was a costly and time-consuming exercise. The CTCC offered to provide discrete consumption data for all its customers in the areas of Langa and Guguletu, at a cost of R1700. The data gave the consumption between the monthly readings (most of which occur on or about the 24th of each month). Also provided was an indication of whether the customers were paying for electricity and the size of their arrears. No information that could identify the consumers and thus breach 'consumer confidentiality' was provided.

Arrears on electricity payments in these areas is very high. In June 1991, 6 450 consumers were in arrears and owed the Cape Town City Council R8.688 million (an average of R1 350 each). By October 1992, 6 905 (70% of all consumers in the areas) owed R11.68 million (Cape Town City Council, Council proceedings, 29 October 1992) – an average of R1 692 for each connection. This indicates that in one year electricity arrears have risen by 34%; the number of consumers defaulting on their payments has increased by 7%.

Figure 3.10 compares the number of consumers who fall into the three consumer categories for Langa and for Guguletu: those who have made no payments, those who have made payments but whose arrears are still growing, and those who are making payments that keep up with their electricity consumption or reduce their arrears. This figure shows that the numbers of consumers in each of the categories in Langa and Guguletu are similar. Both areas have about 70% of the consumers with increasing arrears despite having made some payments over the 12-month period for which data was available. In both areas, nearly 15% of the consumers fall into the other two categories – that is, those who have not made any payments, and those who are making payments that keep up with their electricity consumption or are reducing their arrears.

City Treasures

Consumer categories
Langa

Consumer categories
Gugulethu

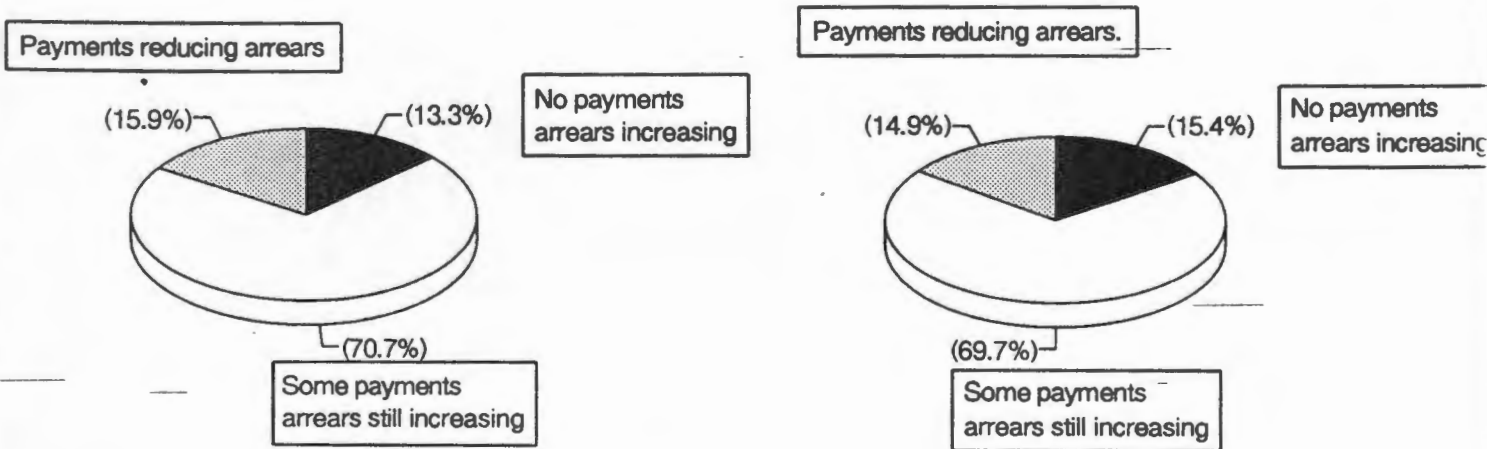


FIGURE 3.10: Consumer groups in Langa and Guguletu

3.3.1 Langa

Figure 3.11 presents the monthly averages for all electricity consumers in Langa for the period from October 1991 to September 1992.

The 2 570 consumers recorded at the beginning and the end of this period were, on average, R1 084 in arrears. It appears that few new connections are being made and any variations in the number of consumers are due to disconnections and reconnections resulting from arrears or tampering with the connection. The summer and winter means were 411 and 508 kWh/month (a difference of 97 kWh/month), compared to Khayelitsha, where the summer and winter means are 210 and 290 kWh/month. The *annual* mean for all consumers in Langa for the 12 months from December 1991 to December 1992 was 497 kWh/month. A record of this data was not available during phase 1.

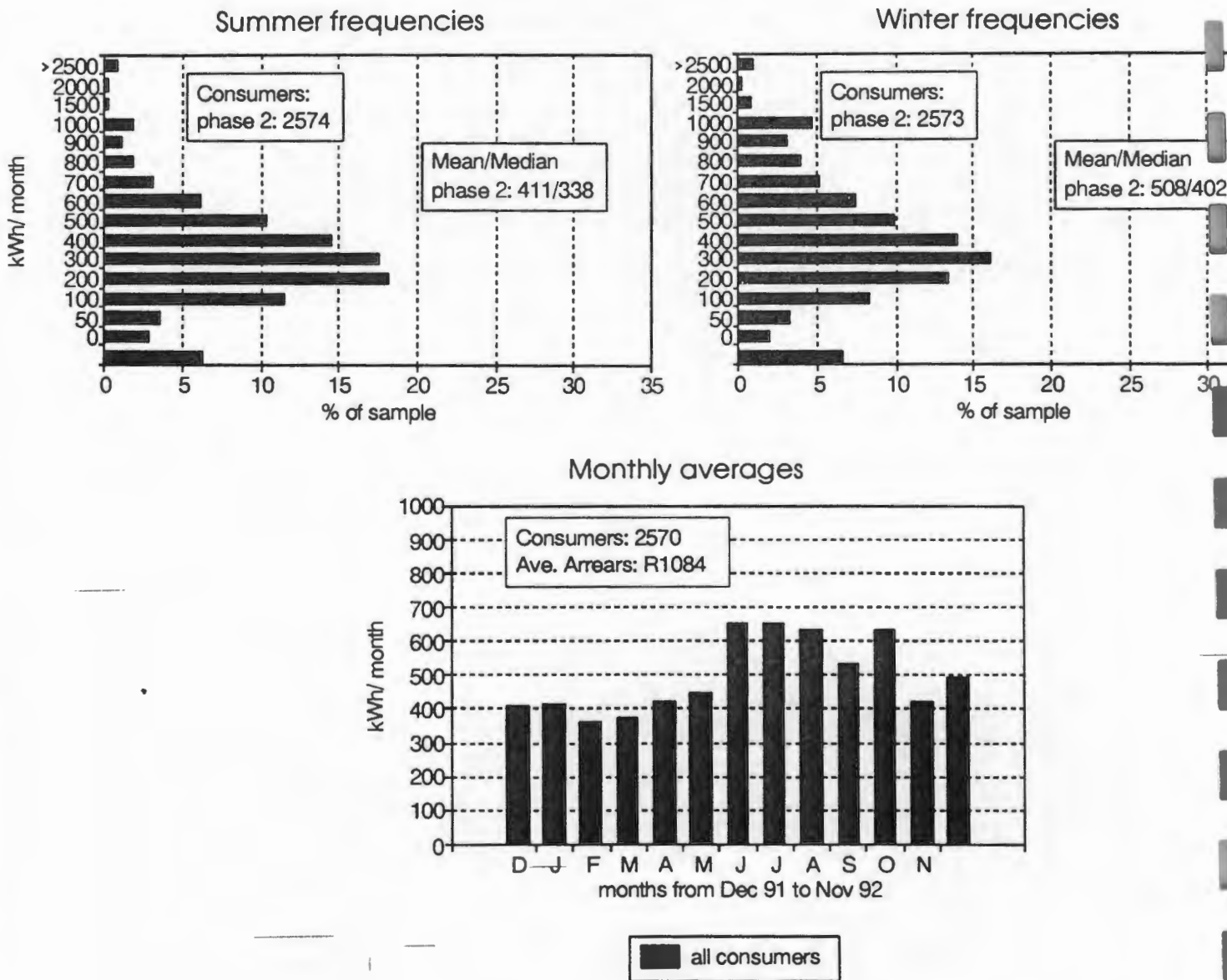
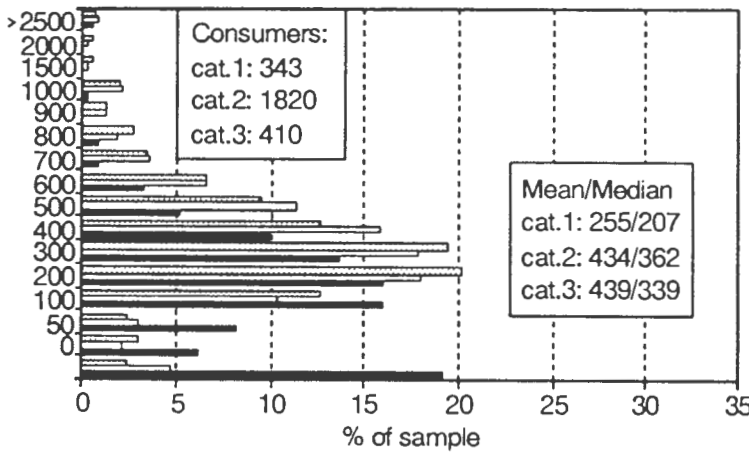


FIGURE 3.11: All consumers in Langa

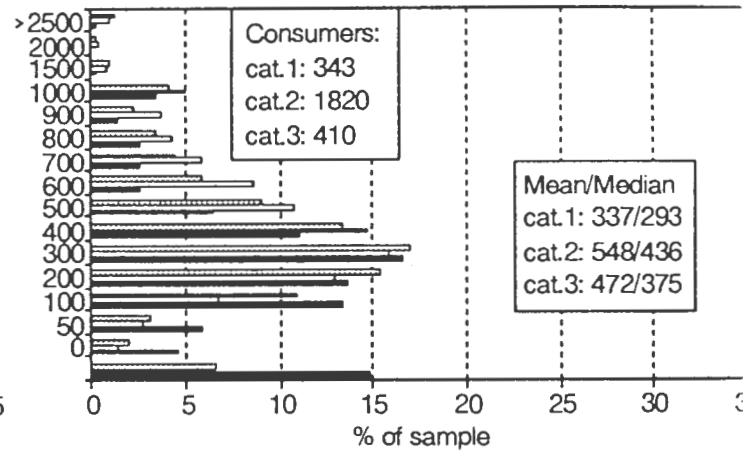
Figure 3.12 presents a comparison of the three consumer categories. The averages show that the 343 who are not paying have the lowest consumption levels, with summer and winter means of 255 and 337 kWh/month. These consumers have the highest arrears at an average of R1 855. The low consumption levels of this group may be as a result of the policy that led to disconnections of 20% (in summer) and 15% (in winter) of consumers (see Figure 3.12: Winter and summer frequency distributions). Those using the most electricity are the 1 820 who are making payments for their electricity service but are not keeping up with the growth in their arrears, (which stand at an average of R1 028). Their summer and winter means are 434 and 548 kWh/month. The third category of consumers in Langa comprises either those with no arrears or those paying amounts that over the past year have resulted in a net decrease in their arrears. The 409 consumers in this group have the lowest average arrears of R571. Their summer and winter averages are 439 and 472 kWh/month.

The third category of consumers in Langa comprises either those with no arrears or those paying amounts that over the past year have resulted in a net decrease in their arrears. The 409 consumers in this group have the lowest average arrears of R571. Their summer and winter averages are 439 and 472 kWh/month.

Summer frequencies



Winter frequencies



Monthly averages

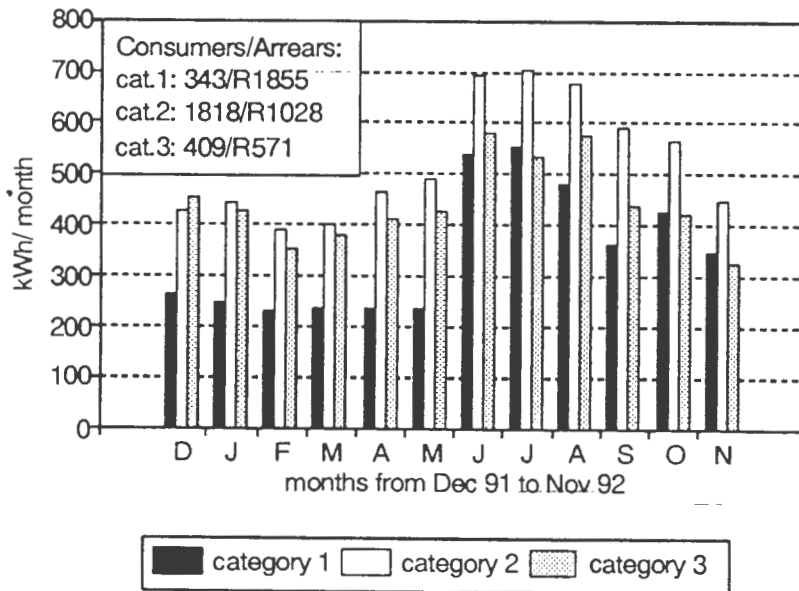


FIGURE 3.12: Three consumer categories in Langa

3.3.2 Guguletu

Figure 3.13 presents the monthly averages for all electricity consumers in Guguletu over the period from October 1991 to September 1992. This analysis is from the discrete data provided by the City Council. The number of billed consumers was 7 405 at the beginning of this period, and the average arrears as of November 1992 was R1 388. The summer and winter means were 453 and 538 kWh/month. This is a difference of 85 kWh/month, lower than would be expected for the seasonal difference at these levels of electricity consumption. The annual mean for electricity consumption was 523 kWh/month. This data was not available in phase 1.

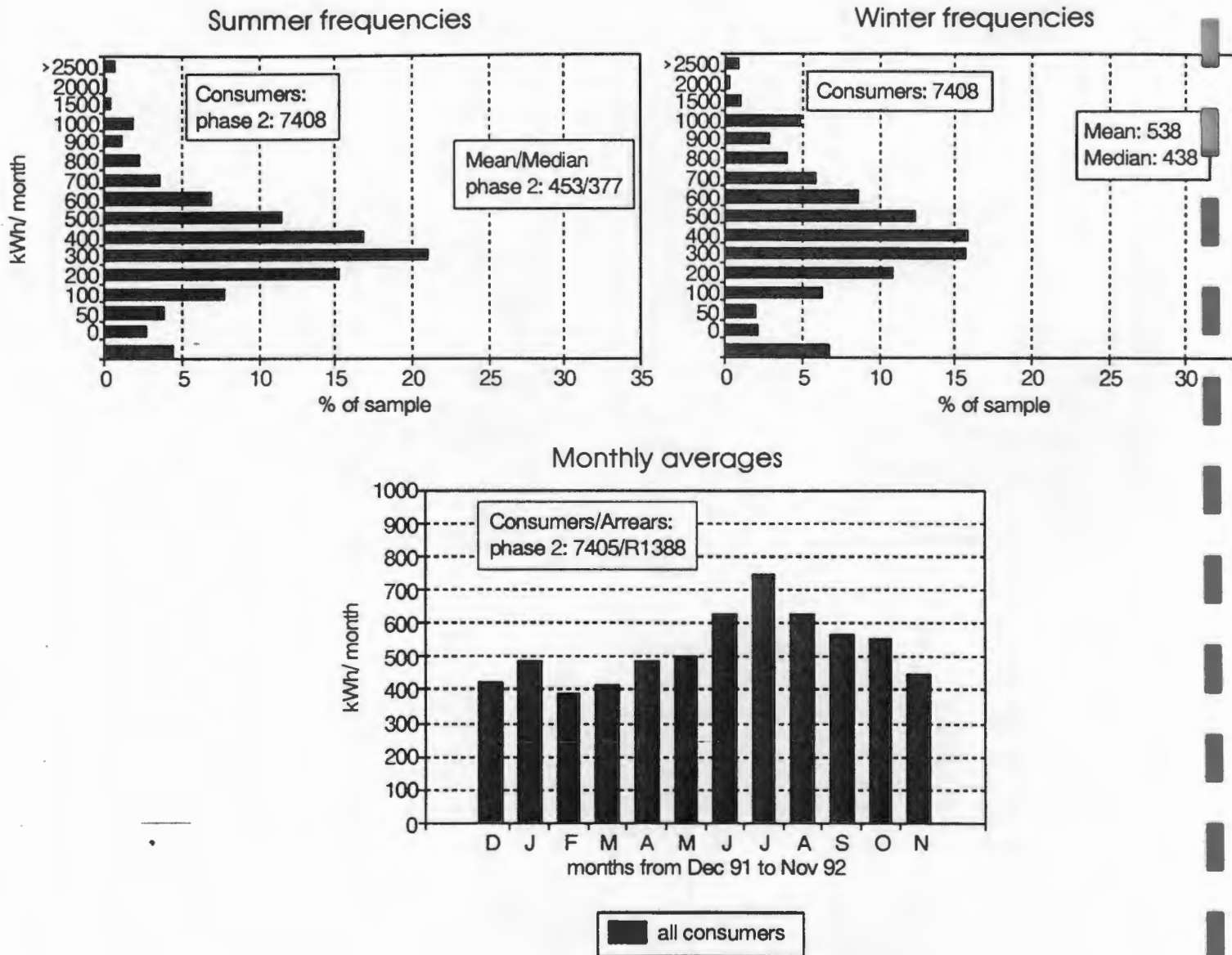


FIGURE 3.13: All consumers in Guguletu

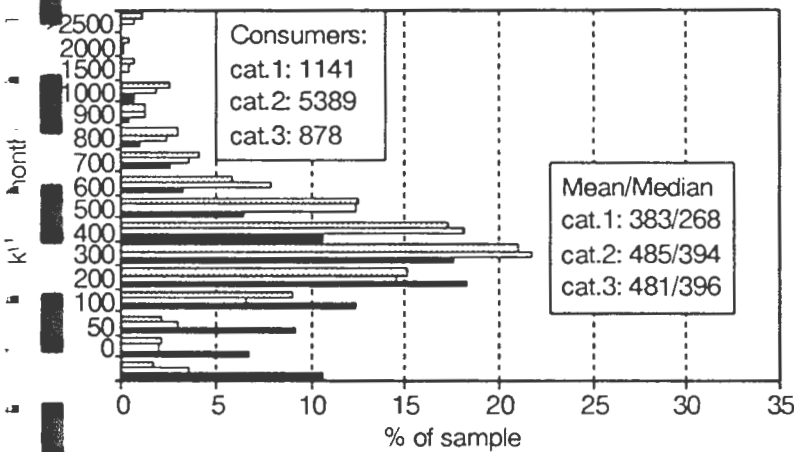
Figure 3.14 presents a comparison of the three consumer categories. The consumer categories in Guguletu follow the trends described for Langa.

The largest category comprises the 1 141 consumers who are paying but whose arrears are still increasing (and, by November 1992, had reached an average of R1541 per consumer). The summer and winter means for this group are 485 and 584 kWh/month, and the annual mean was 537 kWh/month.

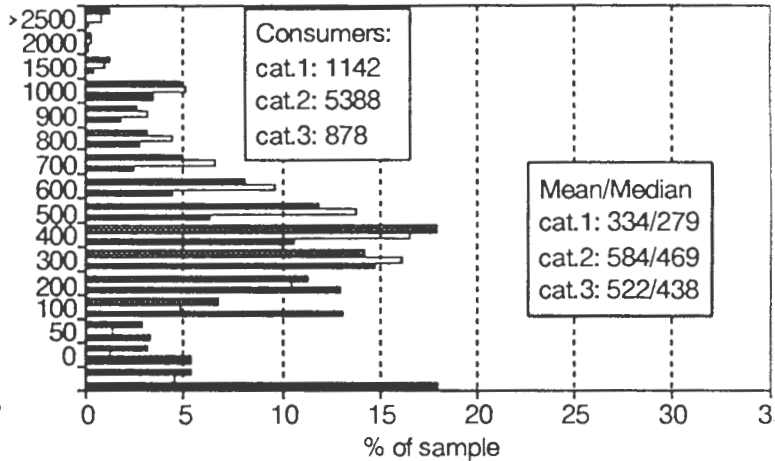
The category consuming the least comprises those who have not made payments in the last twelve months – there were 5 389 in this category. Their arrears are increasing, having reached R2 315 by November 1992. The average summer and winter means were 383 and 334 kWh/month. This reversal, with summer demand being higher than the winter, could be explained by the large number of disconnections in the winter months. In summer 10% of the consumers used no electricity; by winter this had reached 18%. The annual mean for the group was 381 kWh/month.

Those paying sufficient to keep up with their consumption or reducing their arrears were, on average, R515 in arrears. There were 878 consumers in this category. The summer and winter averages were 481 and 522 kWh/month; the annual mean for this group was 438 units per month.

Summer frequencies



Winter frequencies



Monthly averages

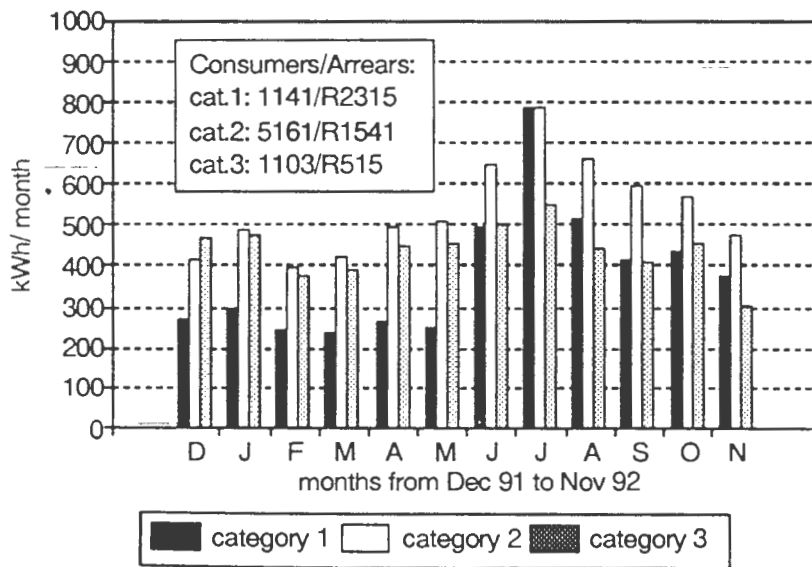


FIGURE 3.14: Three consumer categories in Guguletu

3.4 Electricity consumption in the survey sample

In phase 1, a sample of households was chosen from each of the areas noted above (with the exception of Tembani and Town 2 Villages 4b and 4c). The second criterion of selection was on the basis of information from electricity-consumption records. A stratified sample of high electricity consumers (those using more than 250 kWh/month), medium consumers (using between 250 and 150 kWh/month), and low consumers (using less than 150 kWh/month) was selected within each area.

In Jonkersdam and Bongweni, one-third of those selected had pre-payment meters. The remainder have credit meters. In Langa and Guguletu, households were chosen on the same basis – as high, medium and low consumers of electricity. Where respondents in the sample of phase 1 were not available to answer the questionnaire, replacements were found who fitted the criteria for selection of the original sample. The same method was used to expand the size of the sample.

The electricity consumption information of the households surveyed, as obtained from Electricity Department records, is shown in Table 3.1. In some cases, the number of months of consumption information is less than others; for example, only ten months of data was available for credit-meter users in Jonkersdam and Bongweni, with only six months overlapping with the pre-payment data.

3.4.1 The Khayelitsha sample

Figure 3.15 shows the seasonal variation in the average monthly consumption of households in the sample in Khayelitsha. For comparison the mean monthly averages for all consumers in Khayelitsha is shown. With the exception of the winter months of 1991, there is close correspondence between sample and the larger group. The reason for the large increase in electricity consumption for the sample over the winter of 1991 could be explained by the lack of data prior to the winter period for the group of consumers consuming above-average amounts of electricity, that is, Bongweni and Jonkersdam. However, this phenomenon could be related to the heating appliances owned by this group and discussed in Chapters 6 and 7.

The implication of this winter 1991 high level of electricity consumption is that the average consumption for sample in phase 1 is higher than that for phase 2, a trend opposite to that of all consumers in Khayelitsha.

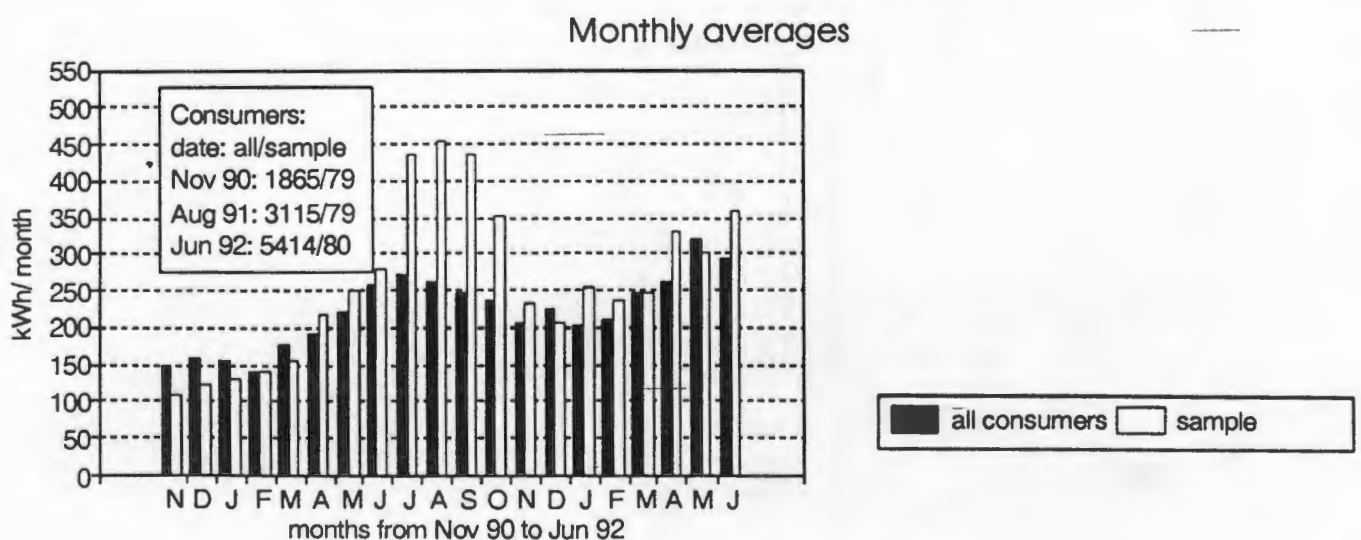


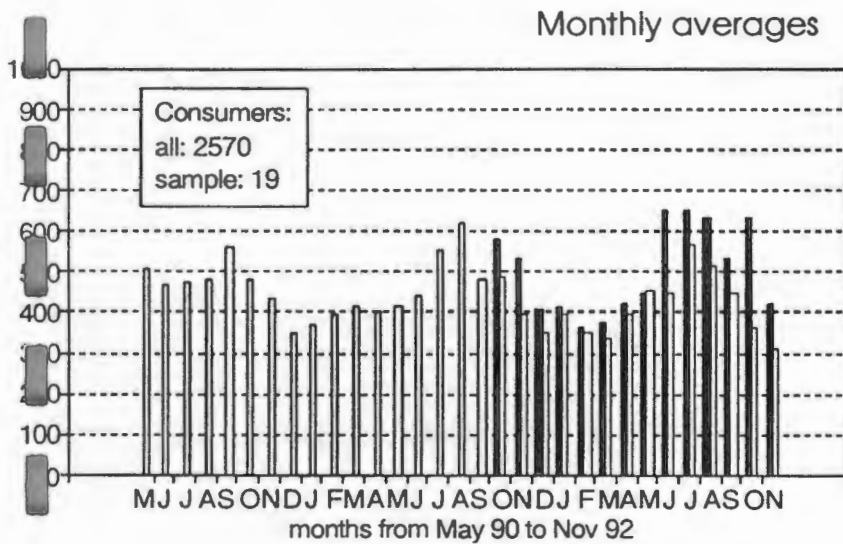
FIGURE 3.15: Sample Khayelitsha

3.4.2 The Langa and Guguletu survey samples

Figure 3.16 and 3.17 show seasonal variations in the average monthly consumption of households in the sample. In phase 1 the sample was not divided between the two areas. A winter mean of 644 kWh/month and summer mean of 585 kWh/month were calculated (a difference of 59 kWh/month). In phase 2 the sample size for the two areas was enlarged to 15 in Langa and 19 in Guguletu. Data presented is for the summer of 1991/92 and the winter of 1992.

Figure 3.16 compares the sample to all consumers in Langa. The summer and winter means for the sample were 381 and 427 kWh/month. This compared to 411 and 508 kWh/month for all consumers in the area. The sample means for summer and winter were 30 and 81 kWh/month less than those for all consumers in the area.

Figure 3.17 shows the monthly averages of the sample and of all consumers in Guguletu. The sample has summer and winter averages of 615 and 635 kWh/month, compared with 453 and 538 kWh/month for all consumers in the area. The sample means for summer and winter were 162 and 97 kWh/month higher than for the all consumers in Guguletu.



— Cost monthly averages for Guguletu and Langa and particular for some of hshlds.

FIGURE 3.16: The Langa sample

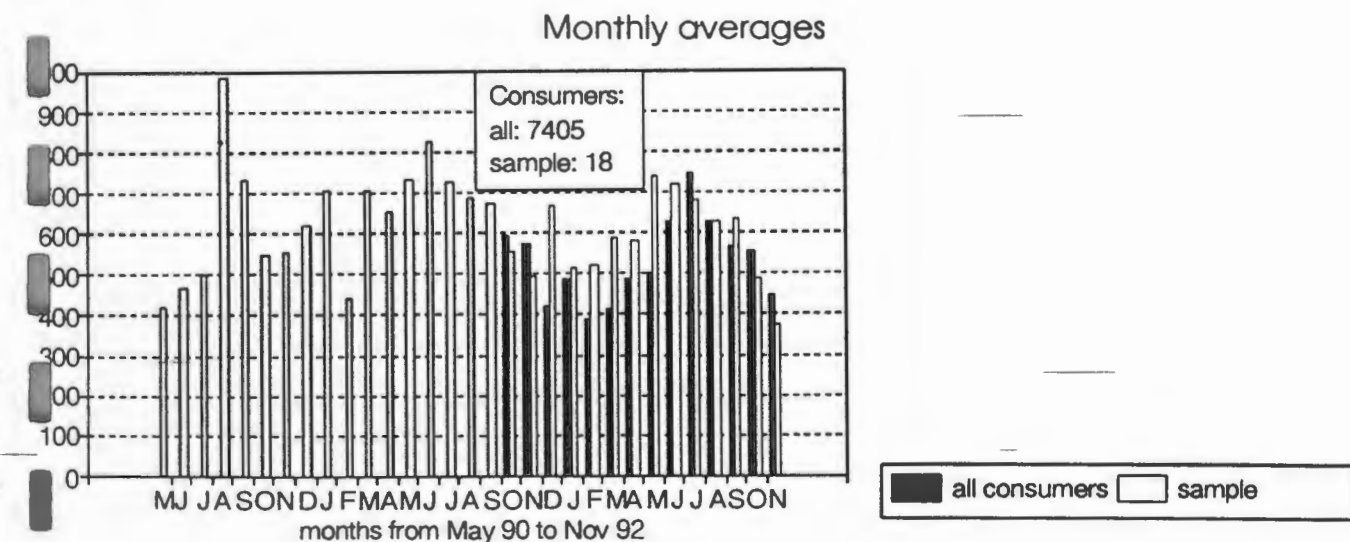


FIGURE 3.17: The Guguletu sample

3.5 Conclusions

The main points emerging from this chapter can be summarised as follows:

- The number of *all* domestic consumers in Khayelitsha has increased since December 1990 from 1 865 to 5 414 by the end of June 1992, or 190%.
- Summer and winter means of electricity consumption for *all* electricity consumers in Khayelitsha were 154 and 248 kWh/month in phase 1 and 210 and 290 kWh/month in phase 2.
- The annual mean for *all* electricity consumers in Khayelitsha has increased from 200 kWh/month in phase 1, to 244 kWh/month in phase 2, despite the increase in new consumers mentioned above.
- There are substantial variations in average consumption levels in different areas. For example, winter levels in Bongweni are up to 80% higher than average.
- The areas in Khayelitsha with the smallest increases, or even decreases, in electricity consumption, are those that have the largest increases in the number of new consumers. Generally, new consumers use less electricity. Town 2 Village 4a is an exception.
- In most areas the seasonal effects on electricity use are less than those recorded in phase 1 of the study.
- The average amount by which *all* electricity consumers in Langa and Guguletu are in arrears has increased from R1 123 to R1 692. In both areas 85% of the consumers are not keeping up with their electricity payments. The CTCC has no consistent policy to address this issue.
- There is not a significant difference in the amount of electricity being consumed by those paying and by those not paying for the electricity.
- The summer and winter means for *all* electricity consumers in Langa are 411 and 508 kWh/month. In Guguletu these figures are 453 and 538 kWh/month. The *annual* means are 497 and 523 kWh/month for Langa and Guguletu respectively.
- The annual mean electricity consumption for the Langa and Guguletu *sample* has decreased from 632 in phase 1 to 520 in phase 2.
- Average consumption levels of households in the survey *sample* for Langa and Guguletu respectively are 489 and 635 kWh/month (winter means) and 420 and 615 kWh/month (summer means).

All Electricity Consumers

areas	phase 1 kWh/month			phase 2 kWh/month		
	summer	winter	year	summer	winter	year
T1	147	222	194	212	260	229
T2V1	246	351	248	197	271	252
T2V3	124	194	157	162	212	185
T2V4A	261	399	280	315	387	304
Jonkersdam	196	279	216	205	276	247
Bongweni	291	424	342	305	463	396
other pre-payment credit meters	*	*	*	350	467	403
All Khayelitsha	154	248	200	210	290	244
Langa	*	*	*	411	508	497
Gugulethu	*	*	*	453	538	523

Sample

areas	phase 1 kWh/month			phase 2 kWh/month		
	summer	winter	year	summer	winter	year
T1	217	209	171	212	260	198
T2V1	233	299	198	197	271	277
T2V3	188	217	155	185	212	185
T2V4A	275	329	261	315	387	318
Jonkersdam	335	386	374	205	276	434
Bongweni	358	535	735	217	462	527
All Khayelitsha	175	441	344	258	315	313
Langa	585	644	632	381	427	520
Gugulethu	#	#	#	615	635	#

* indicates no data available

indicates that the figure for Langa is the average for both Langa and Gugulethu combined

TABLE 3.2: Summary of electricity consumption

Chapter Four

SOCIO-ECONOMIC INFORMATION

4.1 Introduction

This chapter provides socio-economic information collected in the areas surveyed, as background information for use in later chapters. The following aspects are examined:

- household sizes, and their composition;
- education levels;
- waged work;
- the time lived in the house (occupancy);
- income levels;
- expenditure levels.

Information is presented for different areas in Khayelitsha, and in Langa and Gugulethu, and will show comparisons between phases 1 and 2 of the project. Names and addresses of the households surveyed are shown in Table 4.1, as well as the names of the interviewers.

NO.	NAME	AREA	INTERVIEWER
1	Mthetho	Gugulethu	Lizo Ntloko
2	Elizabeth	Gugulethu	Nodumo Tom
3	M.Qobo	Gugulethu	Freeman Ntoyanto
4	A.Mbinda	Gugulethu	Nodumo Tom
5	Nthabiseng	Gugulethu	Nodumo Tom
6	S.Ntloko	Gugulethu	Nodumo Tom
7	Eunice	Gugulethu	Nodumo Tom
8	Mrs M. Makhuluma	Gugulethu	Nodumo Tom
9	G.Hlwayi	Gugulethu	Nodumo Tom
10	V.Lethabiko	Gugulethu	Freeman Ntoyanto
11	B.Mhlawuli	Langa	Christina Vuso
12	H.Mabe	Langa	Christina Vuso
13	P.Mathole	Langa	Christina Vuso
14	S.Xhamalashé	Langa	Christina Vuso
15	N.E.Kula	Langa	Christina Vuso
16	J.Sitsila	Langa	Christina Vuso
17	Ndobini	Langa	Christina Vuso
18	E.Mapete	Jonkersdam	Lizo Ntloko
19	Mndzula	Jonkersdam	Lizo Ntloko
20	P.Gcwele	Jonkersdam	Lizo Ntloko
21	F.Matshaya	Jonkersdam	Lizo Ntloko
22	N.Dubisiko	Jonkersdam	Lizo Ntloko
23	J.Wondo	Bongweni	Lizo Ntloko
24	D.Fink	Bongweni	Lizo Ntloko
25	N.Moni	Bongweni	Lizo Ntloko
26	Thabo	Bongweni	Lizo Ntloko

NO	NAME	AREA	INTERVIEWER
27	Letia	Bongweni	Lizo Ntloko
28	L.Noyi	Town 2 Village 3	Lizo Ntloko
29	S.Motsamai	Town 2 Village 3	Lizo Ntloko
30	K.Zenzile	Town 2 Village 3	Lizo Ntloko
31	Makhalima	Town 2 Village 3	Lizo Ntloko
32	Mrs Fan	Town 2 Village 3	Lizo Ntloko
33	Gladys Mangxola	Town 2 Village 3	Lizo Ntloko
34	Mrs Mhlana	Town 2 Village 3	Lizo Ntloko
35	Mrs Njelu	Town 2 Village 3	Lizo Ntloko
36	Mrs Mateta	Town 2 Village 3	Lizo Ntloko
37	Mrs Sigoba	Town 2 Village 3	Lizo Ntloko
38	Mrs Mbolekwa	Town 2 Village 3	Lizo Ntloko
39	Mrs Gqodi	Town 2 Village 3	Lizo Ntloko
40	Mrs Monki	Town 2 Village 3	Lizo Ntloko
41	Ms Nkala	Town 2 Village 3	Lizo Ntloko
42	N Magodlo	Langa	Lizo Ntloko
43	N Myeni	Langa	Christina Vuso
44	C.Tetyana	Langa	Christina Vuso
45	T.Ntenetya	Langa	Christina Vuso
46	M.Mbizela	Langa	Christina Vuso
47	Bongani	Gugulethu	Nodumo Tom
48	Nobathane	Gugulethu	Lizo Ntloko
49	T.Ndimande	Gugulethu	
50	B.Mngxunya	Gugulethu	Lizo Ntloko
51	B.Bam	Gugulethu	
52	Edwin	Langa	Christina Vuso
53	Sylvia Maya	Langa	Christina Vuso
54	Mrs Mbula	Town 2 Village 4a	Lizo Ntloko
55	Mrs Mashiya	Town 2 Village 4a	Lizo Ntloko
56	Mrs Mpekula	Town 2 Village 4a	Lizo Ntloko
57	Mrs Makinana	Town 2 Village 4a	Lizo Ntloko
58	Nonkosi	Town 2 Village 4a	Lizo Ntloko
59	A. Manaiwa	Town 2 Village 4a	Lizo Ntloko
60	Mrs Cwaba	Town 2 Village 4a	Lizo Ntloko
61	K. Ndude	Town 2 Village 4a	Lizo Ntloko
62	N.Mazwi	Town 2 Village 4a	Lizo Ntloko
63	Lucy Ntsendwana	Town 2 Village 4a	Lizo Ntloko
64	Mrs Sityoshwana	Town 2 Village 3	Lizo Ntloko
65	Mrs Wana	Town 1	Lizo Ntloko
66	R.Khau	Town 1	Lizo Ntloko
67	G.Mtyando	Town 1	Lizo Ntloko
68	N.Vuma	Town 1	Lizo Ntloko
69	Z.Nonde	Town 1	Lizo Ntloko
70	I.Gom	Town 1	Lizo Ntloko
71	Mr Qubile	Town 1	Lizo Ntloko
72	L. Mahlasela	Town 1	Lizo Ntloko
73	Mrs Mabele	Town 1	Lizo Ntloko
74	N.Mayembani	Town 2 Village 1	Lizo Ntloko
75	Xakuma	Town 2 Village 1	Lizo Ntloko
76	L.Sihawu	Town 2 Village 1	Lizo Ntloko

TABLE 4.1: Details of households surveyed

NO.	NAME	AREA	INTERVIEWER
77	V.Gae	Town 2 Village 1	Lizo Ntloko
78	J.Mbokotho	Town 2 Village 1	Lizo Ntloko
79	J.Dumse	Town 2 Village 1	Lizo Ntloko
80	M.Tabile	Town 2 Village 1	Lizo Ntloko
81	M.Sibeko	Town 2 Village 1	Lizo Ntloko
82	N.Ntloko	Town 2 Village 1	Lizo Ntloko
83	M.Peterson	Town 2 Village 1	Lizo Ntloko
84	Mrs N. Vena	Town 2 Village 1	Lizo Ntloko
85	Qhagana	Town 2 Village 1	Lizo Ntloko
86	N.Kwinana	Town 2 Village 1	Lizo Ntloko
87	M.Mbanga	Bongweni	Lizo Ntloko
88	C.Ndlanla	Bongweni	Lizo Ntloko
89	Qethuka	Bongweni	Lizo Ntloko
90	N.Mtsi	Bongweni	Lizo Ntloko
91	D.Zethu	Bongweni	Lizo Ntloko
92	Miss Toni	Bongweni	Lizo Ntloko
93	Mrs Mwanda	Bongweni	Lizo Ntloko
94	Bongi	Bongweni	Lizo Ntloko
95	Miss Vasi	Jonkersdam	Lizo Ntloko
96	Mrs Khwinana	Jonkersdam	Lizo Ntloko
97	Davide	Jonkersdam	Lizo Ntloko
98	K.Weldman	Jonkersdam	Lizo Ntloko
99	Nolitha	Jonkersdam	Lizo Ntloko
100	N.Mbenenge	Jonkersdam	Lizo Ntloko
101	Vuyiswa	Jonkersdam	Lizo Ntloko
102	Lily Madiba	Jonkersdam	Lizo Ntloko
103	M.Somphali	Jonkersdam	Lizo Ntloko
104	S. Venifolo	Town 1	Lizo Ntloko
105	Mrs Duna	Town 2 Village 1	Lizo Ntloko
106	Z. Bevu	Bongweni	Lizo Ntloko
107	S. Sibotho	Jonkersdam	Lizo Ntloko
108	A. Mashiya	Town 2 Village 1	Lizo Ntloko
109	X.Mvango	Bongweni	Lizo Ntloko
110	Mrs Mfiki	Gugulethu	Lizo Ntloko
111	Mrs Mjolly	Gugulethu	Lizo Ntloko
112	G.Ntwana	Gugulethu	Lizo Ntloko
113	Mrs Macwili	Gugulethu	Lizo Ntloko
114	Miss Lugalo	Gugulethu	Lizo Ntloko
115	Mrs L. Ngoma	Langa	Christina Vuso
116	Mrs L. Gabuza	Langa	Christina Vuso
117	Mrs S. Mqayi	Langa	Christina Vuso
118	Mildred Nojilana	Langa	Christina Vuso

TABLE 4.1: Details of households surveyed

4.2 Household size and composition

4.2.1 Average household size

The 'household' was defined in this survey as the group of people using the same source of electricity. People living in backyard shacks on the property were thus included if they used electricity supplied to the main house. Figure 4.1 shows the average household size in the areas surveyed, and the number of people living in backyard shacks who are *not* part of the household.

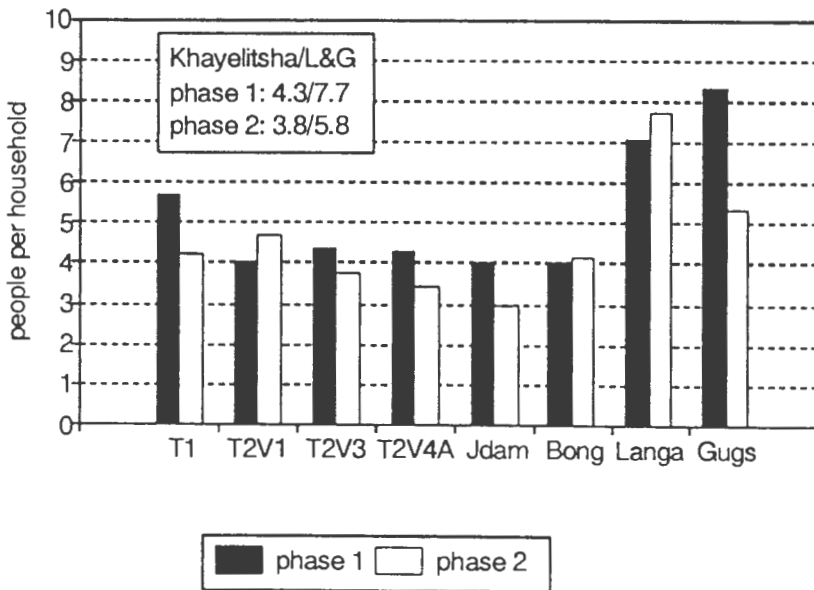


FIGURE 4.1: Average household size

The average for Khayelitsha has dropped marginally from 4.3 to 3.8 people per household, while for Langa and Guguletu the drop is significant, from 7.7 to 5.8; the number of people on the property has also declined from 8.1 to 6.5. The magnitude of the decrease in the size of households in the 36 households that make up the Langa and Guguletu sample can mainly be attributed to two large households of extended families having split up: one was reduced from 20 to 5 and the other from 21 to 10. Two other houses were reduced by 5 persons. The trend towards a decreasing size of household is apparent within the sample. The overall figures reflect a reduction in the size of households in two of the three areas sampled. Guguletu has the largest reduction in the size of the household, from 8.1 to 5.3, while Town 2 Village 1 reflects the largest increase from 4 to 4.6 people.

Households in the Khayelitsha sample are smaller than in Langa and Guguletu. Within Khayelitsha, households are larger in the older areas of Town 1. The population of households in these areas appears to be in a state of flux as relatives of the city-dwellers come and go from the rural areas. There are also those who are moving permanently to the city. As a result of the housing shortages, many people initially stay with family in established areas, before moving to other sites as they become available. The decrease in the average size of households in the sample may result from more accommodation becoming available – for example, the formalisation of previously informal residential areas and the establishment of site and service areas. This hypothesis was not specifically tested in the questionnaire.

4.2.2 Average number of adults

'Adults' are all those born before 1973 (ie, older than 18 in 1991) for phase 1. For phase 2, the category comprised those born before 1974. The information for all areas suggest that the households are homes to extended families. In phase 1, all areas other than Khayelitsha Town 2 Village 4a and Bongweni, were homes to extended families (with more than two adults); in phase 2, Jonkersdam is the exception. On average the number of adults is increasing: in Khayelitsha the average has moved from 2.5 to 2.7, and in Langa and Guguletu from 4.1 to 4.5.

4.2.3 Average age of adults

The areas which show the largest changes are Jonkersdam and Guguletu, where drops in averages of from 6 to 8 years were recorded. All other areas changed marginally.

4.2.4 Gender of household heads

The figures for households being headed by women are very high. Phase 2 shows a reduction in the number. In Khayelitsha, phase 1 reported 66% while phase 2 returned results of 61% of the sample; in Langa and Guguletu these figures were 76 and 62% respectively.

4.3 Education levels

This is one measure of the levels of education in households interviewed. More than half of the sampled areas show increases in the number of years of formal education. The areas showing the largest increases in phase 2 were Town 1, Town 2 Village 3, and Langa – areas that returned the lowest figures in phase 1.

4.4 Waged work

Within the sample, levels of waged work are higher in the newer areas of Khayelitsha. While this trend still holds in phase 2, the gap between the Khayelitsha and Langa and Guguletu samples is decreasing. Khayelitsha showed a decrease in the number of adults doing waged labour from 61% (in phase 1) to 55% (in phase 2). Langa and Guguletu showed an increase from 42% to 46% in the same period.

4.5 Occupancy

Langa and Guguletu are established townships, whereas Khayelitsha has only been in existence for about seven years. The average number of years people have lived at the same address in areas surveyed increased, indicating that few households have moved. For Khayelitsha the average increased from 2.2 to 4.1 years. In Langa and Guguletu the average increased from 20.1 to 23.6 years. The increase in the Langa and Guguletu sample accounts for this unexpected rise of 3.5 years of residence in one year.

4.6 Income and expenditure

Figure 4.2 is a scatter plot of total household nominal expenditure and total household nominal income. A regression analysis indicates that the two amounts are not especially well-correlated, producing a linear regression (R squared of 0.232). This is an improvement on the phase 1 results of 0.153, but may still suggest that the information provided is not totally accurate. It could also be argued that respondents did not reveal undeclared income-sources such as those as coming from work in micro-enterprises on which no tax is paid.

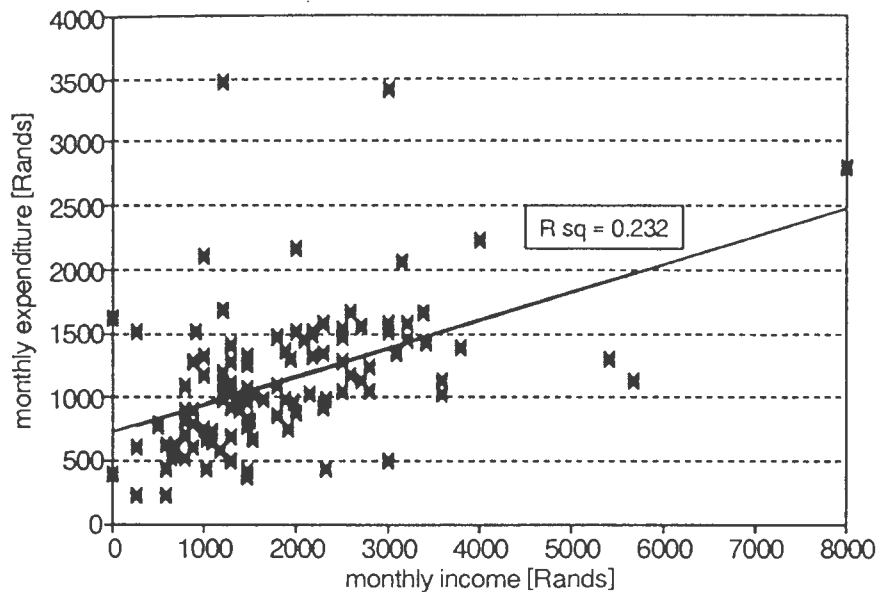


FIGURE 4.2: Monthly income versus expenditure

Figure 4.3 provides similar information, with averages taken in the areas surveyed. Agreement between income and expenditure is particularly poor in Khayelitsha Town 2 Village 4a and in Guguletu. In all areas declared income is higher than declared expenditure.

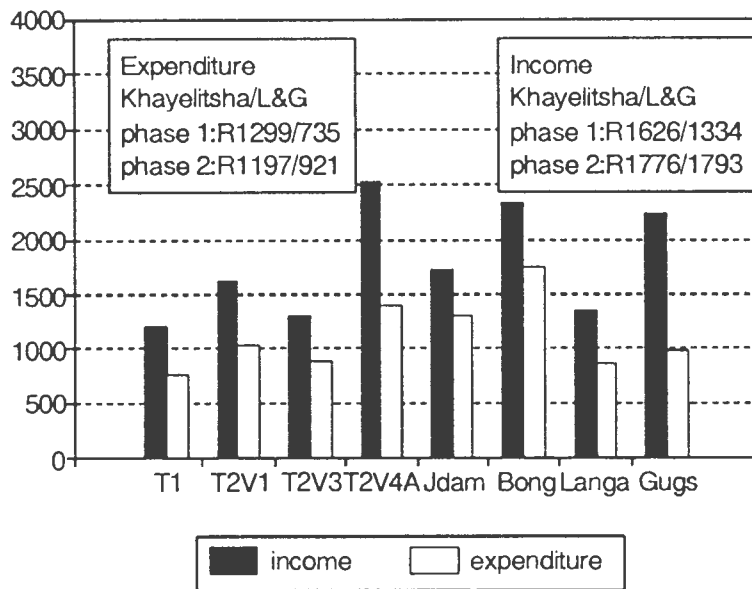


FIGURE 4.3: Average income and expenditure

Figure 4.4 compares the incomes and expenditure for the two phases, revealing an increase in nominal monthly household income from R1 626 to R1 776 for Khayelitsha. The same trend is apparent in the case of Langa and Guguletu, which shows an increase from R1 334 to R1 793. If inflation of 15% p.a. is taken into account between phases 1 and 2, this will reveal a real decrease for Khayelitsha, and increases in the case of Langa and Guguletu. While wage increases have not kept up with the rate of inflation, analysis shows an increase in the number of adults involved in waged work in Langa and Guguletu, which corroborates the increase in household income.

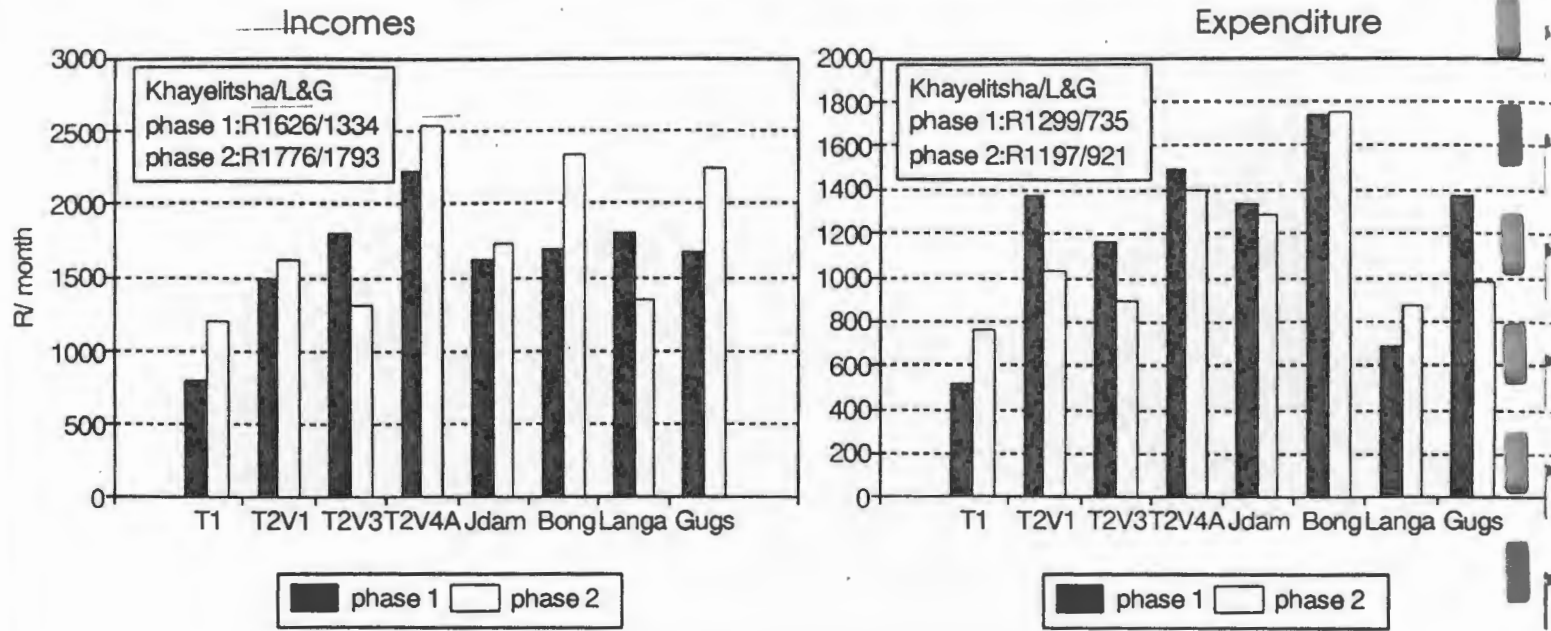


FIGURE 4.4: Income and expenditure

Figure 4.5 provides aggregated frequency distribution diagrams for nominal income levels for households in Khayelitsha and Langa and Gugulethu. 69% of incomes in Langa and Gugulethu were less than R2 000 per month, while for Khayelitsha the figure was 64%. These levels are lower than those produced in phase 1, which showed 83% and 75% falling below the R2 000 mark for Khayelitsha and for Langa and Gugulethu, respectively.

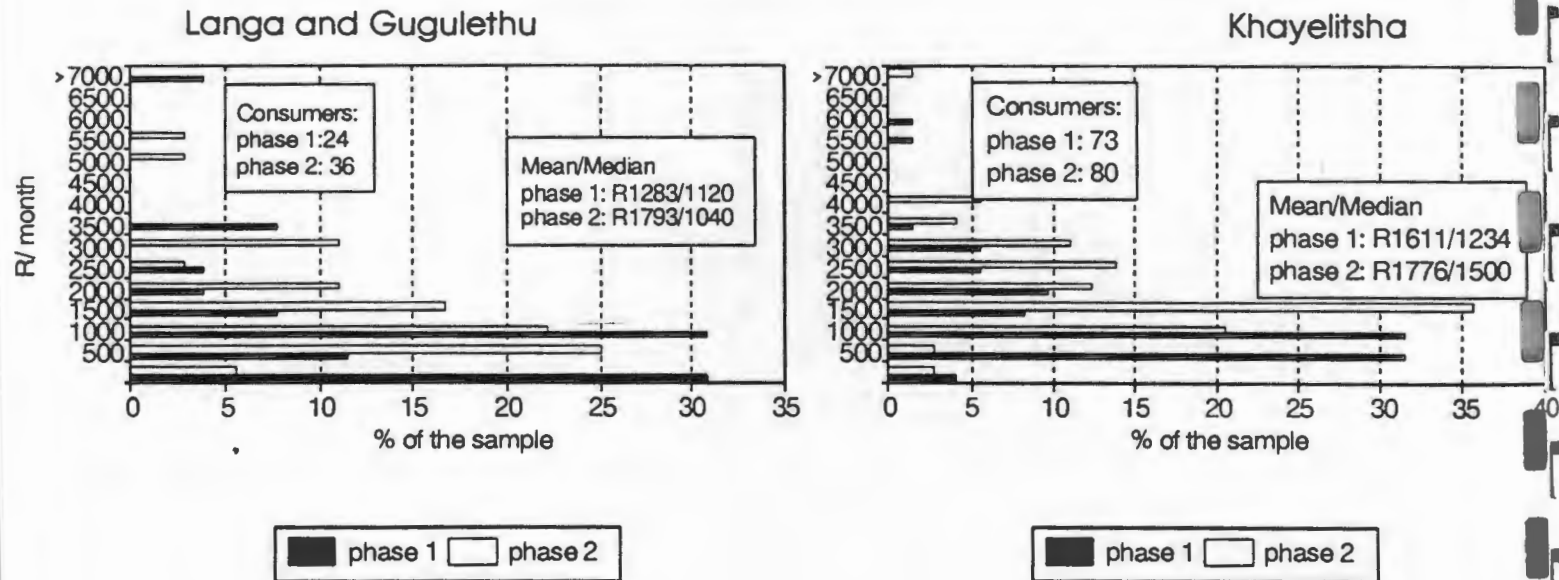


FIGURE 4.5: Frequency distributions of income levels

4.7 Conclusion

The information above was presented in order to characterise the two areas studied. Points relevant to future sections are the following:

- Households in the Langa and Guguletu and the Khayelitsha samples have reduced in size.
- The average number of adults (those over 18 years old) per household in the sample has increased in both areas.
- In the second phase of the project, fewer women were reported as being head of the household.
- The average number of years of education successfully completed has increased.
- Amongst the sample, the percentage of adults employed in waged work has increased in Langa and Guguletu from 42% to 46%, and decreased in Khayelitsha from 61% to 55%.
- Households in the Langa and Guguletu sample have been at their present addresses for 23.4 years – far longer than those in the Khayelitsha sample average of 4.1 years.
- The number of households with incomes of greater than R2 000 per month has increased from 17% and 25% to 31% and 36% for the Langa and Guguletu and Khayelitsha samples respectively.
- The reported incomes (corrected for inflation) of households in the Langa and Guguletu sample have, on average, increased. In the Khayelitsha sample there is a decrease in reported incomes.
- The expenditure of households in the Khayelitsha sample has decreased, while in the Langa and Guguletu sample, an increase was reported.

Chapter Five APPLIANCES

5.1 Introduction

Appliance ownership and use in the 116 households surveyed are examined in this chapter. The following aspects are explored:

- appliance ownership (electrical, gas, paraffin and others); and
- appliance use for major energy consuming activities (cooking, space-heating and water-heating).

5.2 Appliance ownership

5.2.1 Electrical appliances

Figures 5.1a and b show the percentage of the 80 households in Khayelitsha and the 36 households in Langa and Gugulethu which own particular electrical appliances. Appliances are classed in usage categories: food-preparation; heating, cooling and lighting; leisure; and cleaning. The ownership of appliances in the two phases is compared.

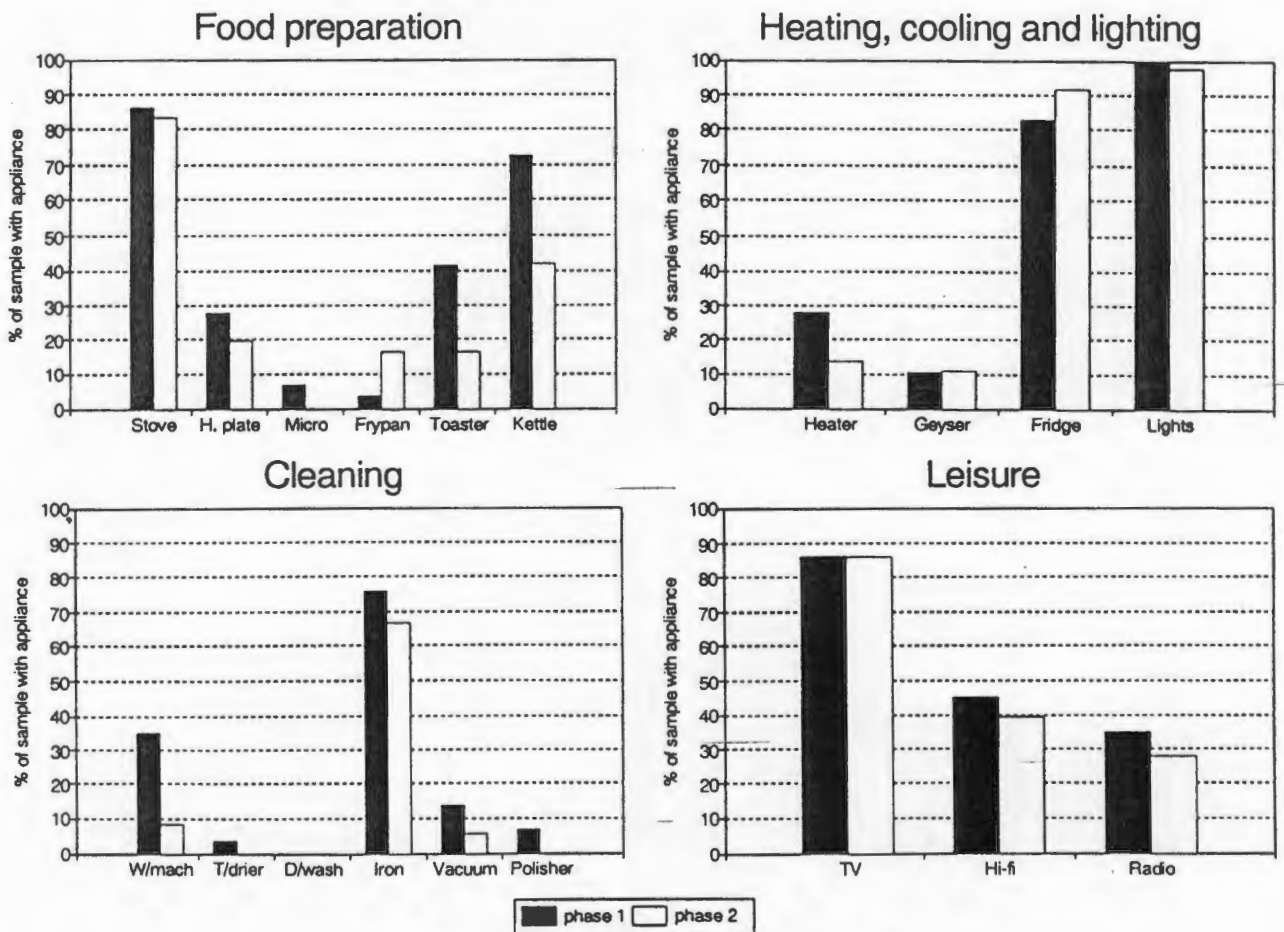


FIGURE 5.1a: Ownership of appliances in Langa and Gugulethu

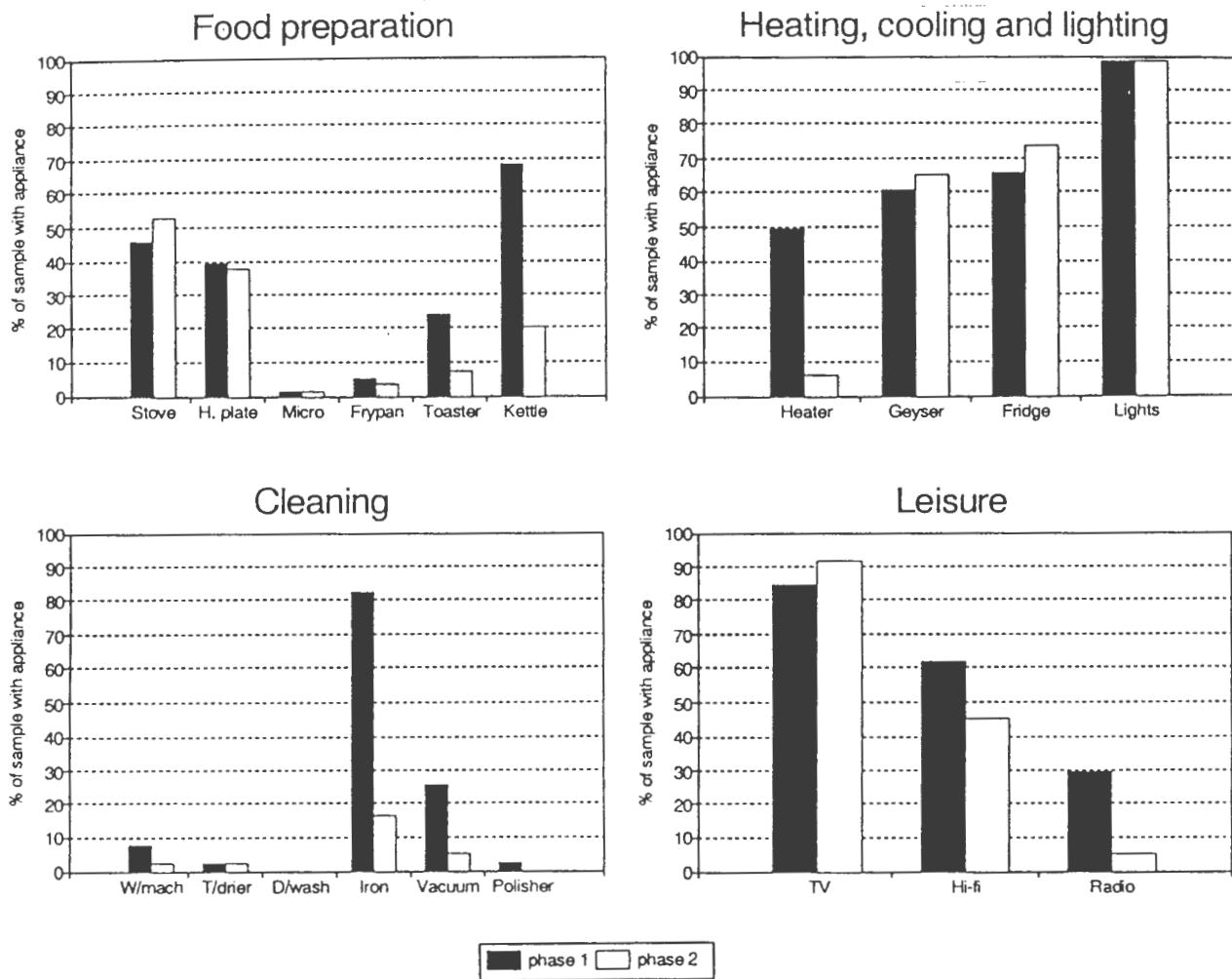


FIGURE 5.1b: Ownership of appliances in Khayelitsha

The following points can be noted:

- The most commonly used electrical appliances in both new and old electrified areas are electric lights. Nearly all households in the sample made use of them. Television sets were owned by nearly 90% of the sample, refrigerators by nearly three quarters. Stoves, hotplates, irons and hi-fi systems are the next most popular appliances in newly-electrified households. Geysers were installed at the time of construction.
- 83% of households sampled in Langa and Guguletu owned electric stoves. In Khayelitsha stove-ownership had increased from 46% to 52%. Of Khayelitsha households, 39% own electric hot-plates (some owning both stoves and hot-plates).
- Phase 1 recorded that 60% of the Khayelitsha sample own geysers; the figure for phase 2 was 65%. These are mostly households in Town 2 Village 4a, Town 2 Village 3, Bongweni and Jonkersdam, where geysers were installed at the time of construction. In Langa and Guguletu 10% of households own geysers.
- Refrigerators are owned by a majority of households and the numbers are increasing: 73% in Khayelitsha, and 92% in Langa and Guguletu.
- Television sets are owned by the majority of households in the sample. Phase 1 reported that 85% of the Khayelitsha and 86% of the Langa and Guguletu

samples owned television sets. Phase 2 indicated an increase to 91% for the Khayelitsha sample, while Gugulethu and Langa's level of ownership remained constant.

- In old areas that have had access to electricity for a long time the ownership of large electrical appliances like stoves and fridges is more common. This is true for all appliances other than geysers which were installed in the Khayelitsha houses when they were built.

Figure 5.2 shows the particular appliances bought *first* by those household surveyed. Of the 79 households in Khayelitsha sampled in phase 1, 25% recall buying a stove first. An equal number bought television sets first, while 18% bought hot-plates. In phase 2, the 80 households interviewed recalled their appliance acquisitions differently. The figures show 42%, 18% and 22% for the three appliances respectively. This may be as a result of change of respondents from those interviewed in phase 1.

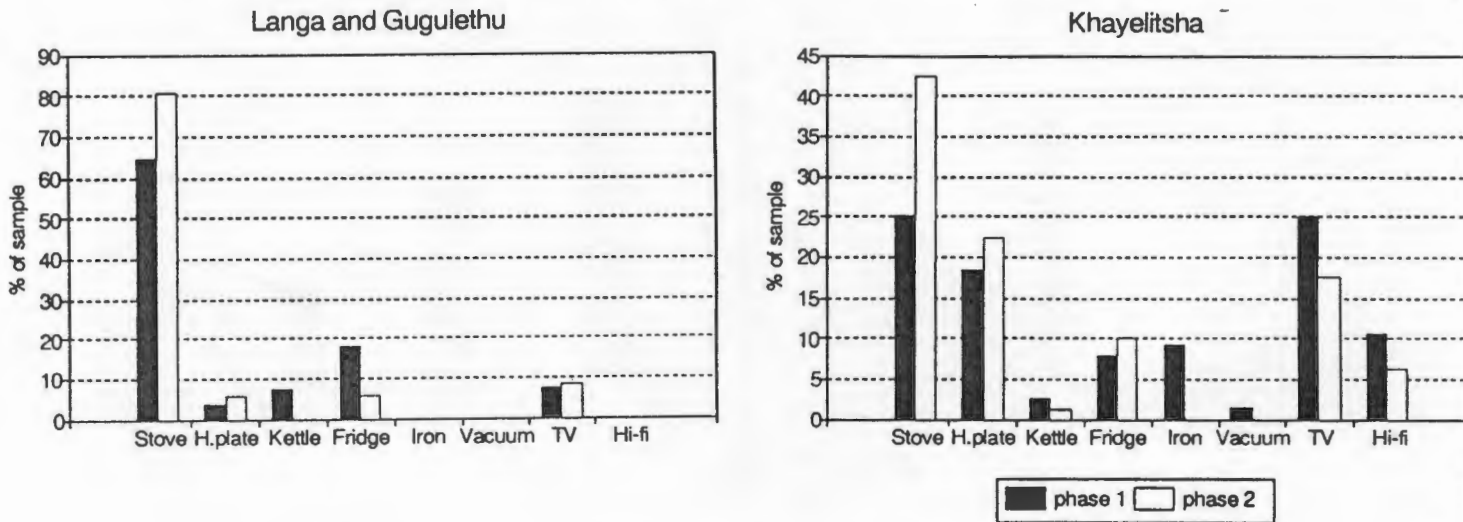


FIGURE 5.2: Electrical appliances bought first

Figure 5.3 compares the particular appliances bought *most recently* by those houses surveyed in the two phases. In phase 1, refrigerators were bought recently by 30% of those in Langa and Gugulethu. Television sets were bought by 20% of those in Khayelitsha and 19% of those in Langa and Gugulethu. In phase 2, 45% of the sample in Khayelitsha and 44% in Langa and Gugulethu reported buying television sets most recently. It is noted that in the Langa and Gugulethu sample 36% of the sample reported that they had not bought any appliances recently.

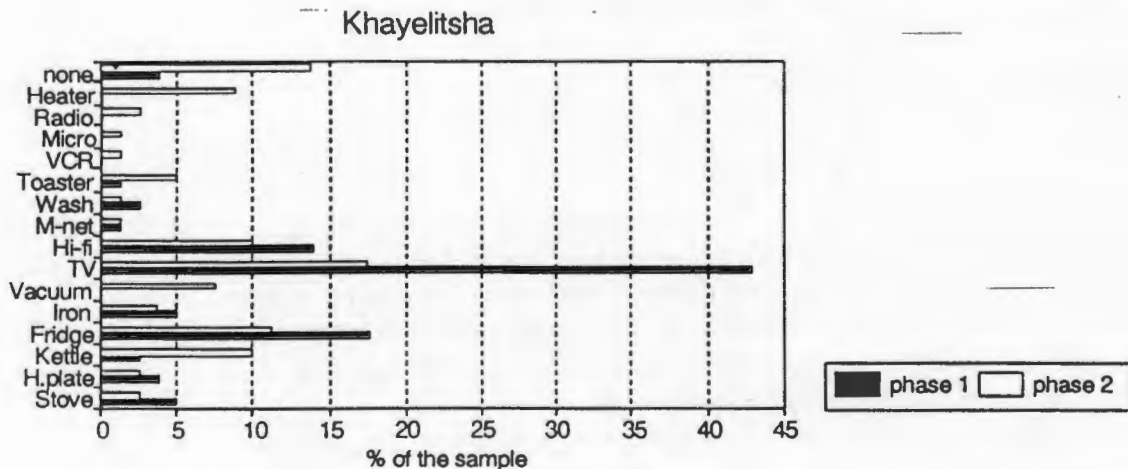


FIGURE 5.3: Electrical appliances bought most recently

Figure 5.4 shows the particular appliances which households *plan* to buy next. In phase 1, 19% of those in Langa and Guguletu and 22% of those in Khayelitsha intended to buy a stove – implying that a significant increase in electricity consumption could be expected in both areas. In phase 1, 13% of those in Langa and Guguletu and 17% of those in Khayelitsha were planning to buy washing-machines. Phase 2 records the increase in the number of stoves. The same trend is not there for washing-machines. In phase 2, 87% of the respondents said they did not have plans to buy any more appliances. Figure 5.4 gives an indication of what the remaining 13% intend buying.

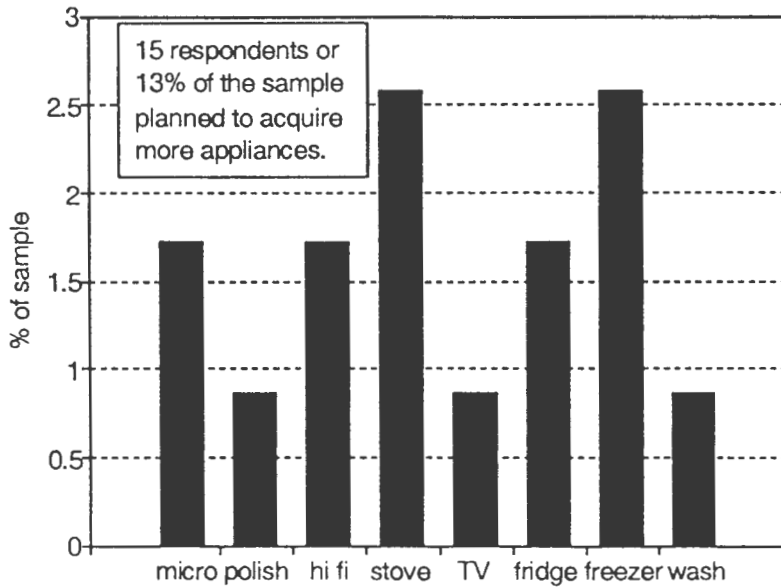


FIGURE 5.4: Intended purchases of electrical appliances

5.2.2 Gas appliances

Figure 5.5 shows the percentage of the sample in each area which owns gas stoves and gas fridges. The survey showed that gas stoves are particularly prevalent in Khayelitsha, although their ownership is decreasing. In phase 1, 47% of all households owned gas stoves, a level reduced to 34% in phase 2. In Langa and Guguletu the ownership of gas stoves is increasing, from 17% to 22% over the same period. Reasons for use of these appliances is discussed in section 5.3.1.

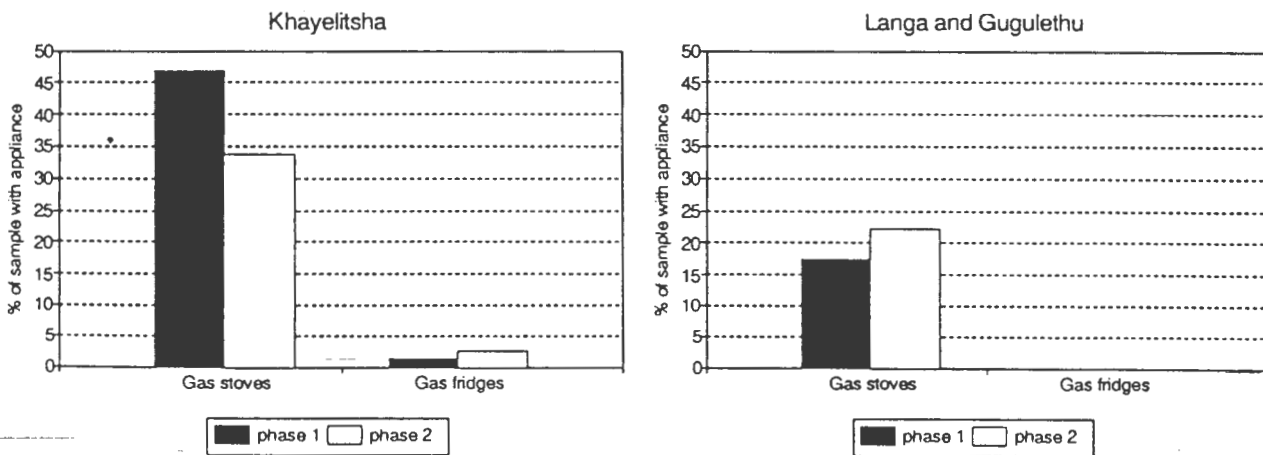


FIGURE 5.5: Ownership of gas appliances

5.2.3 Paraffin appliances

Figure 5.6 shows the percentage of the sample in each area which owns paraffin (Primus and Beatrice) stoves, lamps and paraffin heaters. The ownership of paraffin appliances is increasing in the Langa and Gugulethu sample and decreasing in Khayelitsha. In Langa and Gugulethu ownership of Primus stoves has increased from 28% to 33% and of lamps from 13% to 22% for the two phases; ownership of heaters decreased from 59% to 39%. In Khayelitsha ownership of Primus stoves has decreased from 14% to 10%, lamps from 20% to 18%, and heaters from 38% to 10%. The reason for this trend is discussed in 5.3.1.

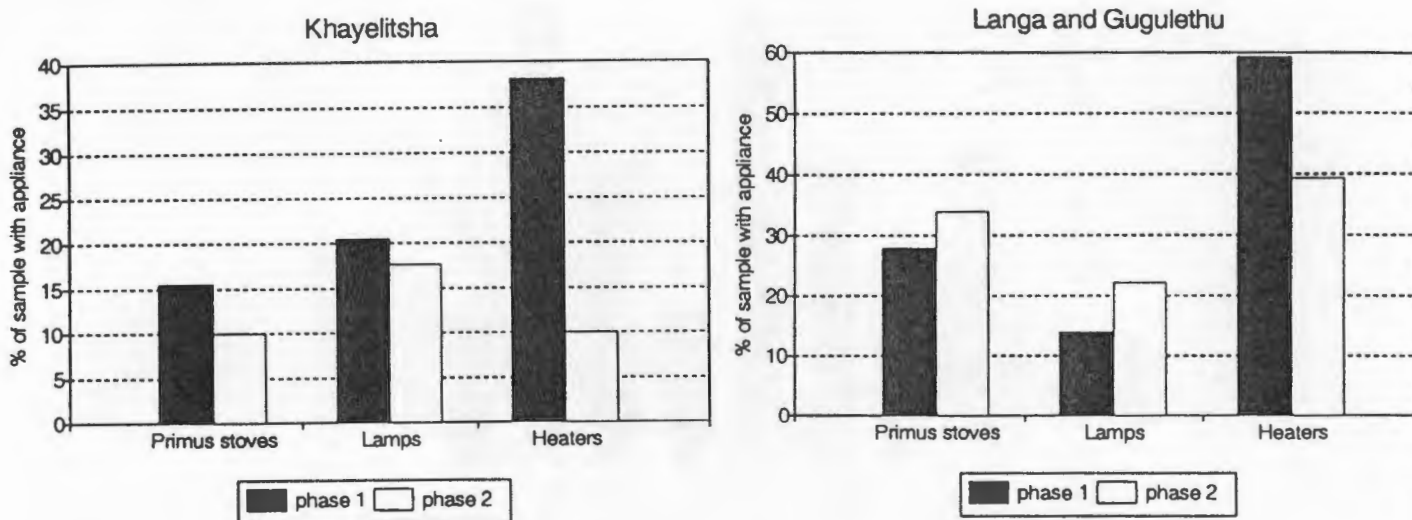


FIGURE 5.6: Ownership of paraffin appliances

5.2.4 Other appliances

The numbers of households owning appliances using other fuels (such as coal- or wood-stoves) was insignificant. In phase 1, of the entire sample, one household in Jonkersdam owned a fireplace (Jetmaster-type) heater; one household, in Gugulethu, owned a coal-stove. The second phase provided no evidence of coal or charcoal use. Wood is used by many households for cooking traditional meals (on open fires) and, occasionally, braais. Phase 2 indicated one household that used wood in a business activity. One household, in Langa, used car batteries to power a television set and a hi-fi set – the household head worked at a garage and could charge batteries for free.

5.3 Appliances used for major energy-consuming activities

5.3.1 Cooking

Figure 5.7 shows the *primary* appliance used for cooking. In cases where a combination of appliances is used on a daily basis, households are placed in the category: 'mix'. The distinction between appliances owned and those primarily used is drawn because some appliances that are owned are used only in case of blackouts, disconnections or when fuels run out.

In Langa and Gugulethu, electric stoves are owned by most households (83%). The number using electric stoves as their primary means of cooking has decreased from 79% to 64%; that using a mixture of cooking appliances has increased from 7% to 17%. Electric hotplates in daily use has increased from 10% to 16%. 3% cook primarily with a paraffin stove. Gas stoves are not used on a daily basis by any

households in the Langa and Gugulethu sample, even though their ownership has increased from 17% to 22%.

In Khayelitsha households which own electric stoves increased from 46% to 53%. These figures are identical to the number of households that use electric stoves as their primary means of cooking. Gas-stove ownership has decreased from 47% to 33% of households, reflected in the decrease from 18% to 8% in their primary use in cooking.

Primary use of hotplates in cooking has increased from 17 to 30%, while ownership has decreased from 40% to 37%. The number of households using a mix of appliances has decreased from 16% to 6%. The ownership of paraffin cooking appliances has dropped from 15% to 10%, and their daily use from 1% to 0%. This trend is substantiated in the chapter by the movement towards greater reliance on electricity in Khayelitsha and away from reliance on electricity in Langa and Gugulethu, between phases 1 and 2.

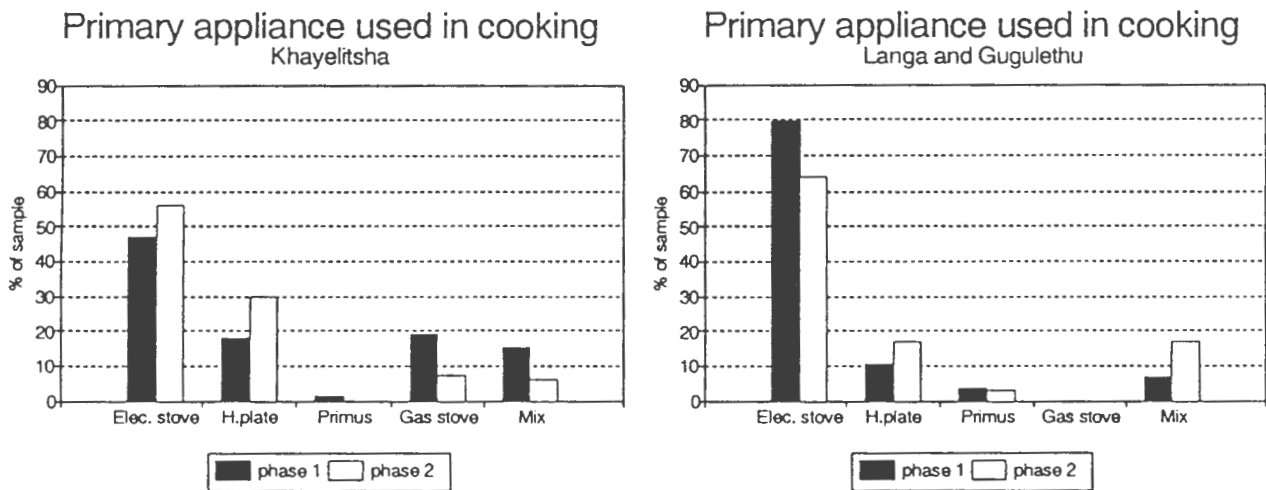


FIGURE 5.7: Primary appliances used in cooking

5.3.2 Space-heating

Figure 5.8 compares ownership of space-heating appliances. In phase 1 electric bar heaters were marginally more popular than paraffin heaters in Khayelitsha (44% as opposed to 38%), but phase 2 returned an ownership profile of 6% and 10% for the same appliances. The same trend is evident in Langa and Gugulethu: where phase 1 showed 28% and 59% of households owning these appliances, the figures in phase 2 were 12% and 33%. Reasons for this large reduction in the number of space-heating appliances are not evident from the survey, but could result from the interviews being conducted over a period that spanned the winter and summer seasons. The warmer weather of summer in which some of the interviews were conducted could have resulted in heaters being stored and forgotten. The movement of smaller appliances such as heaters needs further research.

5.3.3 Water-heating

The only category used for water-heating is ownership of electric geysers. Figure 5.9 shows the percentage of the households in the areas sampled that have geysers. In the case of Khayelitsha ownership increased from the 60% recorded in phase 1 to the 65% in phase 2. In Langa and Gugulethu ownership had been recorded at a low 10%; by phase 2 only 8% reported owning an electric geyser.

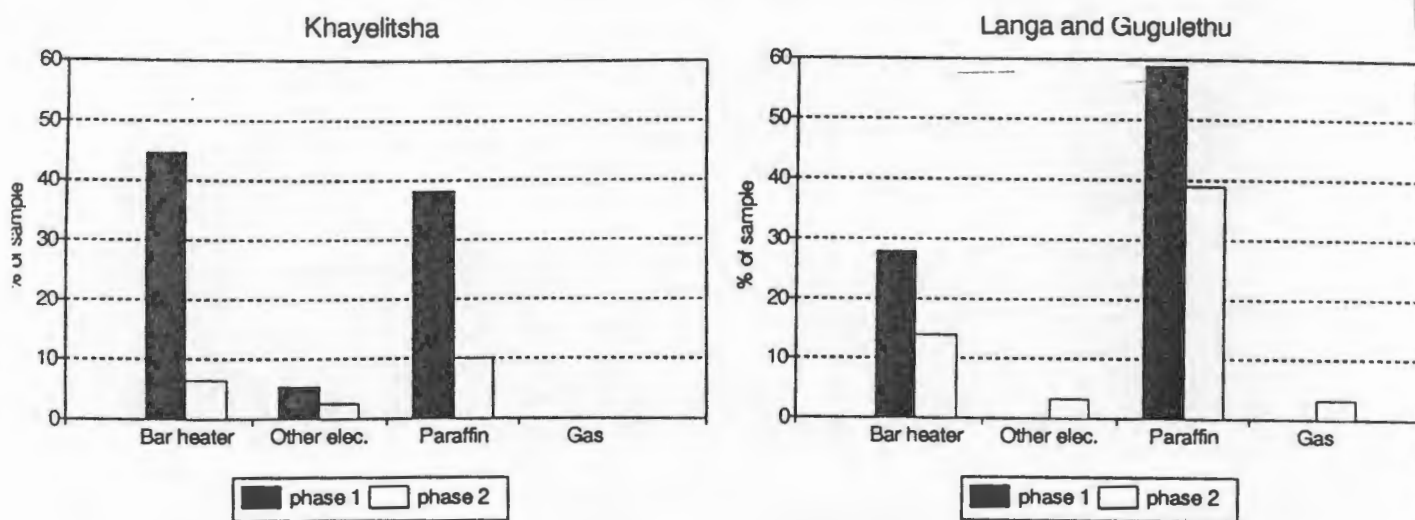


FIGURE 5.8: Ownership of space-heating appliances

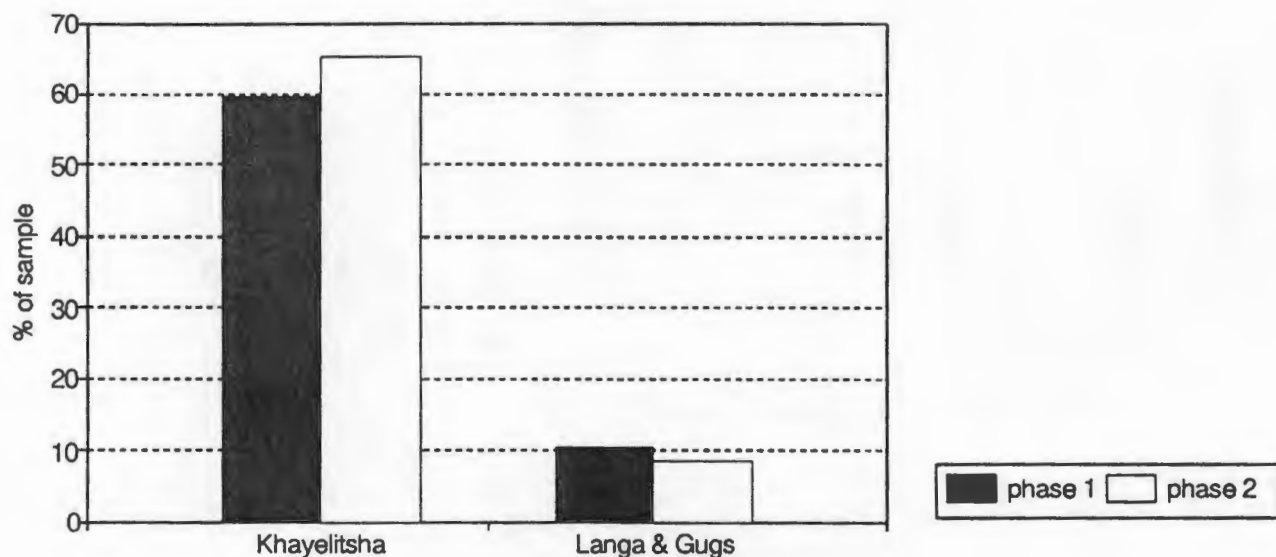


FIGURE 5.9: Ownership of geysers

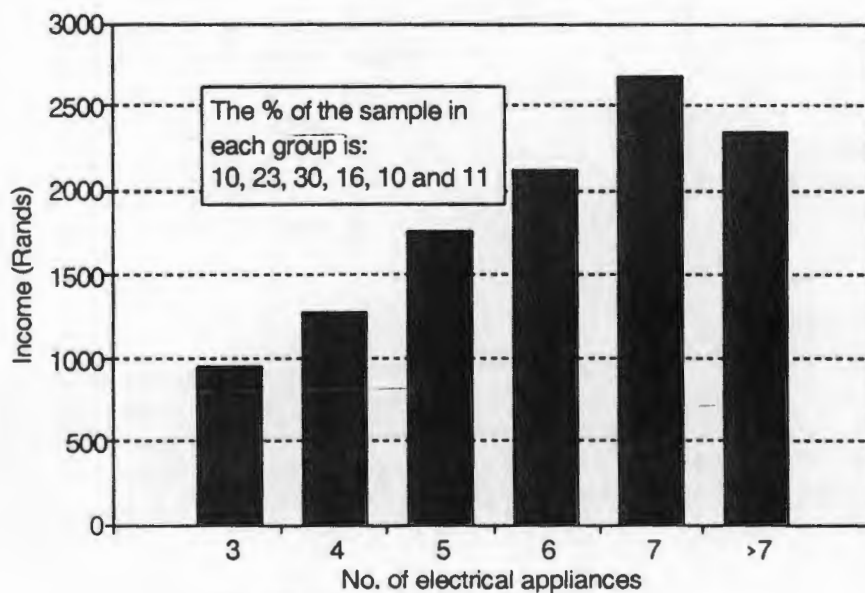


FIGURE 5.10: Electrical appliances and income

5.3.4 The relationship between income and appliance ownership

Figure 5.10 shows the relationship between income and the total number of appliances owned in Khayelitsha. All lights used in a household are counted as one appliance. There is a striking correlation between income and appliance ownership.

5.4 Conclusion

The main points of this chapter are the following:

- Electric lights are used by all but two households in the survey sample.
- Where electrical appliances are not used, paraffin appliances are more prevalent than gas appliances in Langa and Guguletu. The reverse is true in Khayelitsha.
- Ownership of electric stoves is much more widespread in Langa and Guguletu than in Khayelitsha.
- Television sets were bought by nearly 45% of the sample that reported buying appliances recently.
- The numbers of electric geysers and refrigerators are increasing in Khayelitsha.
- Cooking with electricity on a daily basis is well established in most households in Langa and Guguletu, with, however the trend there being towards a mix of primary cooking appliances. In Khayelitsha, stove-ownership is increasing. Nearly 85% cook primarily on electric stoves and hotplates. The increase in electric-appliance cooking has resulted in a reduction of gas- and mixed-appliance-cooking.
- There appears to be a strong correlation between household income and electrical appliance ownership.

There is clearly some need to uncover the patterns which determine the movement of appliances in the three areas covered by the survey. For this purpose further primary research could contribute to understanding these movements not explored in the scope of this study.

Chapter Six

THE USE OF FUELS

6.1 Introduction

This chapter examines fuel-use in the 116 households sampled in Langa, Guguletu and Khayelitsha. The fuels examined are electricity, gas, paraffin, wood, coal, car batteries and candles. Information is provided on the following aspects of fuel-use:

- the frequency with which each fuel is used;
- the contribution of fuels to energy consumption levels;
- the breakdown of expenditure related to household energy service costs;
- the modes and costs of transport used by households.

Information is given for different groups within the sample, with comparisons drawn between households in Khayelitsha and households in Langa and Guguletu, and also – in order to analyse trends – between the results of phases 1 and 2.

6.2 The frequency of fuel use

The frequency with which particular fuels are used by all the households sampled is shown in Figure 6.1. The categories specified in the questionnaire were 'daily', 'seldom' and 'never'.

Electricity was used by 100% of respondents on a daily basis. There was no change here between the two phases.

Gas was used daily by 14% of respondents primarily for cooking – a decrease from the 20% recorded in phase 1. Nearly 70% never use gas.

Paraffin use is decreasing. 32% of households sampled use it seldom, while 9% use it on a daily basis. Phase 1 recorded 44 and 20% of the households using paraffin seldom and daily. Daily users of paraffin use it primarily for space-heating and cooking.

Wood is used seldom, primarily for the preparation of traditional meals, and for braais. The number of households that never use wood has increased from 68 to 90%. Only one household uses wood on a daily basis for a micro-enterprise.

Coal is not used by any of the respondents. In phase 1 a few respondents reported using coal for space-heating in winter.

Car batteries are used by a very small group of respondents, primarily for powering television sets. In phase 1 there were two households using car batteries on a daily basis; this figure has decreased to none on a daily basis. Two households use batteries seldom.

Candles are increasingly used: 90% reported using them seldom, up from the 51% in phase 1; more use candles in the event of power-failures (blackouts); and the number of households that never use candles has decreased from 46 to 8%. This increase in usage could be attributed to the improvement of the electricity service

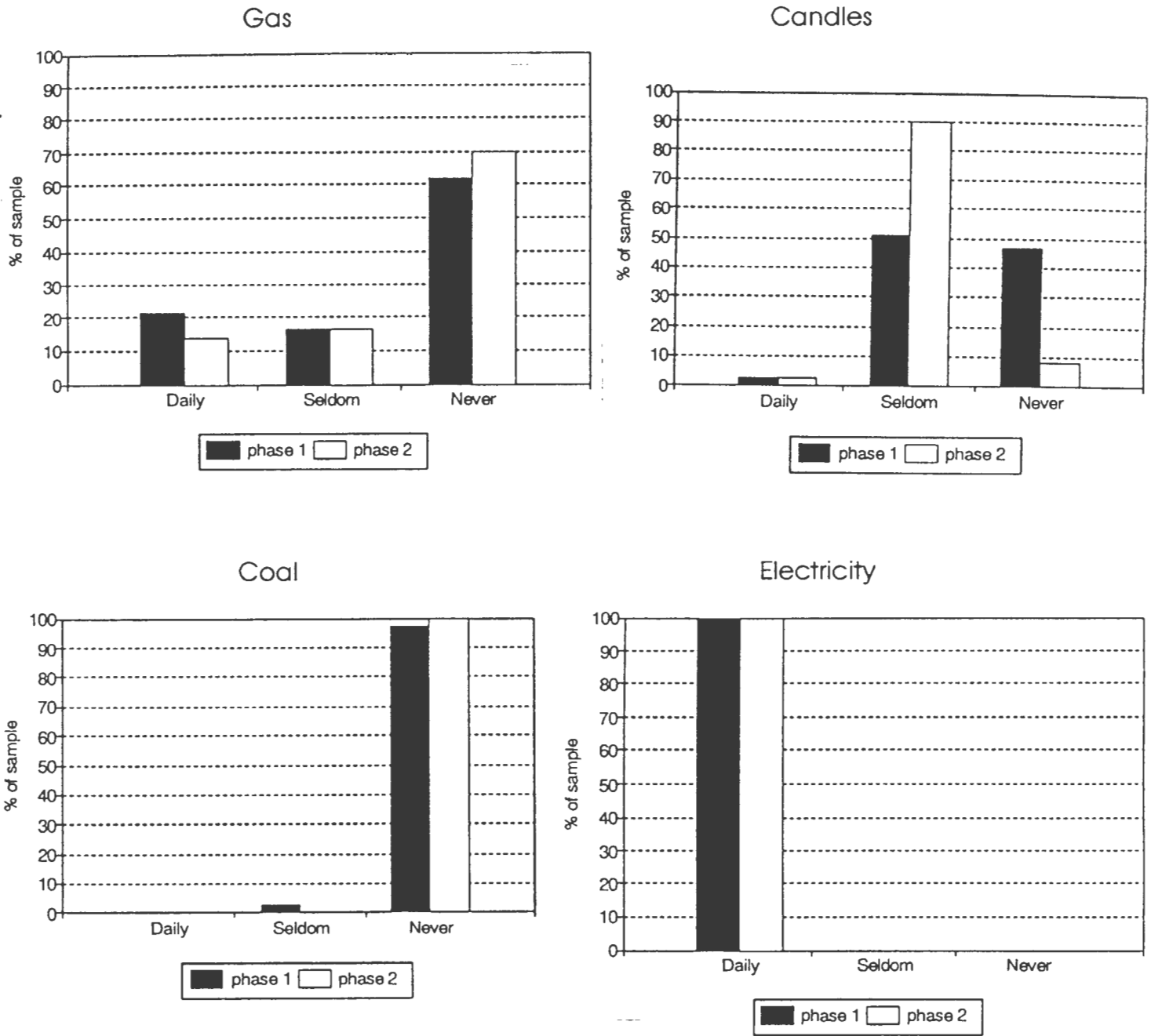


FIGURE 6.1: Frequency of fuel-use by all households sampled

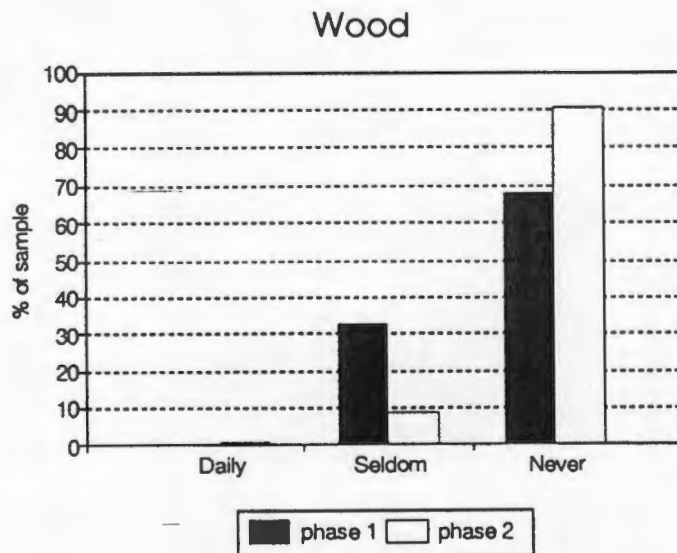
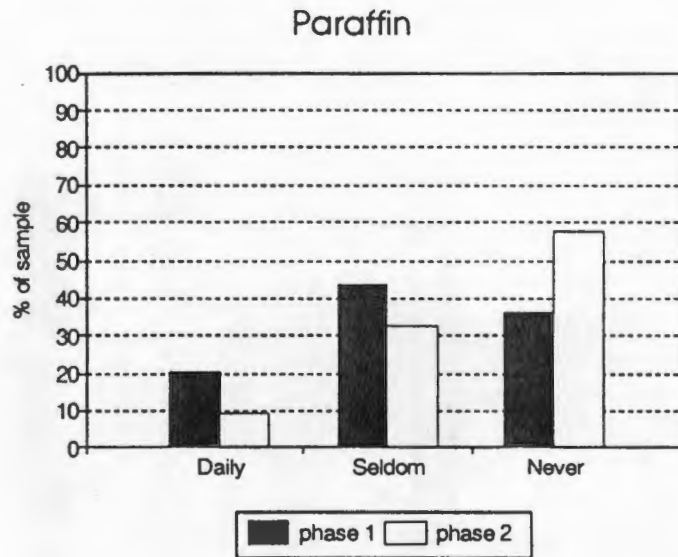
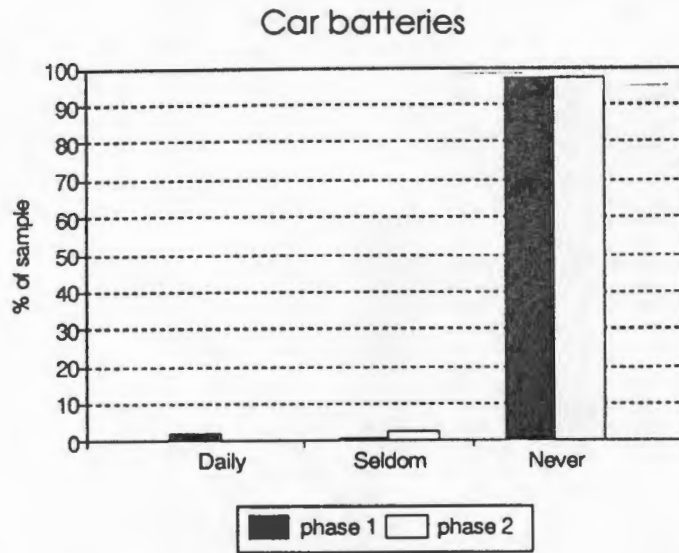


FIGURE 6.1: Frequency of fuel-use by all households sampled

in Khayelitsha. Households are starting to rely on electricity more for their energy services, with candles still being kept in case of blackouts. Candles as a standby have also replaced gas and paraffin appliances which have also been replaced by more dependence on electricity.

Figure 6.2 shows the proportions of the sample using combinations of fuels on a daily basis. In phase 1, two-thirds of the sample were entirely dependent on electricity, the remainder using multiple fuels on a daily basis. In phase 2 the proportion of the whole sample dependent exclusively on electricity had reached three-quarters. The combination of gas and electricity had increased from 12.1% to 12.9%, while all other fuel combinations had decreased.

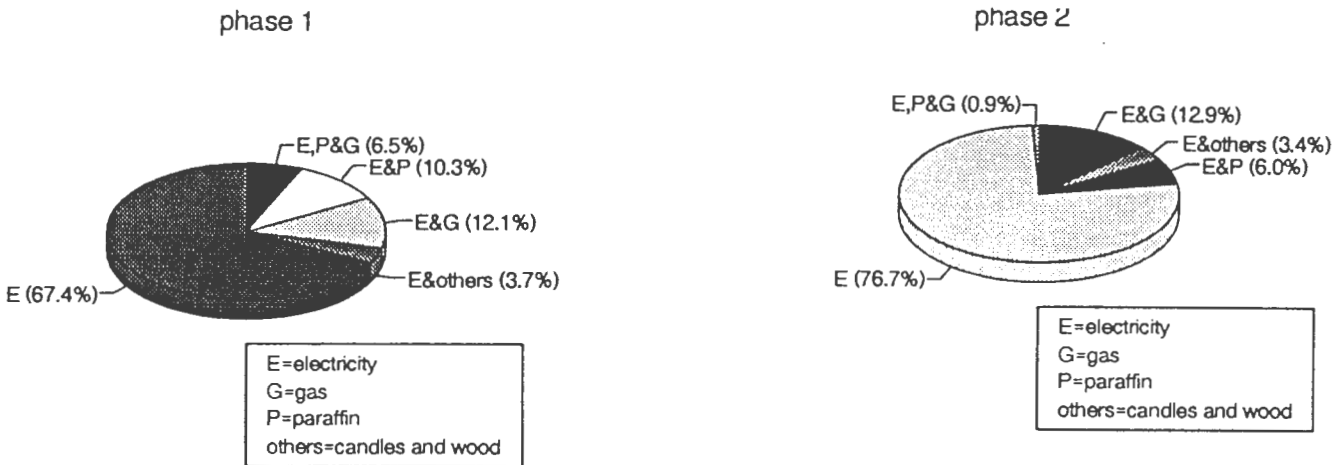


FIGURE 6.2: Proportions using fuel combinations daily

Figure 6.3 compares fuels used daily in Langa and Gugulethu to those used daily in Khayelitsha. In Khayelitsha the trend of increasing dependence on electricity as the sole fuel is reflected in the decrease in the use of gas as a daily fuel: gas use is down from 27% to 18% of the households in the newer area, and paraffin down from 17 to 3%. Conversely, paraffin use in the older areas is up from 24% to 27% amongst the sample in Langa and Gugulethu. This can be put down to the increase in the occurrence of blackouts.

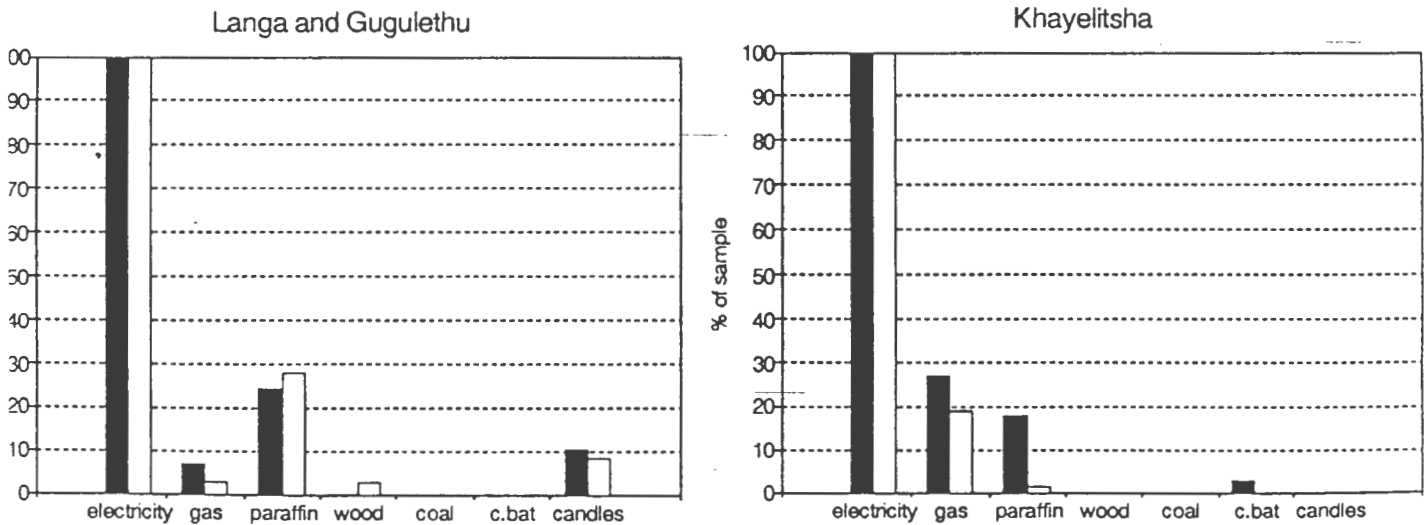


FIGURE 6.3: Fuels used daily

Figure 6.4 compares combinations of fuels used daily in the two different areas. In Khayelitsha there was an increase between phases 1 and 2 from 60% to 81% using only electricity on a daily basis. This trend is reversed in the case of Langa where the numbers using electricity alone decreased from 72% to 66%. For Khayelitsha the increase in those using electricity alone has been at the expense of those using combinations of fuels on a daily basis, while in Langa there was an increase in fuel mixes used. Daily multiple fuel use in the older areas (which have been electrified for many years) is significant and increasing in response to the poor service (many blackouts), disconnections as result of increasing arrears, and fluctuations in fuel costs. This is explored in more detail in Chapter 8.

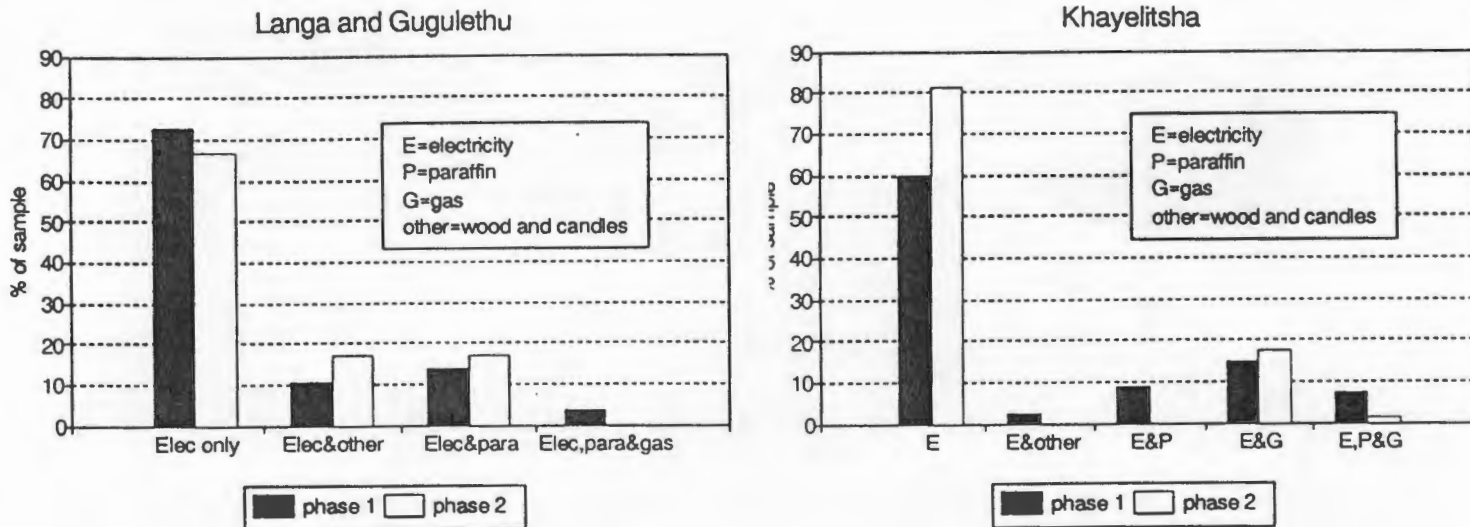


FIGURE 6.4: Combinations of fuels used daily

6.3 Contributions of fuels to energy consumption

6.3.1 Net and useful energy consumption

Table 6.1 shows the average monthly consumption of fuels, in physical units, in the households sampled. Electricity consumption data for the households was obtained from distribution authority records. The amount of other fuels consumed was recorded in the survey. Average monthly electricity consumption in Langa and Gugulethu is significantly higher than in Khayelitsha.

Table 6.2 shows the energy content of each of the fuels. These values were used to translate physical quantities of fuel into the net energy that they contain.

Figure 6.5 shows the average monthly *net* energy consumption in the areas sampled and also compares the net energy used in phase 1. In all areas there is a significant decrease in the net amount of energy consumed. These figures are compared to the average net consumption of electricity in the Cape Town City Council areas of supply.

Net energy consumption per household in Langa and Gugulethu and Khayelitsha in phase 1 was 3 291 and 2 241 MJ/month respectively. The net energy consumptions in phase 2 were lower at 2 809 MJ/month in Langa and Gugulethu and 1 490 MJ/month in Khayelitsha, largely due to the higher consumption of electricity and paraffin in the older areas. The increase in the dependence on electricity in Khayelitsha in phase 2 more than offset the higher amount of gas consumed in Khayelitsha in phase 1. The major contribution to net energy consumption in both

Fuel	Units	Whole sample		Langa & Gugulethu		Khayelitsha	
		phases 1	2	phases 1	2	phases 1	2
Electricity	kWh/month	420.7	377.2	631.6	519.7	344.0	313.1
Gas	kg/month	6.9	3.08	2.1	2.92	8.8	3.15
Paraffin	l/month	16.1	8.6	22.4	17.4	13.2	4.63
Wood	kg/month	3.0	3.4	3.5	7.9	2.5	1.3
Coal	kg/month	0.7	0	0.3	0	1.1	0
Car batt.	charges/month	0.5	0.02	0.7	0	0.4	0.03
Candles	packets/month	0.6	.75	0.7	.81	0.6	.73

TABLE 6.1: Monthly consumption of fuels

Fuel	Energy content
Electricity	3.6 MJ/kWh
Gas	49 MJ/kg
Paraffin	37 MJ/l
Wood	17 MJ/kg
Coal	27 MJ/kg
Car batteries	1.3 MJ/charge
Candles	20.7 MJ/packet

TABLE 6.2: Energy content of various fuels
Sources: Borchers et al. (1991); Viljoen (1989)

areas is the amount of electricity used. As seen in Chapter 3, electricity consumption for the sample households has decreased in phase 2 from phase 1. In the case of Khayelitsha this decrease is in contrast to the increasing consumption of electricity by all consumers. Thus energy use trends in the sample may not be representative of overall trends.

The study can say nothing of the trends for all electricity consumers in Langa and Gugulethu (as comparative data was not available for phase 1); however, Chapter 4 reports the decreasing size of households in the sample. If the number of residents is a determinant of electricity consumption, as was suggested in phase 1, this would explain the trend. This explanation is tested in the Figure 6.7 and then further explored in Chapter 7.

Table 6.3 shows the conversion efficiencies assumed for appliances using each of the fuels. These values were used to translate net energy used into the useful energy used.

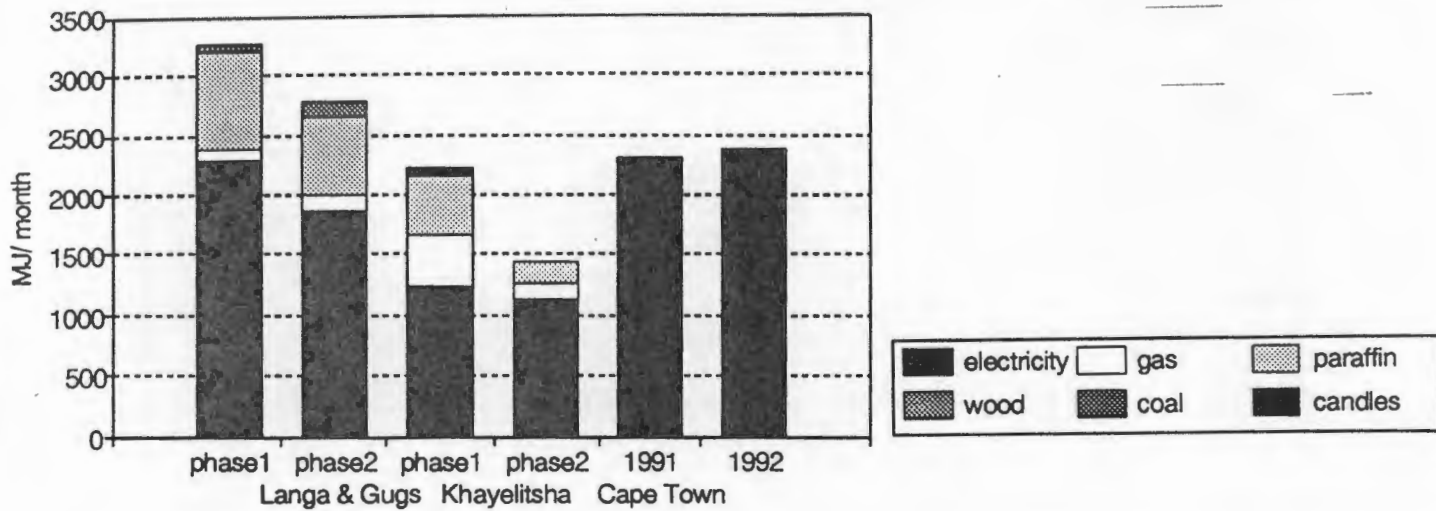


FIGURE 6.5: Average monthly net consumption

Fuel	Conversion efficiency
Electricity	80.0
Gas	70.0
Paraffin	50.0
Wood	10.0
Coal	20.0
Car batteries	80.0
Candles	50.0

TABLE 6.3: Conversion efficiencies for various appliances
Source: Bennett (1977)

Figure 6.6 shows the average monthly *useful* energy consumption in the areas sampled, and other areas. Included are the consumption figures for the near 23020000 domestic customers in the Cape Town City Council area of supply. The figures for Cape Town are only for the consumption of electricity, which shows a marked increase from 1991 to 1992 (Cape Town City Council, Annual Report of the City Electrical Engineer, 1990 and 1992). The levels of consumption are roughly equivalent to those of the Langa and Guguletu sample, but higher than those in Khayelitsha. Useful consumption in Langa and Guguletu is once again higher (1 941 MJ/month) than in Khayelitsha (1 105 MJ/month). This is a reduction from the useful energy consumption in phase 1, which reported 2 323 and 1 553 MJ/month for the two areas, implying reductions of 16% and 29% for the households in the two areas.

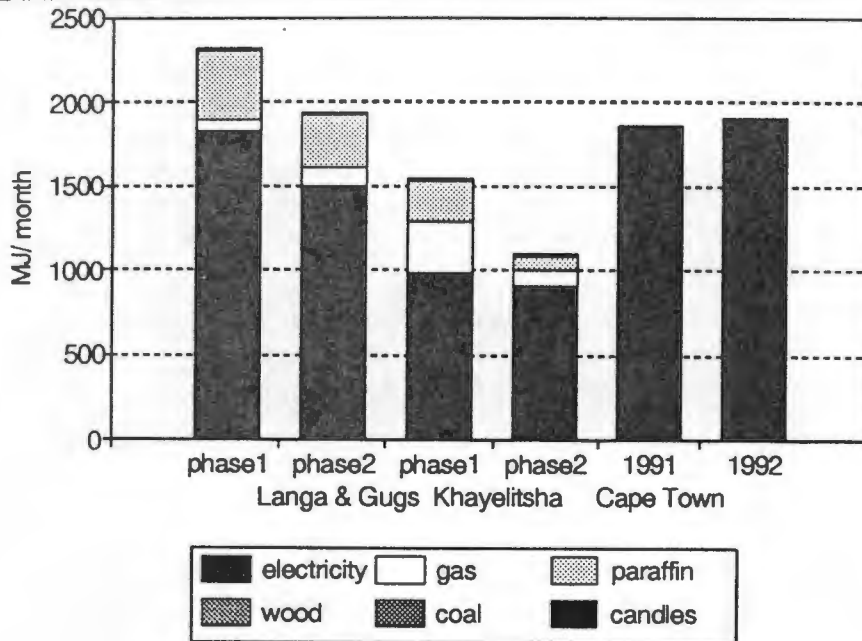
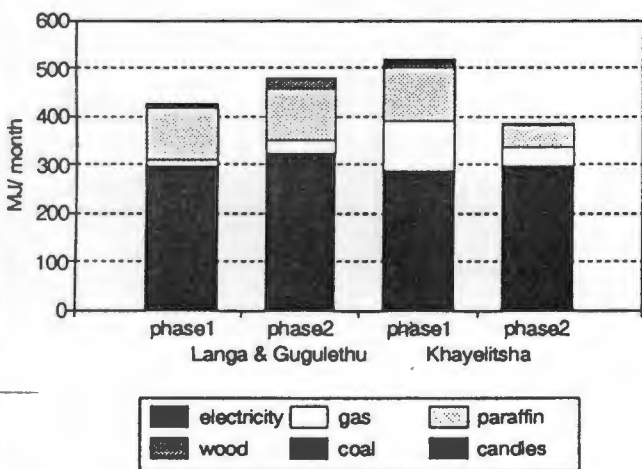


FIGURE 6.6: Average monthly useful energy consumption

6.3.2 Per capita net and useful energy consumption

Figure 6.7 shows the average monthly net and useful per capita energy consumption in the areas surveyed in phase 2. Average household size for the whole sample was lower than in phase 1. In phase 1 energy consumption per household in Langa and Guguletu was higher than in Khayelitsha, but energy consumption per capita is lower. In phase 2 per capita net and useful energy consumption was lower than in phase 1. The whole sample has reduced consumption from 490 to 420 MJ/month for net and 340 to 305 MJ/month for useful per capita energy consumption. Langa and Guguletu showed increases in net and useful per capita energy consumption, while Khayelitsha recorded a decrease, mainly as a result of decreased gas and paraffin usage. Electricity increased in its contribution to net and useful energy consumption in both sample areas.

Net energy consumption per capita



Useful energy consumption per capita

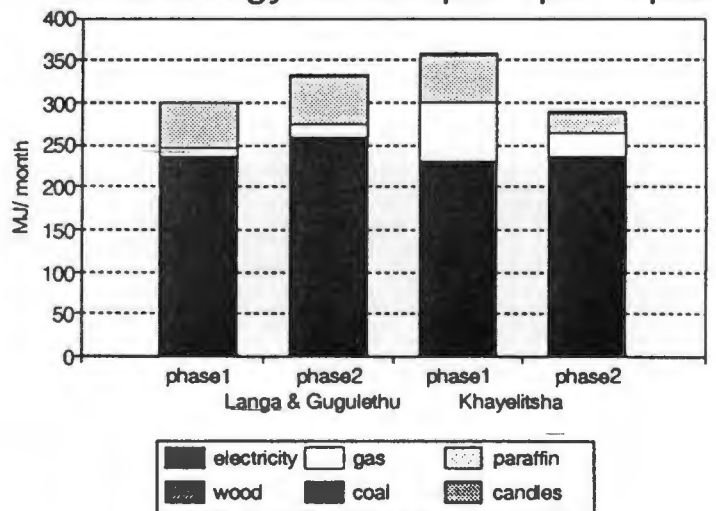


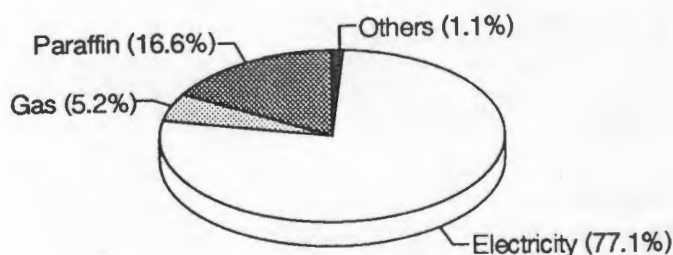
FIGURE 6.7: Average monthly per capita net and useful energy consumption

6.3.3 Percentage contribution of fuels to useful energy consumption

Figure 6.8 shows the percentage contribution of the various fuels to useful energy consumption in the areas surveyed. Since phase 1, the contribution of electricity has increased in Khayelitsha from 63.8% to 81.6%. In the most recent study it contributed more to households' useful energy consumption than in Langa and Guguletu, which has decreased its contribution to useful energy consumption from 78.3% to 77.1%.

This trend of electricity consumers decreasing reliance on electricity in Langa and Guguletu may result from the deteriorating electricity service and disconnections as a result of increasing arrears. This issue is further explored in Chapter 8.

Langa and Guguletu



Khayelitsha

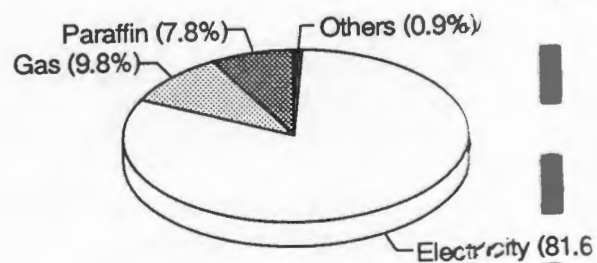


FIGURE 6.8: Useful energy consumption using various fuels

6.3.4 Relationships between energy consumption and household income levels

Figure 6.9 provides a breakdown of useful energy consumption in the areas surveyed. In each case, the energy consumption of highest income group is marginally higher than consumption in the lower income groups. In Langa and Guguletu the *useful* energy used ranged between 1 700 and 1 900 MJ/month for all income groups. For the Khayelitsha sample, all income groups showed decreases, while the range was between 800 and 1 250 MJ/month per household. This trend differs from the same analysis in phase 1, where energy consumption was significantly higher amongst high-income households, a trend that was particularly marked in Langa and Guguletu when phase 1 was conducted. On the information presented above it is clear that electricity consumption and income are related: households with higher incomes use more electricity and less of the other fuels. This correlation is explored in Chapter 7.

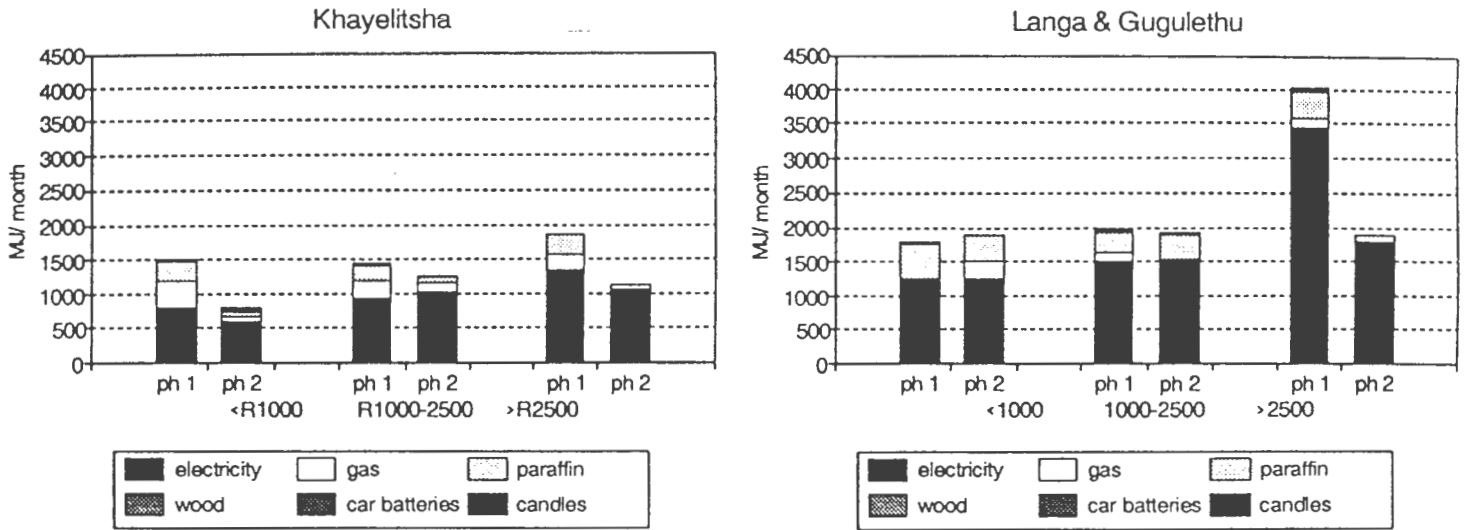


FIGURE 6.9: Useful energy consumption for different income groups

6.4 The costs of fuels used

This section examines the contribution of different fuels to household energy expenditure. Firstly, fuel prices in Langa and Guguletu and Khayelitsha are examined. Secondly, average monthly energy costs in the areas surveyed are presented. Thirdly, the relationship between energy costs and income levels is explored. Fourthly, the contributions of fuels to the household energy budget are described. Finally, the significance of energy costs in total household budget is explained.

6.4.1 Fuel prices in the areas surveyed

Table 6.4 indicates the actual costs per unit of useful energy obtained from different fuel/appliance combinations. The useful energy costs are presented graphically in Figure 6.10. These figure were calculated using:

- the actual amount that households paid (or were charged) per litre, kg or kWh of paraffin, gas or electricity, (reported in the interviews),
- average appliance efficiencies, as specified in Table 6.3., and
- the calorific values of gas (per kg) and paraffin (per litre) included in Table 6.2.

In phase 1 electricity was shown to be the cheapest fuel for cooking (either on a full stove or a hotplate) both in Langa and Guguletu and in Khayelitsha. Phase 2 showed that while the nominal retail price of electricity has increased, it has decreased in the cases of paraffin and gas, making both of them cheaper for cooking than electricity, in all the areas surveyed. The large decrease in the gas price from R2.4 to 1.59 per kilogram in Langa and Guguletu is worth noting. There were only two gas users in the sample during phase 1, one of whom reported paying R3.6 per kilogram from the retail outlet, which skewed the price per kilogram.

In useful energy terms, wood, coal, car batteries and candles are all very expensive.

Fuel	Unit	Khay. ph 1	ph 2	Langa & ph 1	Gugulethu ph 2
PHYSICAL QUANTITIES					
Elec. unit charge	c/kWh	15.00	20.7	10.53	16.7
Monthly charge	R	0.00	-	3.00	-
Ave. elec. cost	c/kWh	15.00	20.7	11.2	16.7
Gas	R/kg	1.8	1.77	2.4	1.59
Paraffin	R/l	1.00	.99	1.1	1.02
Wood	c/kg	35	89	25	98
Coal	R/kg	1.6	-	0.9	-
Car batteries	R/charge	3.2	4.00	-	-
Candles	c/candle	30	37	37	40
NET ENERGY COST					
Electricity	c/MJ	4.2	5.8	3.1	4.6
Gas	c/MJ	3.8	3.6	6.9	3.2
Paraffin	c/MJ	2.7	2.7	3.0	2.8
Wood	c/MJ	2.1	5.2	5.8	5.8
Coal	c/MJ	6.7	-	3.2	-
Car batteries	c/MJ	231	308	-	-
Candles	c/MJ	8.4	10.7	10.3	11.6
USEFUL ENERGY COST IN COOKING APPLIANCES					
Electricity	c/MJ	5.2	7.2	3.9	5.8
Gas	c/MJ	5.3	5.2	9.9	4.6
Paraffin	c/MJ	5.4	5.4	6.0	5.5
Wood	c/MJ	53	52	58	58
Coal	c/MJ	33	-	16	-
Car batteries	c/MJ	289	385	-	-
Candles	c/MJ	17	22	21	23

TABLE 6.4: Energy costs

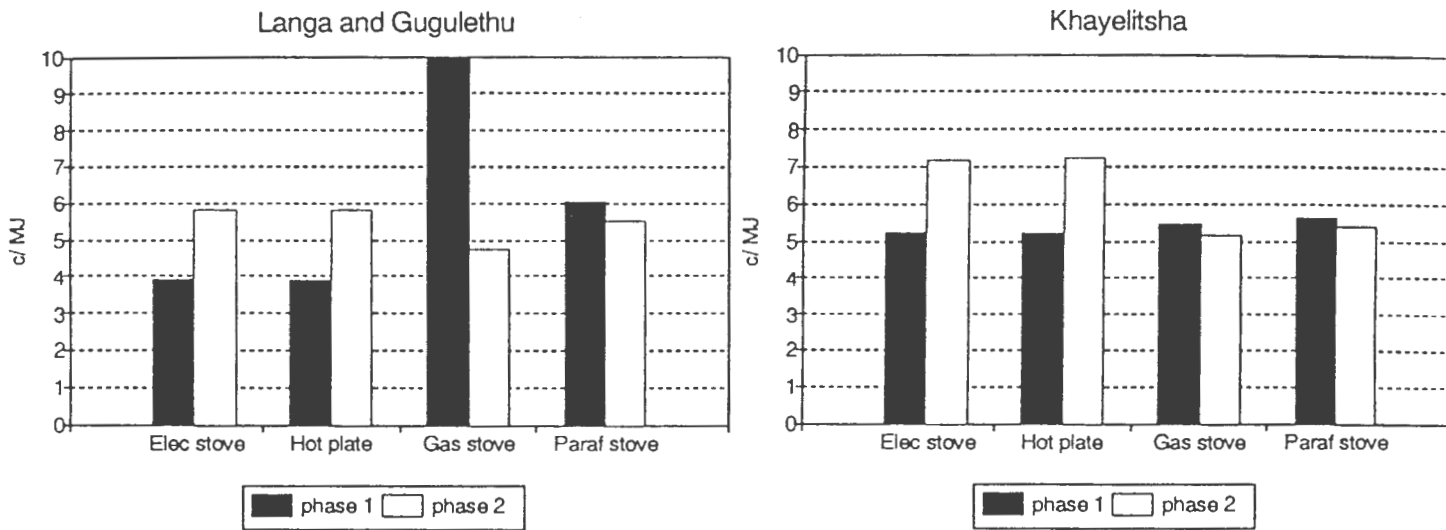


FIGURE 6.10: Net cost of useful energy

6.4.2 Average monthly energy costs

Figure 6.11 shows the average monthly energy service costs for households and per capita usage in the areas surveyed. The figures include costs related to hire-purchase (HP) payments, but not cash costs for electrical appliances. Within the Khayelitsha sample there has been a decrease in nominal expenditure on energy services, from R151 per month to R84 per month. In Langa and Gugulethu a similar trend is apparent, with a reduction from R122 per month to R108/month. In the case of Khayelitsha the reduction can be attributed primarily to the decrease in monthly hire-purchase costs from R71 per month to R17/month.

The two electrified samples are compared to the non-electrified area of Khayelitsha (Towns 1 and 2) which returned figures of R127 (in 1992 rands) per month on energy services (Macroplan, 1992). This study only included the costs of the fuels used in assessing energy service costs. If the basis of comparison is limited to the cost of fuels, households in non-electrified areas spend more on energy services.

Energy service costs per capita have risen in Langa and Gugulethu between the two phases. In Khayelitsha, there is a decrease in energy service cost per capita. In phase 1, appliance purchases were clearly a priority for newly-electrified residents in Khayelitsha; the decrease in such expenditures in phase 2 could be attributed to the appliances having been paid for or repossessed. However, no information gathered in this survey can verify either of these assumptions.

6.4.3 The relationship between household income and energy expenditure

Figure 6.12 shows the average monthly energy costs of households in the areas surveyed, in relationship to income-group categories. The Langa and Gugulethu sample shows negligible increases in energy expenditure with income – from R120 to R127 per month (in 1992 Rands). Hire-purchase costs increase with increased income in this sample.

In Khayelitsha the same trend is evident. Energy-service expenditure increases from R60 per month for those in the lowest-income category, to R110 per month for those earning between R1 000 and R2 500, and then decreases to R102 for those

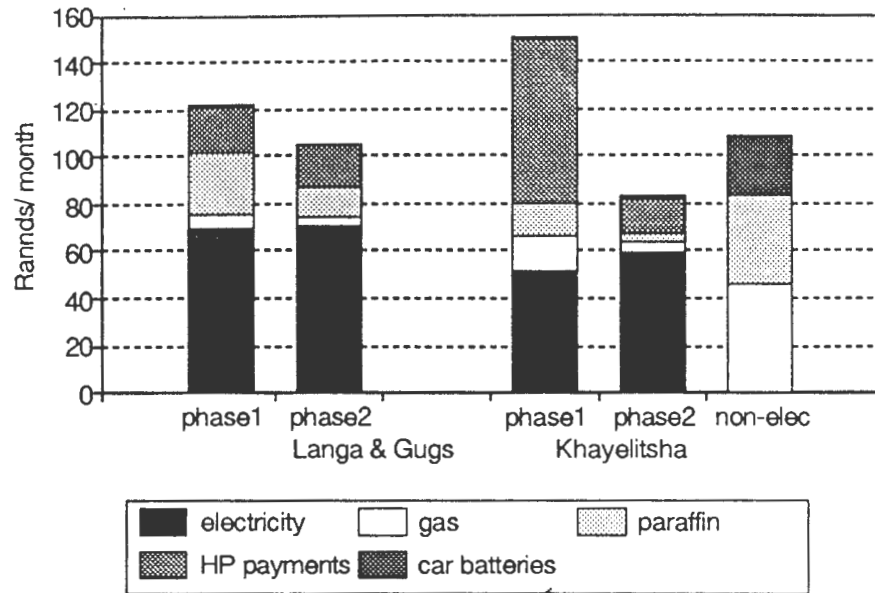
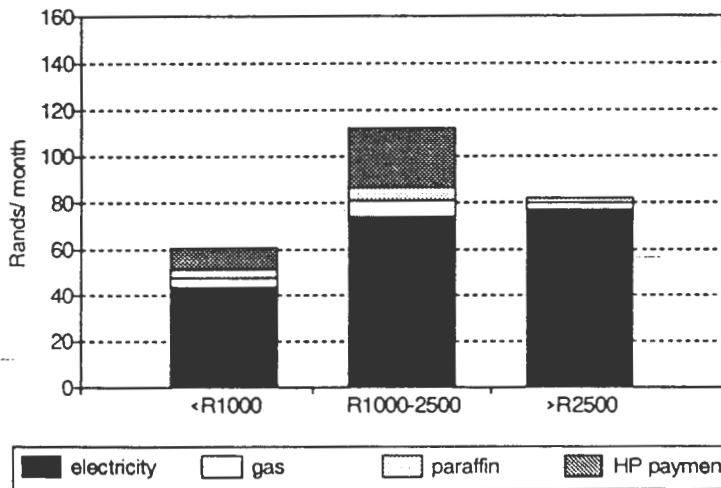


FIGURE 6.11: Average monthly energy service costs

in the highest income category. It is interesting to note that those in the highest income category have no costs attributed to hire purchase. In all areas the amount spent on electricity increases with increasing income. Expenditure on gas and paraffin decreases with increasing income. This could be because electricity is perceived as the most versatile and convenient of fuels rather than the cheapest for the desired energy service.

Income as a determinant of electricity consumption is further explored in Chapter 7.

Khayelitsha



Langa and Gugulethu

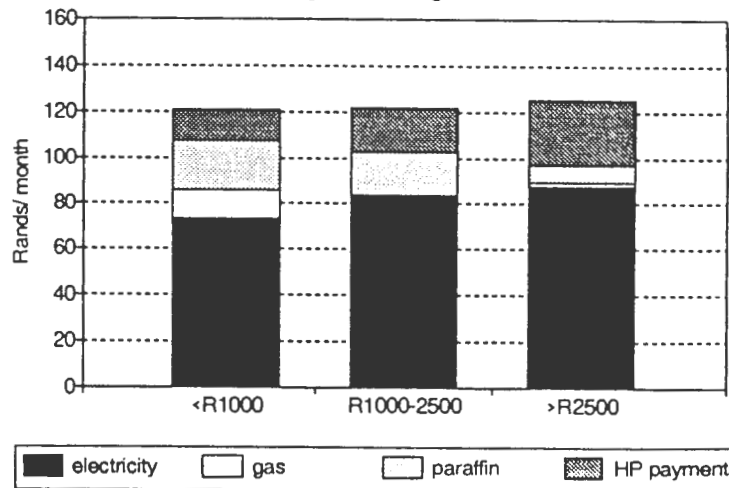


FIGURE 6.12: Energy expenditure by income group

6.4.4 Contributions of fuels to household energy budgets

Figure 6.13 shows the contributions of major fuels to the household energy budget in the areas surveyed. The expenditure on electricity dominates, from 66% for Langa and Guguletu to 69% for Khayelitsha.

Langa and Guguletu

Khayelitsha

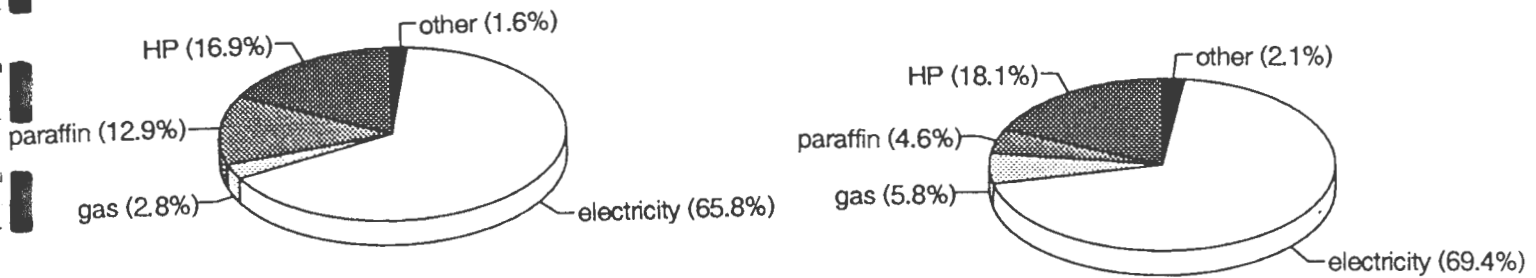


FIGURE 6.13: The proportion of expenditures within household energy service budgets

6.4.5 Energy expenditure and the household budget

Figure 6.14 shows the significance of monthly energy-service expenditure in relation to average monthly household income. The size of the contribution of energy costs in relation to the monthly income decreases as income increases. From phase 1 to phase 2 the monthly energy expenditure has also decreased in relation to income. In Khayelitsha energy expenditure decreased from between 14% and 8% of household income in phase 1 to between 9.5% and 5% in phase 2 across the different income categories. The Langa and Guguletu sample in phase 2 resulted in a range from 16% to 10% as compared with between 17% to 9% in phase 1. In Langa and Guguletu the range of expenditure on energy services has narrowed.

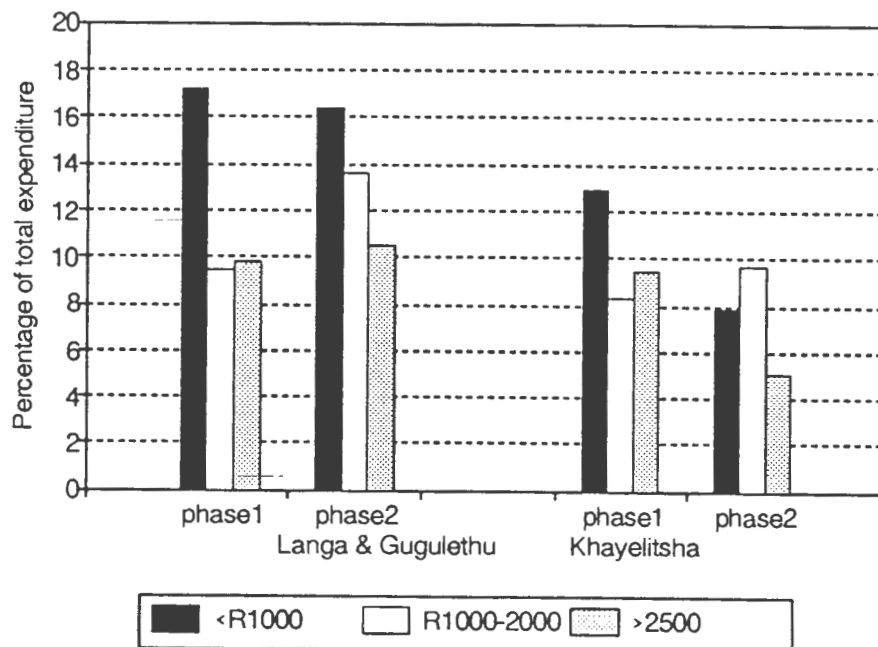


FIGURE 6.14: Energy expenditure as a percentage of household income

6.5 Transport

This section examines transport used by households in the sample living in the areas surveyed. There is debate around whether transport can be considered a household energy service (the World Bank, for example, includes transport costs as household expenditure). This section avoids the debate, and presents transport separately and in comparison with the information presented earlier in this chapter.

6.5.1 Means of transport

Figure 6.15 shows the means of transport used by the members of households sampled in Khayelitsha, Langa and Guguletu. People travel mainly by bus, train and foot. The different means of transport seem to be influenced by local availability. For example, 35% of households in Town 2 Village 1 use trains, which could be attributed to the proximity of the station. The high use of taxis in Town 1 could be attributed to the proximity of the taxi-rank and the main road transport arteries between Khayelitsha and the N2. Bongweni, an area with a higher income than the Khayelitsha average, shows the highest use of transport, probably because of the higher number of employed adults. Many people in the sample use more than one means of transport on a daily basis. Very few households rely on private transport or transport owned by their employers.

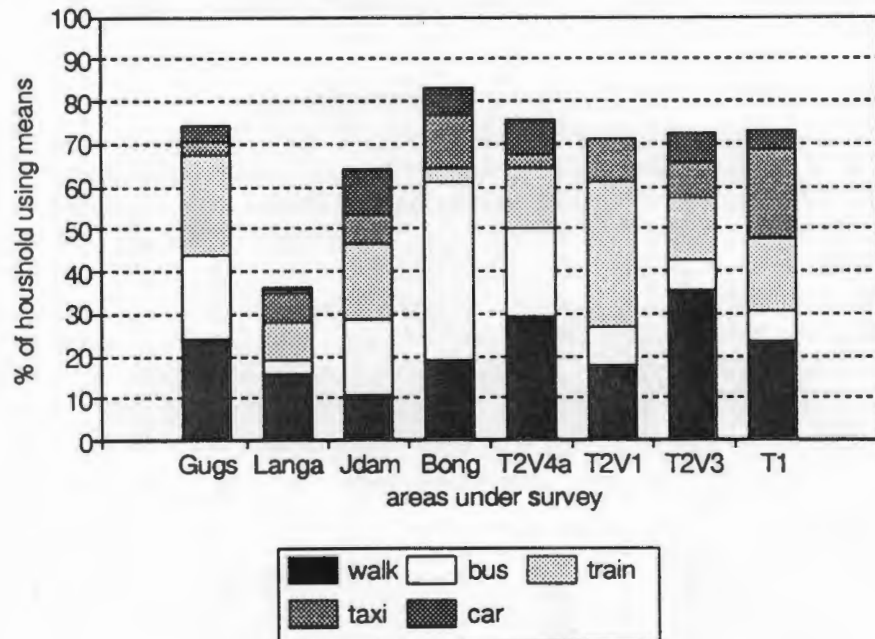


FIGURE 6.15: Means of transport

6.5.2 Transport costs.

Figure 6.16 presents the actual amount spent on transport (corrected for inflation) by households in all areas surveyed in the two phases. This shows that in phase 2, for all areas other than Bongweni, the amount spent on transport is greater than the amount spent in phase 1, with the largest increase in Langa – primarily because of the larger households and the increase in adults doing waged work there.

Figure 6.17 presents the proportion of household expenditure that can be attributed to transport in both phases. The range experienced in phase 1 was between 13.5% and 3.5%, similar to that reported in phase 2. Of those areas showing an increase in transport costs, Langa and Guguletu show the biggest increases, while Town 2 Village 3 shows the largest decrease. Referring to figure 4.6, Guguletu has shown the largest increase in the proportion of adults per household doing waged

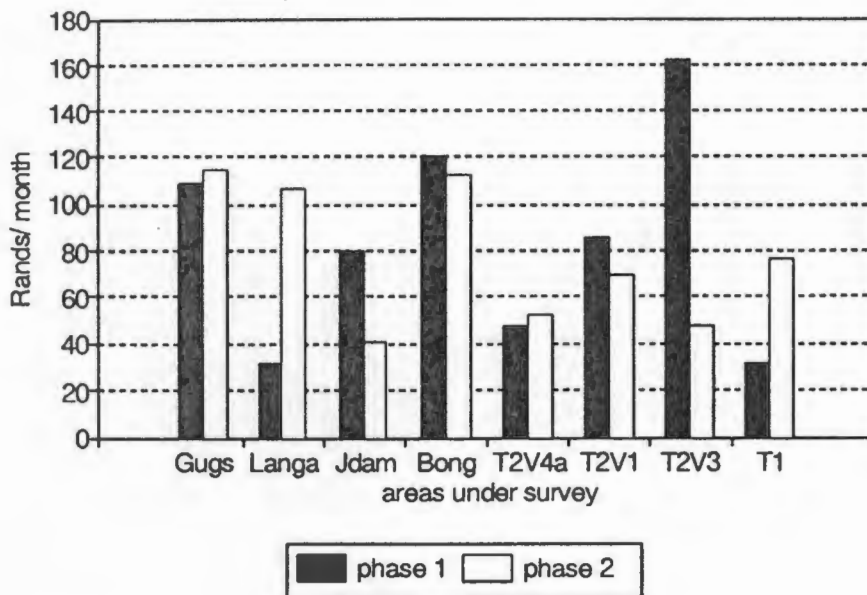


FIGURE 6.16: Transport costs

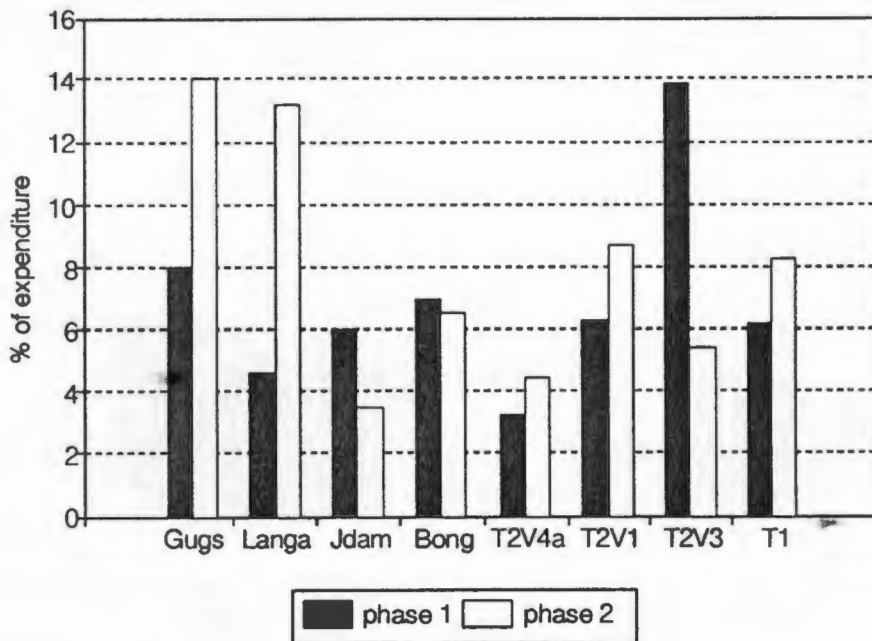


FIGURE 6.17: The proportion of household expenditure attributable to transport costs

work, while the largest decrease in waged work is witnessed in Town 2 Village 3.

Figure 6.18. shows the proportion of income and expenditure that can be attributed to transport. This analysis is only for phase 2.

Figure 6.19 presents the proportion of household expenditure that can be attributed to transport, hire-purchase of electrical appliances and fuels in all the areas surveyed. The figure shows a distinction between the proportions of household's expenditure on energy with and without transport. From this figure it appears that transport contributes 52% in the case of Langa and Guguletu and 45% in Khayelitsha. For Town 1 in Khayelitsha transport and other energy service costs comprise 36% of household expenditure

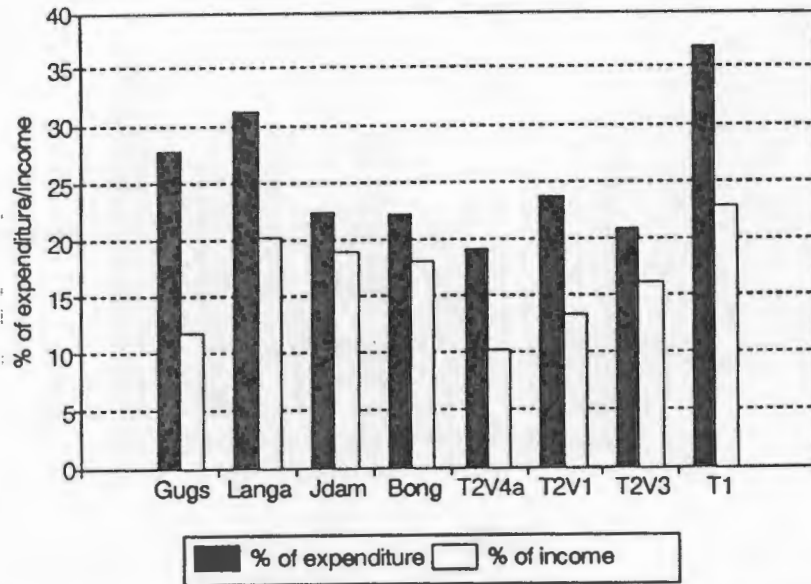


FIGURE 6.18: The proportion of income and expenditure attributable to transport costs

Energy service costs
Langa & Gugulethu

Energy service costs
Khayelitsha

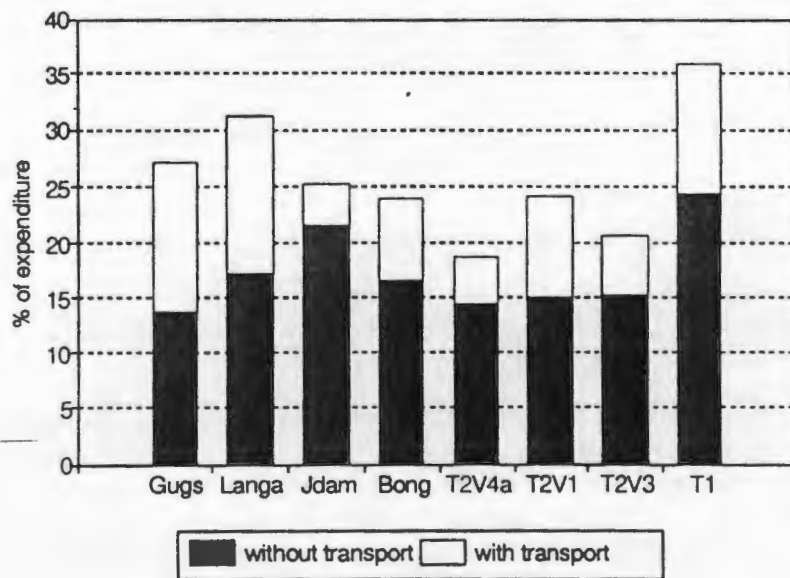
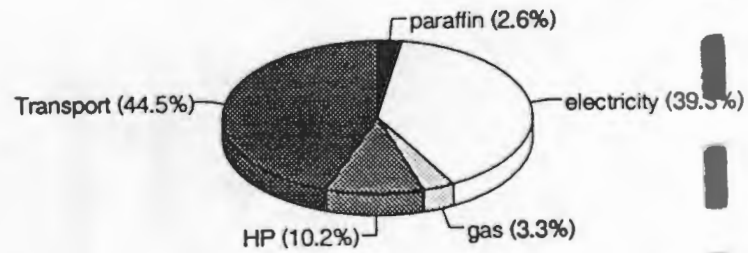
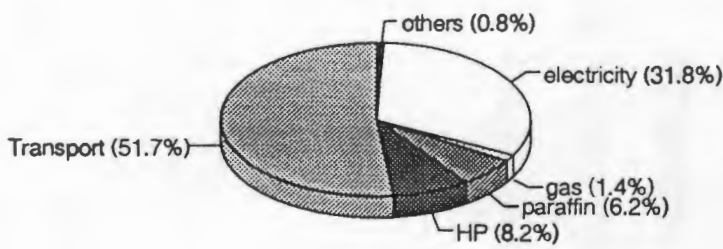


FIGURE 6.19: The proportion of household energy expenditure attributable to transport costs

6.6 Conclusion

Important points emerging from the information presented and discussed in this chapter, with regard to the frequency of fuel use, were:

- The number of households in the sample that are dependent on electricity to provide their daily energy needs has grown from two-thirds to three quarters between phases 1 and 2.
- About one-quarter of electrified households in the areas surveyed still use paraffin and gas daily.
- Dependence on electricity as the only fuel used on a daily basis has increased from 60% to 81% in the Khayelitsha sample and decreased from 72 to 66% in the older areas of the Langa and Guguletu sample.
- Wood, car batteries and coal are very seldom used by low-income households.

With regard to the contribution of fuels to energy consumption, the main points made were:

- *Useful* energy consumption in the areas sampled is roughly equal to the average useful energy consumption of households in the area of supply of the City of Cape Town Electricity Department.
- The contribution of electricity to the energy consumption of households has increased between phases 1 and 2, and increases with increasing income.
- Household electricity consumption in Langa and Guguletu is significantly higher than in Khayelitsha.
- Per capita useful energy consumption has increased in Langa and Guguletu and decreased in Khayelitsha.

With regard to the costs of fuels, the main points were:

- On average, households in electrified areas of Khayelitsha spend R67 per month, while non-electrified adjacent areas of Khayelitsha spend R127.
- Gas and paraffin are cheaper than electricity in both areas on a useful energy basis.
- Hire-purchase payments on electrical appliances contribute significantly to household energy costs, particularly for newly-electrified homes, although hire-purchase payments have greatly reduced in Khayelitsha since phase 1.
- Energy expenditure makes up between 5% and 13% of total household budgets. The percentage contribution of energy is higher for the group of consumers earning less than R1 000 per month.
- If transport is included, energy service expenditure was recorded at a high of 28% for middle-income earners in Langa and Guguletu and a low of 12% in the case of the highest and lowest income groups in Khayelitsha.
- Spending on energy services in nominal Rands has remained steady for the different areas between phases 1 and 2.
- Walking, bus and train are the most commonly used means of transport.
- The choice of means of transport seems to be related to the proximity of means of transport.
- The proportion of household expenditure on transport is roughly similar to hire-purchase costs and all other fuel costs together. For Langa and Guguletu it was 52%, and for Khayelitsha 45%, of the total of transport, hire-purchase (on electrical appliances) and fuel costs.

Chapter Seven

DETERMINANTS OF ELECTRICITY CONSUMPTION

7.1 Introduction

This chapter explores the relationship between electricity consumption and the following variables:

- socio-economic factors (household size, household income and business activities);
- period of access to electricity;
- appliance use for major energy consuming activities;
- perceptions of the quality of service, structure of dwelling and seasonal trends.

Electricity consumption may be affected by many variables. This chapter examines some potential determinants. Conclusions are drawn on the basis of the trends observed from the aggregated data. For most of the variables examined, graphs are presented, describing trends. Where possible best-fit linear regressions are applied to scatter plots and correlations are tested using the R squared statistical tool. In other cases, methods for presenting trends in data are employed that are not statistically rigorous; in such cases apparent trends are noted and reported.

7.2 Socio-economic factors

7.2.1 Household size

Figure 7.1 shows the correlation between electricity consumption and household size in the two areas. Using a linear regression, no clear correlation exists between discrete household versus electricity consumption in either area.

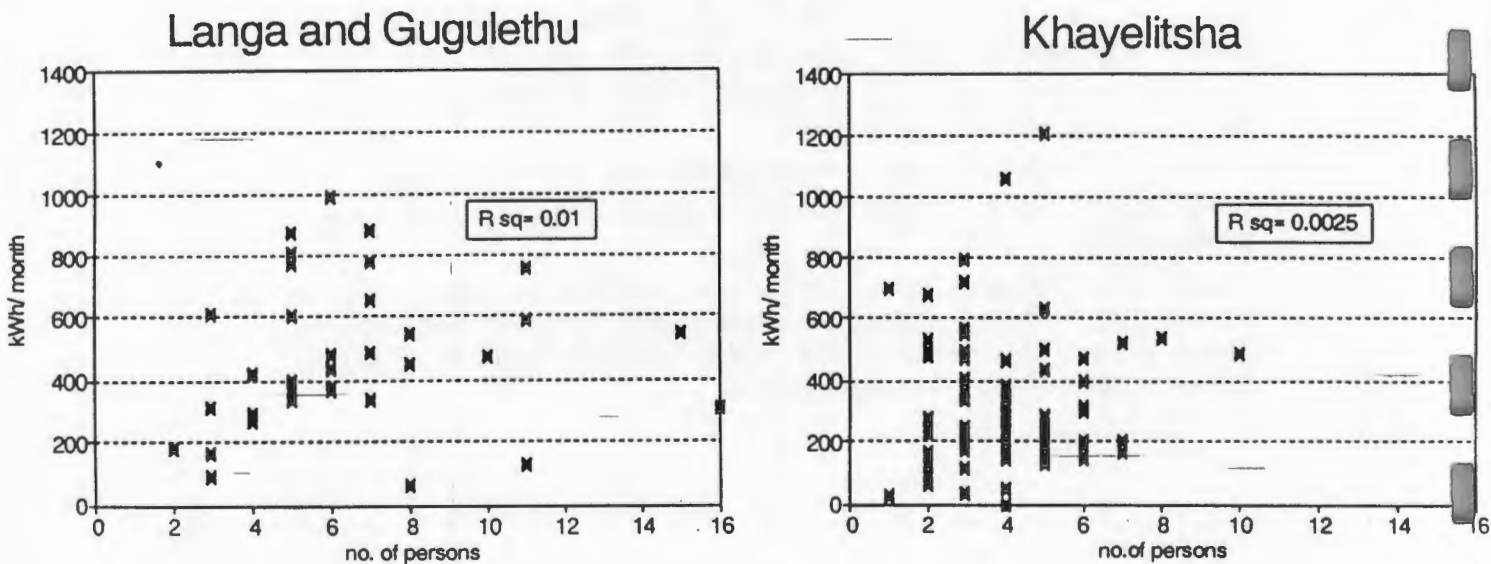


FIGURE 7.1: Household size

Figure 7.2 provides a more useful picture. Using the averages of electricity consumption for categories of household size, a trend can be detected. In Khayelitsha, consumption levels for the two phases were similar at 342 and 335 kWh/month for households with from 1 to 6 members. With households of 7 to 12 people, phase 1 recorded a negligible increase to 350 kWh/month, while phase 2 returned a figure of 390 kWh/month. The phase 2 increase of 55 kWh/month for the larger households indicates a stronger relationship between household size and electricity consumption for the Khayelitsha sample than was shown in phase 1. In Khayelitsha there were no households of more than 12 persons in the sample.

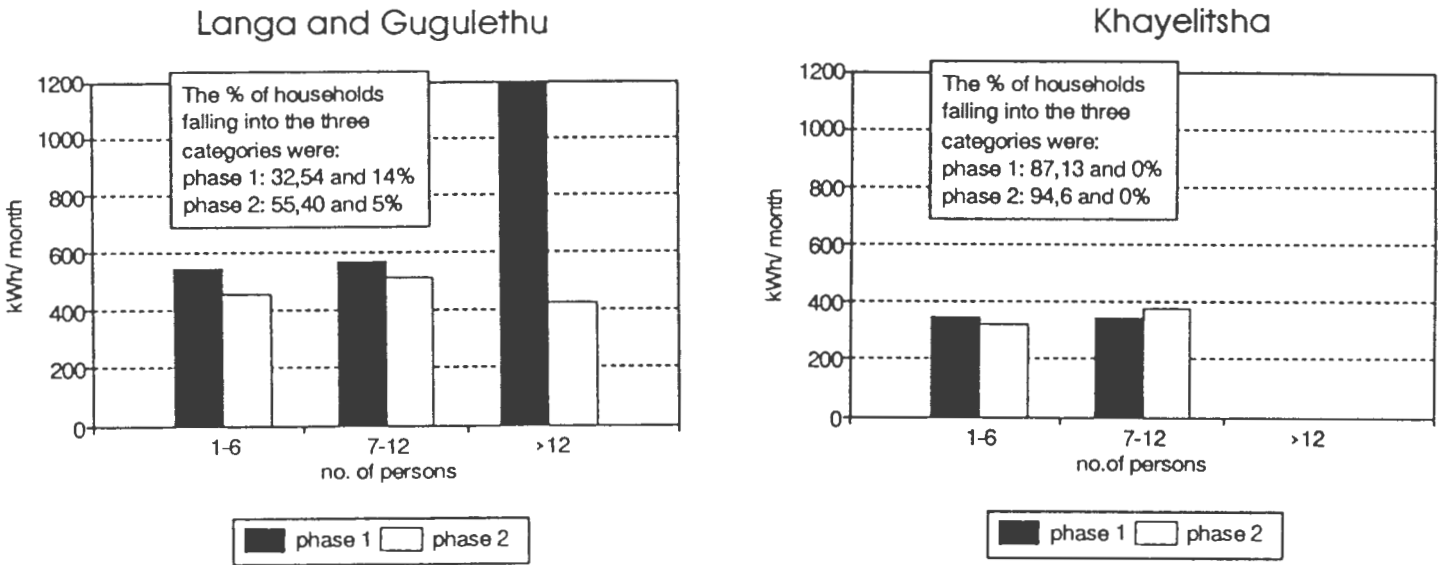


FIGURE 7.2: Household size

In Langa and Gugulethu the very high electricity consumption for the group of largest households was not repeated in phase 2. In phase 1 there was a significant increase in the electricity consumption with a corresponding increase in household size (1 187 kWh/month for the largest households). In phase 2 the largest households showed the lowest electricity consumption (420 kWh/month). However, in both phases the group with the largest household size is small. For the two phases, 14% and 5% of the samples of 29 and 36 consumers, representing 4 and 2 households respectively, were in these groups. In phase 1, one of these four households was a shebeen and had a very high level of consumption. In phase 2 it was impossible to interview the owner of this household, so it was not included in the sample. This would account for the large reduction in consumption for the group with the highest income in phase 2.

From a minority of the sample it is more useful to consider whether household size is a variable that determines electricity consumption over only the first two size-categories. These two groups show an increasing electricity consumption for both phases. Phase 1 shows an increase from 430 to 470 kWh/month, and phase 2 an increase from 450 to 510 kWh/month. Even though there is no correlation according to the R squared analysis, phase 2 shows a trend of increasing electricity consumption with increasing household size.

7.2.2 Household income

Figure 7.3 shows the correlation between electricity consumption and household income in the two areas. When plotting the discrete data of electricity consumption versus household consumption, the correlation proved to be good in the case of Langa and Gugulethu in phase 1. Repeating the exercise in phase 2 showed that

neither of the areas surveyed produced good correlations for the discrete data. In chapter six it was shown that electricity consumption, as a proportion of all fuels, increases as income increases; it seems that fuels are chosen on the basis of convenience. If this assumption holds it could be concluded that the correlation between income and electricity consumption would be strong. The R squared analysis does not affirm the expected trends for either sample.

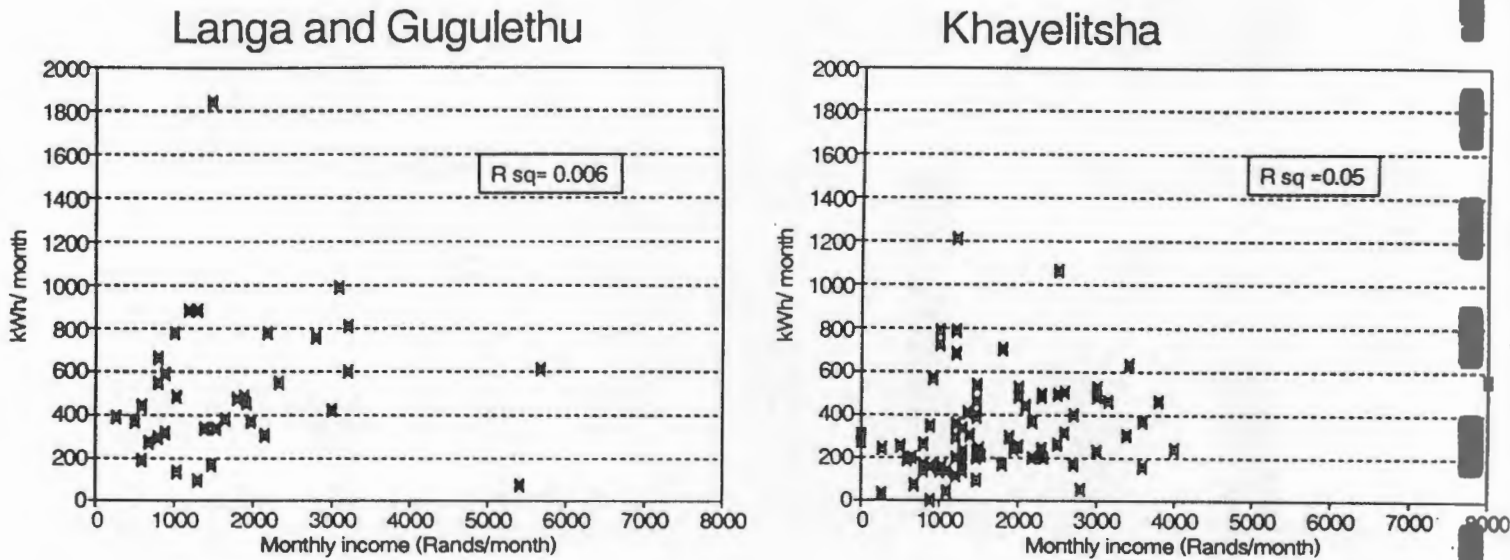


FIGURE 7.3: Household income

Figure 7.4 compares electricity consumption for three income-categories. Phase 1 showed an increase between the first and second categories of 245 to 375 kWh/month, then a reduction to 368 kWh/month for the third category. For phase 2, Khayelitsha shows a slight trend of increasing electricity with the increasing income categories. From the lowest through to the highest group, the increase is from 210 to 360 kWh/month. In phase 2 (as was the case for phase 1) the trend of increasing electricity consumption with increasing income is more exaggerated for Langa and Gugulethu than for Khayelitsha. Phase 2 shows electricity consumption figures of 400, 530 and 610 kWh/month. This trend was more marked in phase 1 where the consumption for the three income categories were

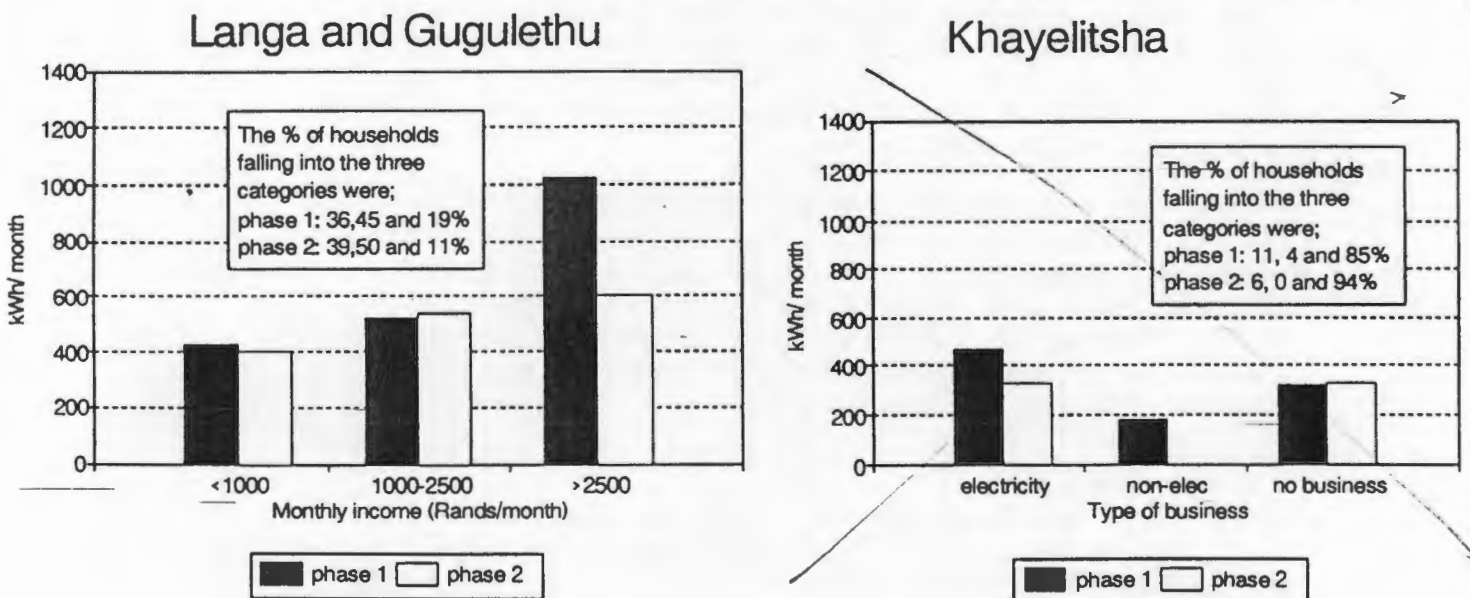


FIGURE 7.4: Household income groups

427, 524 and 1206 kWh/month. Electricity consumption increases slightly with increasing income categories. Income can therefore be considered as a weak determinant of electricity consumption.

7.2.3 Business activities

In this section, business activities are divided into two categories: those for which electricity was used and those in which it was not. For example, the running of a shebeen involves the use of electricity in refrigerators, and would be categorised accordingly. On the other hand a home-based peanut packaging enterprise would not utilise additional electricity and would be categorised as a non-electrical business.

Figure 7.5 examines the effect of business activities on electricity consumption. Unfortunately the percentage of the sample involved in businesses from home is so small that no representative conclusions can be drawn. The figures show that in phase 2 14% of the Langa and Gugulethu sample and 6% of the Khayelitsha sample were involved in businesses from home, compared with 17% and 15% for the two areas in phase 1. (The reason for the reduction in business activities in phase 2 was not explored.) The few businesses that do use electricity, use more electricity than those households that do not manage businesses from home.

Langa and Gugulethu

Khayelitsha

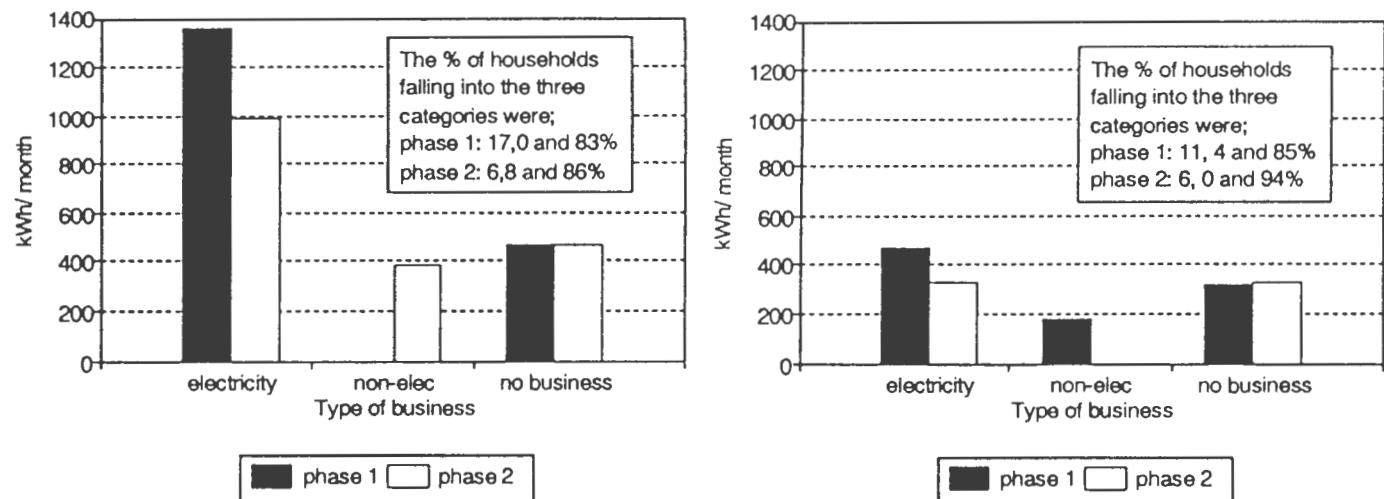


FIGURE 7.5: Business activity

7.2.4 Persons at home during the day

Figure 7.6 provides the relationship between the number of persons at home during the day and the average of the household electricity consumption. It does not present a conclusive trend as to whether the number of people at home during the day is a determinant of electricity consumption.

7.3 Period of access to electricity

The length of time that members of a household have lived in electrified homes can be expected to influence their acquisition of electrical appliances, and hence their levels of electricity consumption. This information was collected in the survey by tracing the movement of each household over the years and ascertaining whether electricity was available at each address recorded. Figure 7.7 indicates that the correlation between discrete consumers and their years of access is poor in both areas surveyed.

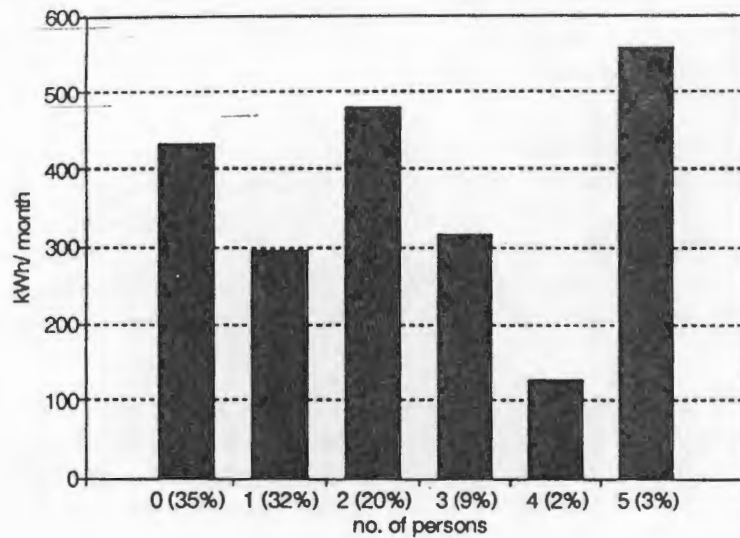


FIGURE 7.6: Persons at home during the day

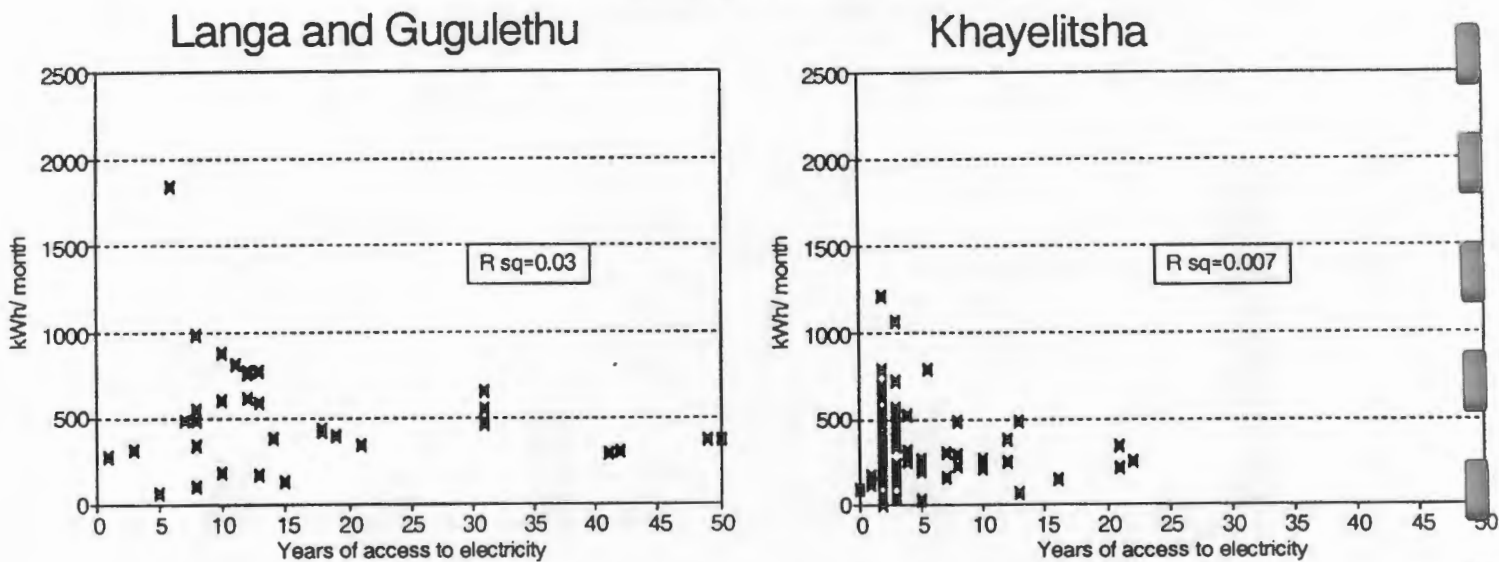


FIGURE 7.7: Years of access to electricity

Figure 7.8 provides a more aggregated version of the information presented in Figure 7.7. In Khayelitsha, households broadly fall into two categories – those who have moved into their first electrified home (those who have had access to electricity for less than 5 years), and those who have moved from an area that was electrified to an electrified part of Khayelitsha (those who have had electricity for more than five years). While phase 1 showed a growing trend from 230 to 445 kWh/month, phase 2 shows a trend that is lower for the category of consumers who have had access to electricity the longest. However, the group that has gained access to electricity for the first time within the last 2 years uses the least electricity.

In phase 1 the Khayelitsha sample confirmed the expected trend of increasing consumption of electricity with increasing access to electricity. From the data gathered in phase 2, the same conclusion cannot be drawn.

In Langa and Gugulethu the nine percent of consumers (or three consumers) in the lower two categories show lower consumption than in the larger group. While this conforms to the trend in phase 1, it is not particularly useful in terms of the representation of this minority of the sample. The figures for the lowest and

highest categories of consumers in phase 2 are 275 and 535 kWh/month. In phase 1 the same groups were at 255 and 646 kWh/month.

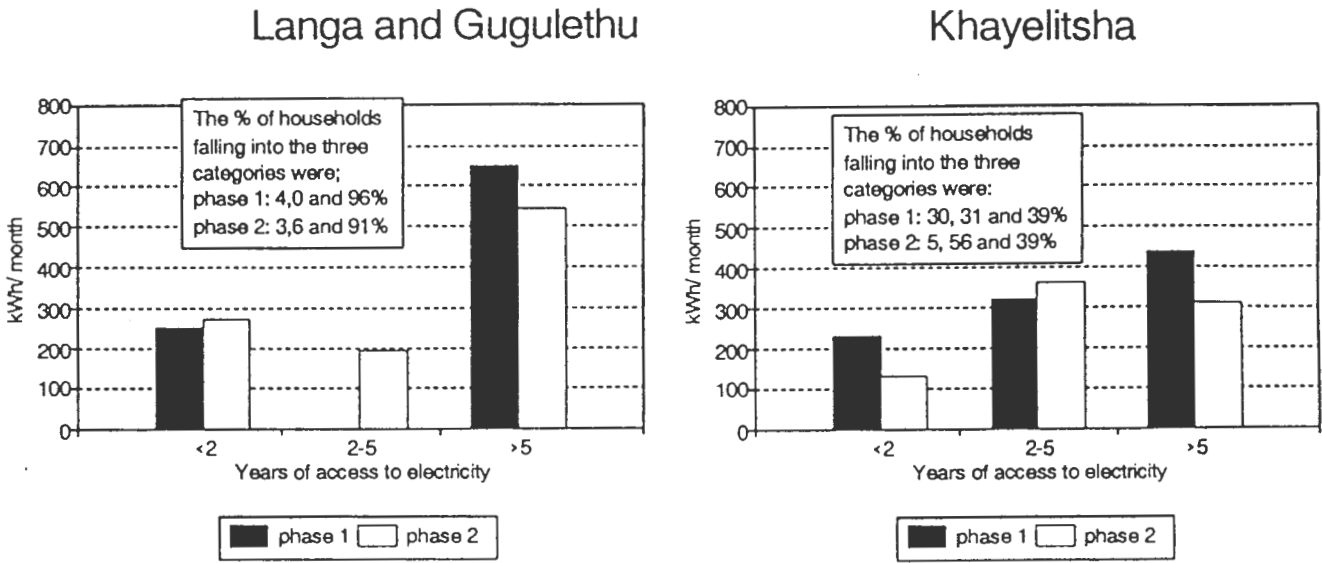


FIGURE 7.8: Years of access to electricity

Another way of illustrating the relationship between electricity consumption and the period of access is shown in Figure 7.9. Using the electricity consumption data for the entire consumer base in Khayelitsha (provided by Lingeletu West City Council), an analysis of consumption data was carried out amongst all households in Town 2 Village 3 that have most recently gained access to electricity.

Khayelitsha Town 2 Village 3

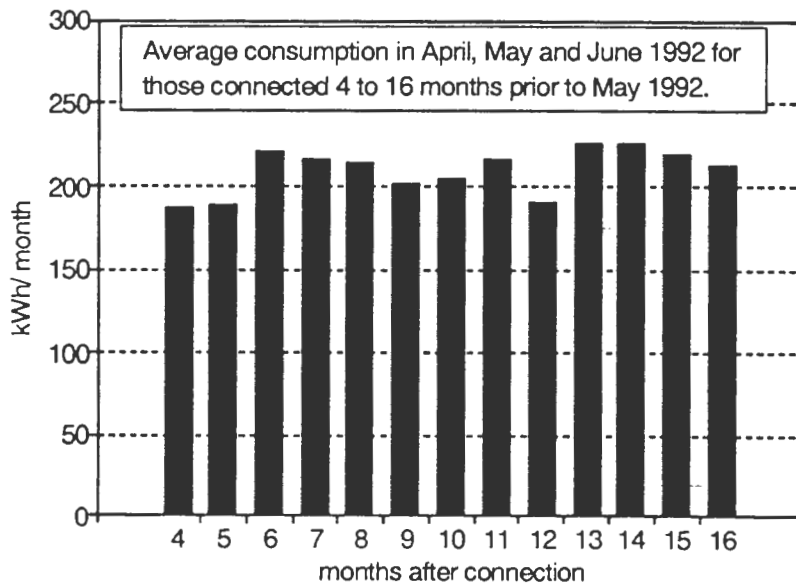


FIGURE 7.9: Period of access to electricity

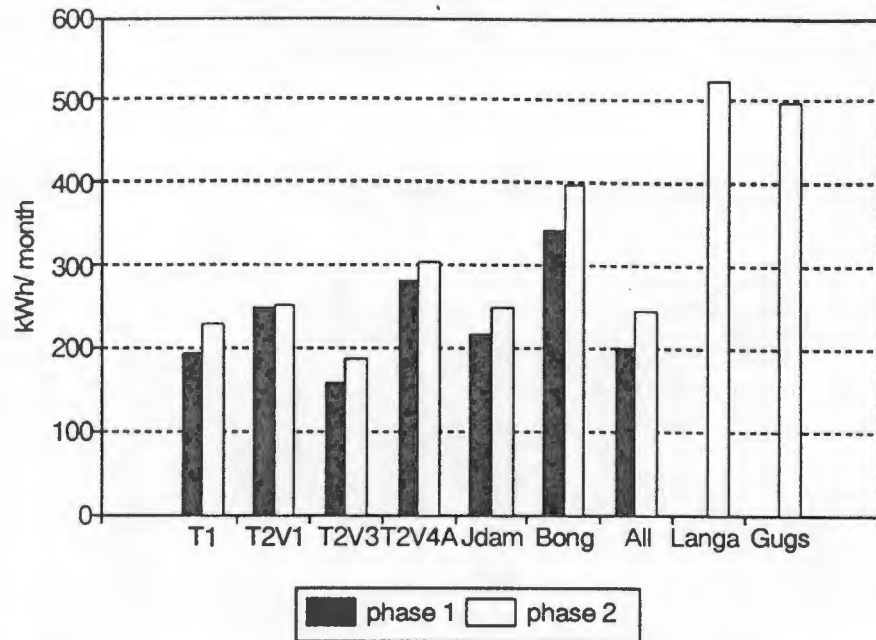


FIGURE 7.10: Annual averages for all consumers in Khayelitsha, Langa and Guguletu

The method in generating the data for Figure 7.9 was similar to that used in phase 1. In phase 2 the method was to calculate the average consumption of electricity over the winter months of April, May and June 1992 for all houses electrified since the beginning of 1991. These averages were grouped into those who had gained access to electricity from four to sixteen months prior to May 1992. This method of analysing the growth in consumption of electricity does not show any clear increase of electricity consumption over time. Consumption remains constant at around 200 kWh/month. However, it does present an increase in the starting-point of electricity consumption from that reported for the groups of newly-electrified consumers in phase 1 (around 150 kWh/month).

While this method of presentation eliminates the seasonal influences that would alter longitudinal trends, it uses new and different groups of consumers for each of the months of consumption data. The reasons for connecting different consumers at different times may relate to the policy of the electricity distribution authority (for example, perceived ability to pay for electricity), and may be related to one or more of the variables discussed in this chapter. This would interfere with the correlation that Figure 7.9 attempts to establish.

From Figure 3.3 it is clear that consumption of electricity is increasing for all consumers in Town 2 Village 3 and, from Figure 3.9, that it is increasing for all consumers in Khayelitsha despite significant increases in the size of the consumer base. This is also corroborated by Figure 7.10, which shows the annual averages for all areas in the survey for phases 1 and 2. Without exception the annual average consumption for the entire consumer base has increased.

7.4 Appliance use

From the household perspective, the factors that influence choice of fuel/appliance combinations (where there is access to fuels and appliances), are determined by the desired energy service and the means to acquire them. From this perspective, cooking, water heating (for washing), refrigeration and space heating are considered the major energy-consuming services. The relationship between the ownership of appliances (that fulfil these service requirements) and their effect on electricity consumption are examined here.

7.4.1 Primary cooking appliances

Figure 7.11 shows electricity consumption by different households using different primary cooking fuels and appliances.

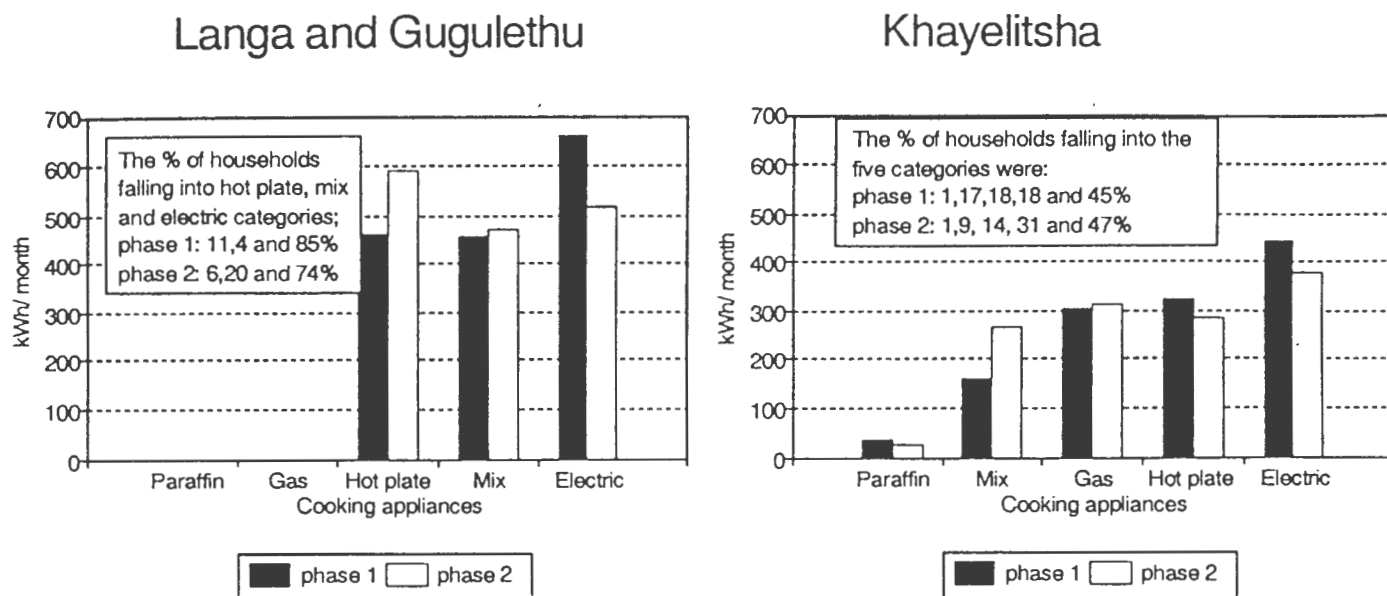


FIGURE 7.11: Total electricity consumption for households using various cooking appliances

Electric hotplates do not have a very significant effect on electricity consumption. Those using electric hotplates as their primary cooking appliance use 280 kWh/month. Stove users, on the other hand, typically use 370 kWh/month in Khayelitsha and 522 kWh/month in Langa and Gugulethu. Stove use thus significantly increases electricity consumption.

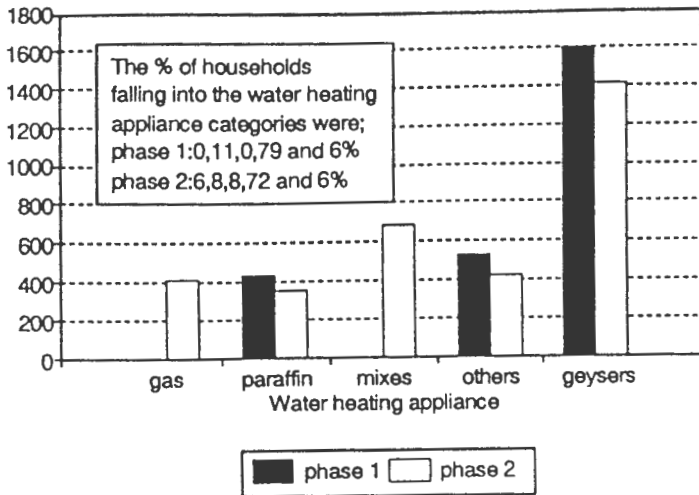
7.4.2 Water-heating appliances

Figure 7.12 displays the relationship between electricity consumption and appliance use for water-heating. Geyser-users in Khayelitsha have increased from 58% to 65% of the sample between phases 1 and 2. Only two of the sample in Langa and Gugulethu use geysers for heating water. Of the 52 households in the Khayelitsha sample using geysers, four use them sometimes (either in winter or before bathing) and two have turned them off. Only one of the respondents could say how much it costs to keep the geyser on all the time. This household was on a very tight budget and explained that the difference between having the geyser turned on or off amounted to R20. (This household preferred to turn their geyser off.)

Figure 7.12 suggests that households with electric geysers use far more electricity than those without geysers. The information provided in the case of Khayelitsha points to 428 and 402 kWh/month for phases 1 and 2 being the electricity consumption for the households with geysers. The 6% (or 2 households) in the Langa and Gugulethu sample using geysers is too small a minority to consider drawing trends from. The category of 'others' refers to all those households who did not specify their methods of water heating.

From Figures 7.11 and 7.12 it is not possible to determine whether there is any overlap between those with geysers and those with electric stoves. The entire sample was thus disaggregated into four groups: those with neither geysers nor stoves; those with a geyser only; those with electric stoves only; and those with both geysers and electric stoves.

Langa and Guglethu



Khayelitsha

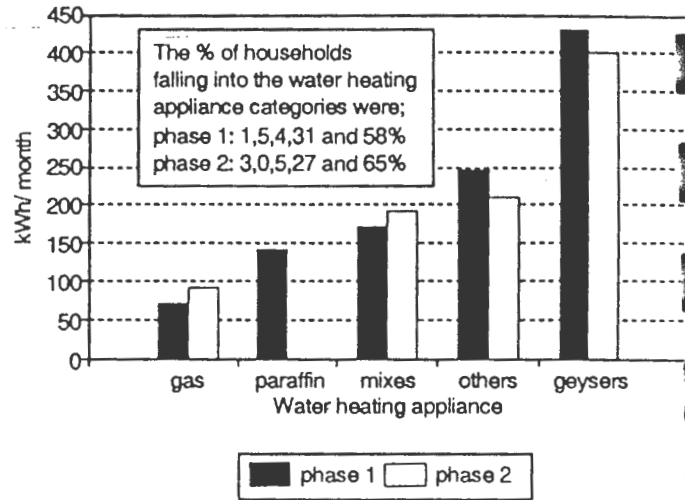


FIGURE 7.12: Total electricity consumption for households using various water heating appliances. (please note the different Y-axis scale)

Figure 7.13 shows the different average levels of electricity consumption for these groups of households. For phases 1 and 2 the geysers-only group showed average electricity consumption of 339 and 355 kWh/month. Those with only a stove showed averages of 448 and 370 kWh/month. The 'both' category showed levels of 649 and 505 kWh/month for the two phases. From the results of both phases it appears that owning an electric stove would result in a higher electricity consumption than just owning a geyser, though this trend is less clear in phase 2 than it was in phase 1.

Within the group that has stoves, geysers increase consumption by 45% and 36% for phases 1 and 2 respectively.

Within the group that does not have stoves, geysers increase the consumption by 66% and 32% for the two phases.

Together, stoves and geysers, have a significant impact on electricity consumption.

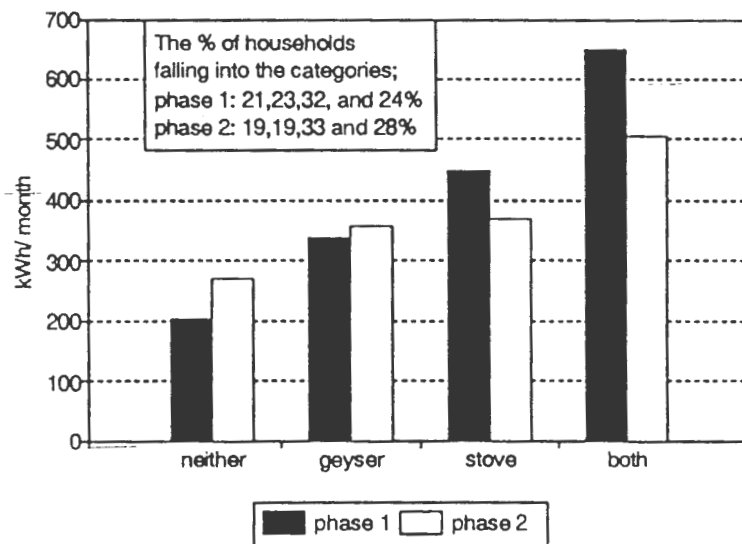


FIGURE 7.13: Total electricity consumption for households using various stoves and/or geysers

Water-heating is seen as a significant energy load on the household. Phase 2 examined the relationship between access to water and electricity consumption. Figure 7.14 looks at Town 1 in Khayelitsha where 6 of the 10 households in the sample do not have water in the house. For Town 1 those with access to water inside the dwelling use 232 kWh/month. This is more than the 170 kWh/month used by the households that do not have easy access to water.

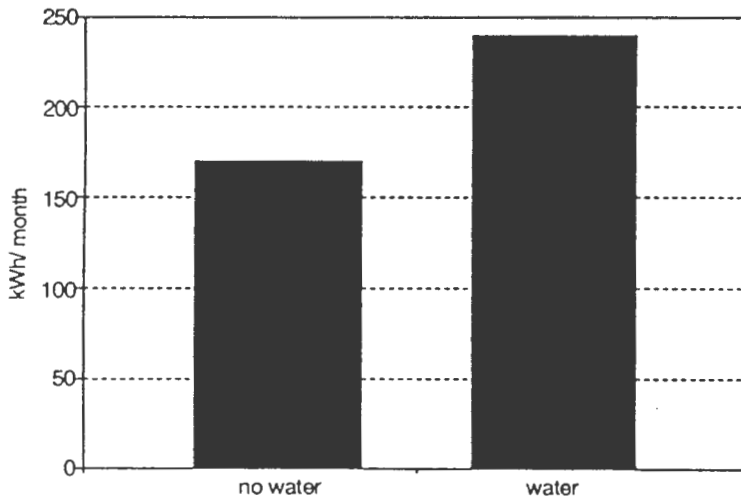


FIGURE 7.14: Access to water in Town 1, Khayelitsha

Figure 7.15 looks at those households in the entire sample that use a bath for washing. The 21% with baths use 410 kWh/month. The other 79% that use basins for washing use 380 kWh/month. Phase 2 determined washing behaviour amongst the sample and established the washing frequencies. From the following information the amount of energy used in ablutions can be calculated:

- the frequency of bathing;
- the number of adult occupants of the household;
- knowledge of how many times the water is used;
- assuming that 45 degrees centigrade is a desirable washing temperature (an average ambient of 15 degrees for Cape Town); and that
- a bath uses 28 litres (Bennett) and a basin 10 litres.

Those using basins would typically use 140 MJ/month, and those using baths 880 MJ/month.

In Chapter 6 the amount of useful energy required per household was calculated to be 1 300 MJ/month per household for all consumers in the sample. From these calculations water-heating for ablution can be considered as a major household consumer of energy.

7.4.3 Space-heating appliances

Figure 7.16 provides information on the electricity-consumption levels of households using different space-heating appliances. (Chapter 4 discusses the use of such appliances.) There has been a reduction in electric space-heating appliances in both areas surveyed. From Figure 7.16 it is evident that more electricity is used in households that use electric heating appliances. In Langa and Guguletu 31% of the sample that used electric heaters use on average 450 kWh/month. In Khayelitsha the 50% of the sample using electric heaters in phase 1 used 443

kWh/month. In phase 2, the 27% still using electric heaters used on average 400 kWh/month.

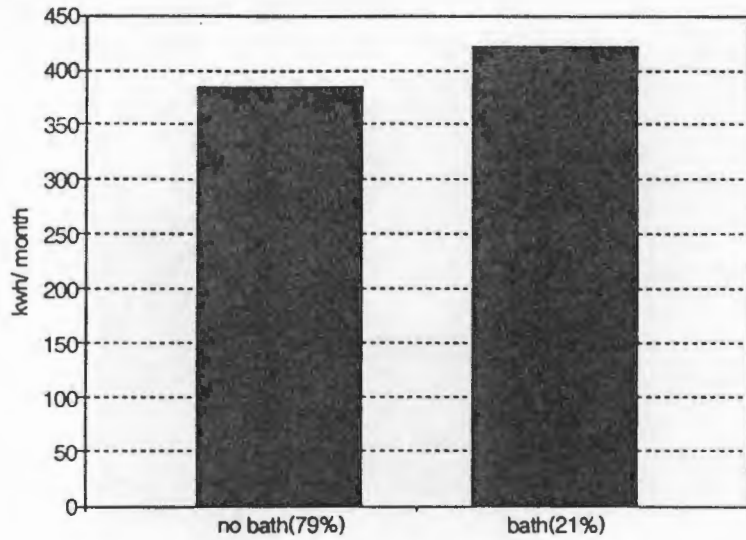


FIGURE 7.15: Households with baths

As can be seen in chapter 5 there is dramatic decrease in the incidence of space-heaters. This has caused some concern as there seems to be no explanation from the study. It is clear that further work is required to discover the reasons for the movement of such appliances.

Langa and Gugulethu

Khayelitsha

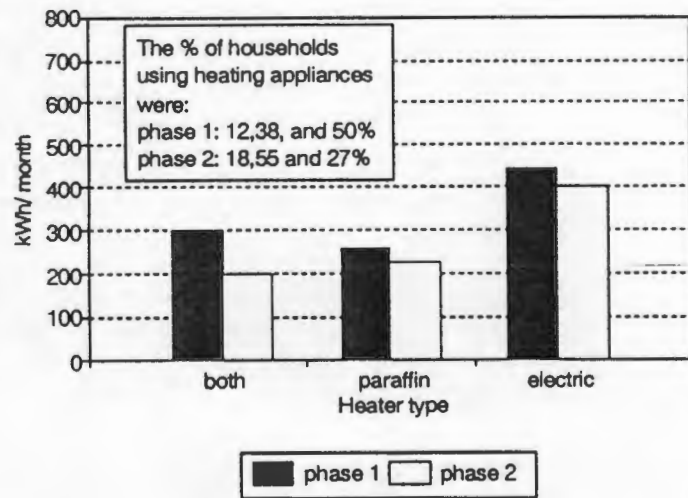
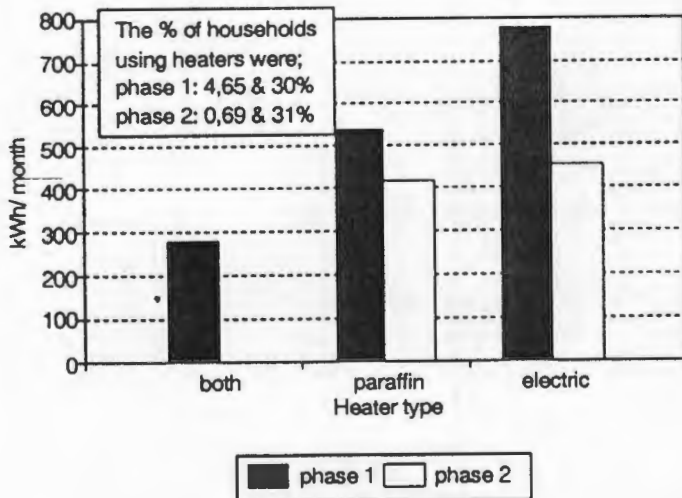
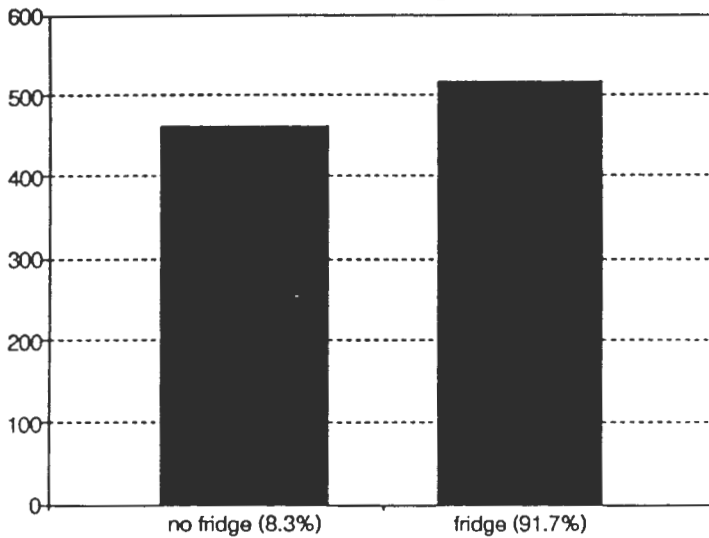


FIGURE 7.16: Total electricity consumption for households in the sample using various space-heating appliances

7.4.4 Refrigerators

Figure 7.17 shows the relationship between electricity consumption and households with refrigerators. For Langa and Gugulethu the 92% using them have an electricity consumption of 515 kWh/month, the 8% that do not consume 460 kWh/month. In Khayelitsha the 74% of the households with refrigerators use on average 370 kWh/month, the 26% without use 235 kWh/month. Refrigerator-owners in Langa and Gugulethu use 12% and in Khayelitsha 57% more electricity than non-owners.

Langa and Gugulethu



Khayelitsha

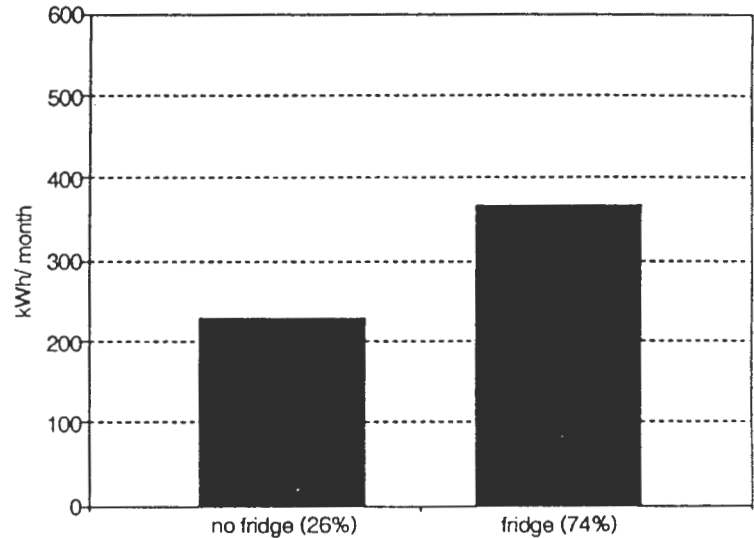


FIGURE 7.17: Refrigerator-ownership and consumption

7.4.5 The number of electrical appliances owned

Figure 7.18 gives the number of electrical appliances owned against electricity consumption. In this case there appears to be a good correlation. The total number of appliances can be considered a good determinant of electricity consumption. In totalling the number of appliances, lights were counted as one appliance.

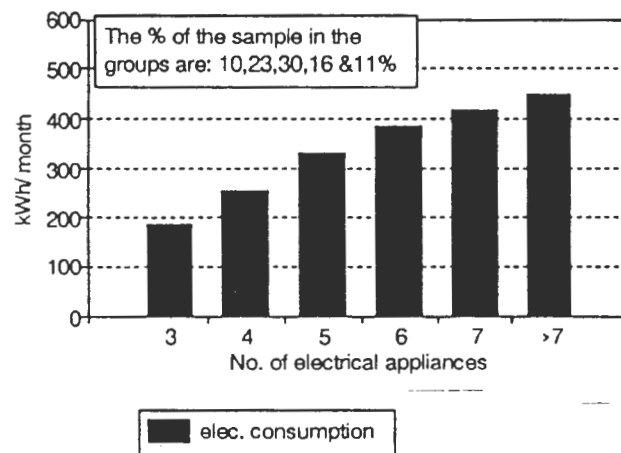


FIGURE 7.18: The total number of electrical appliances against electricity consumption

7.5 Dwelling insulation and ceilings

Figure 7.19 looks at electricity consumption of households with and without ceilings and insulation. For households in the Khayelitsha sample that have both ceilings and insulation the average is 370 kWh/month. For those with no insulation but with ceilings the average electricity consumption is 230 kWh/month; for those with neither ceilings nor insulation, the average electricity consumption is 185 kWh/month. Households with insulation and ceilings therefore use more electricity than those without one or both of these. This is the opposite of what was expected. The absence of ceilings and insulation and their influence on electricity consumption is overshadowed by other determinants of electricity consumption, such as income. For instance, the houses without ceilings are predominantly in the poorest parts of Khayelitsha, such as Town 1. Dwellings in Langa and Guguletu all have ceilings and some insulation.

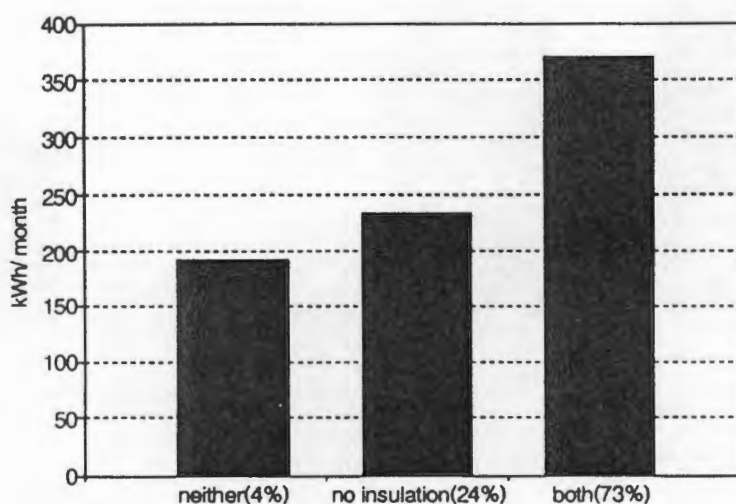


FIGURE 7.19: Ceilings and insulation in Khayelitsha households

7.6 Seasonal trends

Figure 7.20 presents the average minimum temperatures (at D F Malan airport) per month and compares this to the electricity consumption amongst electricity consumers in Khayelitsha. In winter (as opposed to summer) the lighting, space- and water-heating household energy loads increase and this accounts for the increase in the amount of electricity consumed in winter months.

As shown in chapter three, all of the longitudinal electricity consumption trends show seasonal trends.

7.7 Quality of electricity service

Figure 7.21 shows the electricity consumption in households that have reported the duration of blackouts in Khayelitsha. (Blackouts are used as an indicator of the quality of the service in Chapter 8). It appears that as blackouts last longer, reliance on the electricity service decreases.

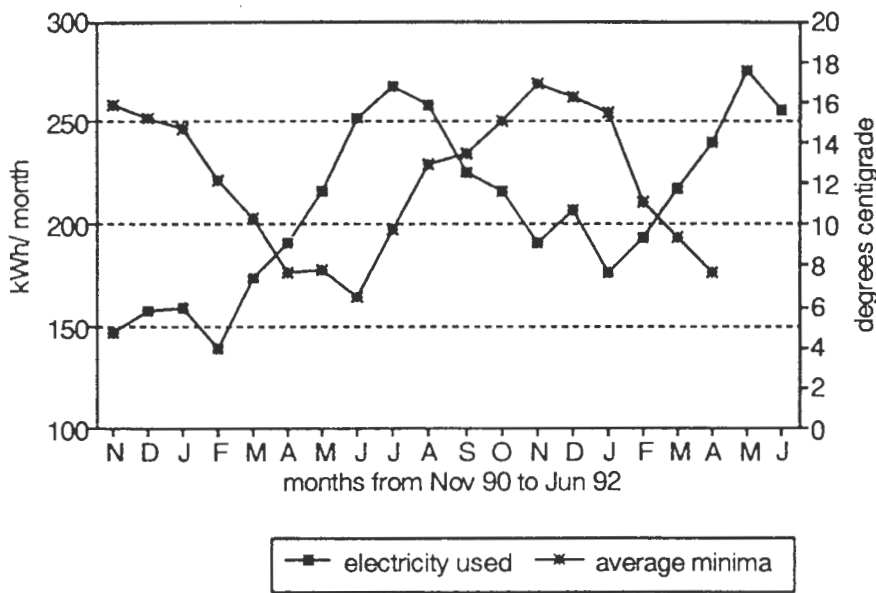


FIGURE 7.20: Monthly averages of electricity consumption and average minimum temperatures

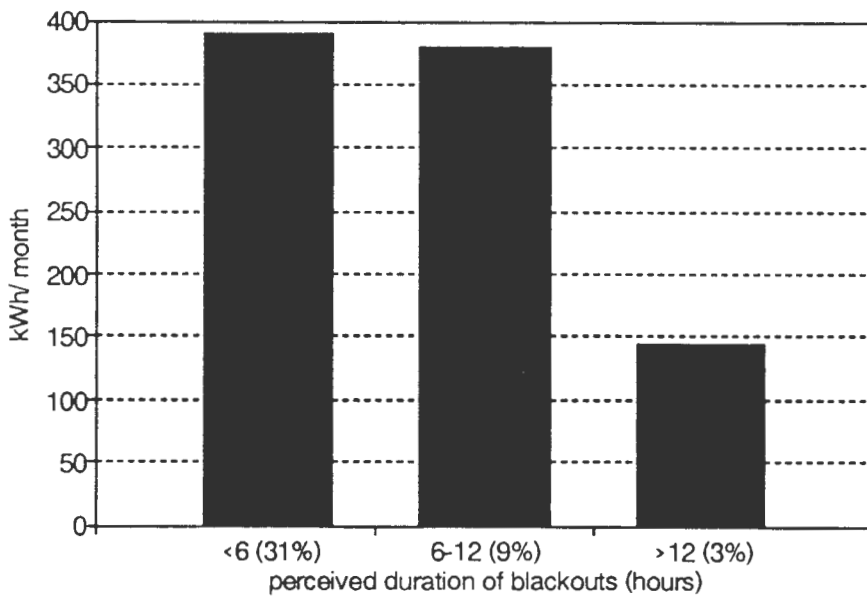


FIGURE 7.21: Perceived duration of blackouts and their effect on electricity consumption

7.8 Conclusions

The main conclusions reached in this chapter are the following:

- In both areas in which interviews were conducted, electricity consumption increases as household size increases.
- Household income is not clearly a determinant of electricity consumption.
- Electricity-using business activities run from home result in more electricity being consumed than in households where businesses run from home do not use electricity.
- The length of time since gaining access to electricity is a determinant of electricity consumption.
- Households which use electric stoves on a daily basis have higher electricity

- consumption than households that do not regularly cook on electric stoves.
- Use of electric hot water geysers increases the electricity consumption.
 - Households with fridges use more electricity than those that do not own them.
 - Households that have access to tapped water inside the dwelling use more electricity than those that do not.
 - Water-heating for ablution could use between 10% and 50% of the energy load for households in the sample, depending on whether a basin or a bath is used.
 - The total number of electrical appliances owned can be considered as a determinant of electricity consumption.
 - Seasonal trends (average minimum temperatures) are a determinant of electricity consumption.
 - The perceived duration of blackouts influences electricity consumption.
 - There is no obvious effect on electricity consumption of either the number of persons at home during the day, nor dwelling-insulation and ceilings.

Chapter Eight

ATTITUDES OF CONSUMERS IN LOW-INCOME AREAS TO ELECTRICITY

8.1 Introduction

This chapter presents information on the attitudes and perceptions of households towards the delivery of electricity services. Included are:

- attitudes towards the quality of supply, and the distribution authority;
- perceptions of the affordability of electricity;
- attitudes towards supply technologies (area lighting, electricity billing, purchasing and metering systems);
- perceptions of the environmental effects of having access to electricity; and
- aspirations with regard to electricity consumption.

8.2 Attitudes to electricity supply

8.2.1 Perceptions of the quality of supply

In phase 1 perception of the frequency of blackouts was considered a useful indicator of the quality of electricity supply; in phase 2 these perceptions are explored, together with perceived duration of blackouts. Figure 8.1 shows the perception of households of the frequency of electricity blackouts. Households were asked whether blackouts occurred often. Since phase 1 there seems to have been an improvement in the reliability of the electricity service in most areas, with Town 2 Village 1, Langa and Gugulethu being exceptions. The problems experienced in phase 1 for the areas of Bongweni have clearly been resolved, or

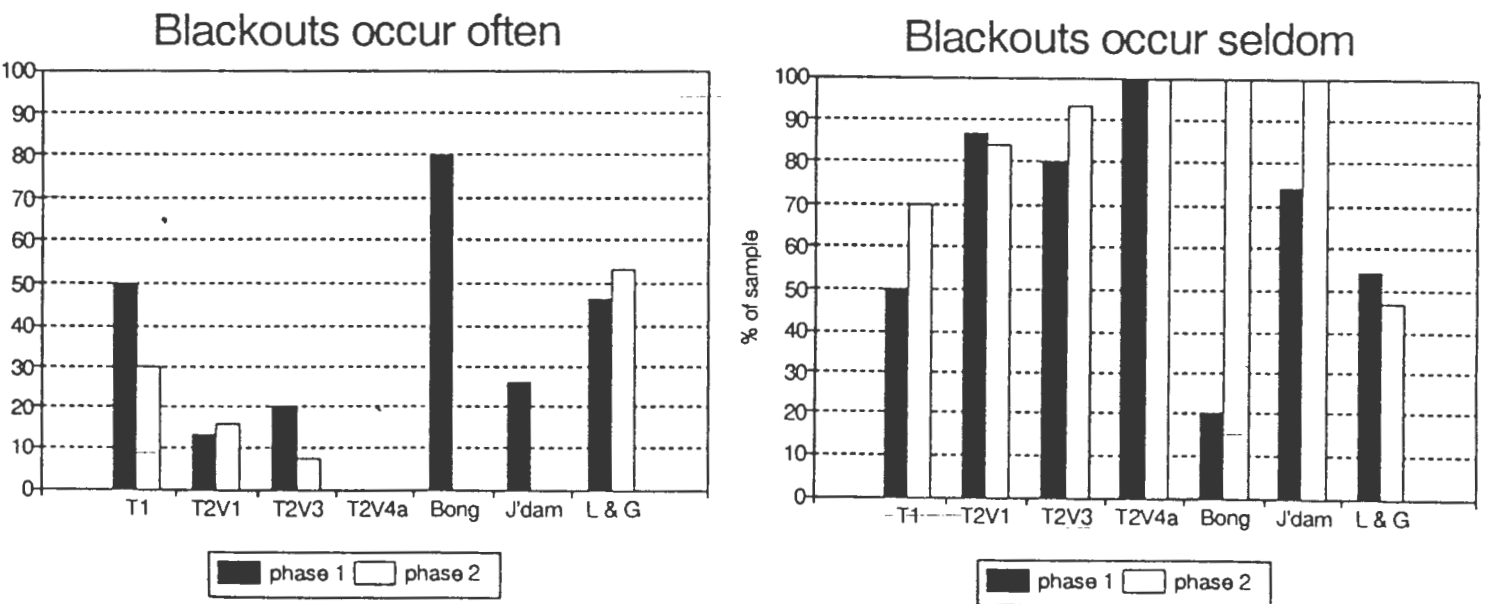


FIGURE 8.1: Perceived frequency of blackouts

households in the sample have become more tolerant of frequent blackouts. Reliability of electricity supply in Town 1 is perceived to be low, with 30% referring to blackouts occurring often.

There were no households that suggested that blackouts occurred 'never'; the balance of the sample suggested that blackouts occur 'seldom'. All members of the sample in Town 2 Village 4a, Bongweni and Jonkersdam believe that blackouts occur 'seldom'.

The duration of blackouts are highest in T2V1 and Langa and Gugulethu, where the average reconnection times are perceived to be 16 and 14 hours respectively.

Figure 8.2 shows the reasons given by households in the sample for using fuels other than electricity. The figure shows that 53% and 83% of the households in the Khayelitsha and Langa and Gugulethu samples respectively define blackouts as the primary reason for using fuels other than electricity. Low levels of reliability prevent households from being entirely dependent on electricity for key activities such as cooking. As was found in Chapter 5, many households own gas and paraffin stoves for use in blackouts. For example, in phases 1 and 2, 47% and 34% of those surveyed in Khayelitsha owned gas stoves, but only 18% and 8% of households use them as the primary appliance for cooking on a daily basis. All households in the sample are multiple fuel users, using fuels other than electricity, at least sometimes.

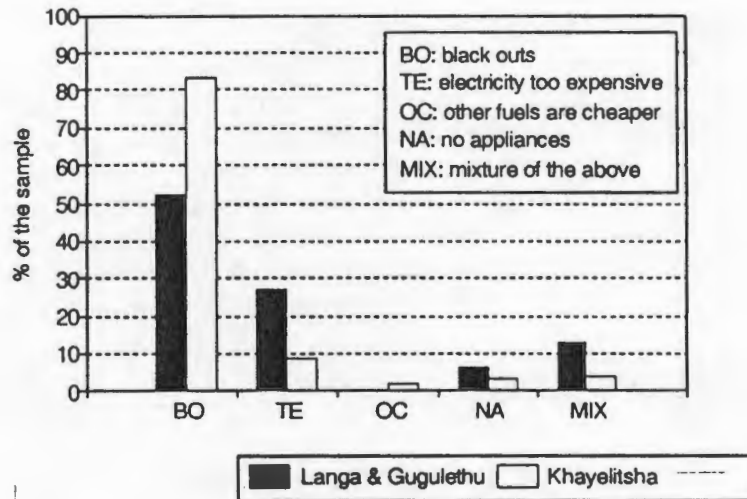


FIGURE 8.2: Reasons for using fuels other than electricity

8.2.2 Perceptions of the distribution authority

Figure 8.3 shows the percentage of households in each area having had to call their distribution authority to report a problem with their electricity supply. In phase 1, very high percentages were shown in some areas, particularly in the older areas of Khayelitsha. In many cases call-outs were to report malfunctioning pre-payment meters. The number of call-outs since phase 1 has been reduced – only in the Langa and Gugulethu sample has the high level of call-outs been maintained (40%). The Town 2 Village 1 sample has the second highest number of call-outs. These figures mirror the extent of blackouts.

As in phase 1, most households appear to have been satisfied with the response to call-outs. One exception was in Langa where a respondent alleged that the burning down of her house was as a result of an electric fire occurring after numerous requests to the Cape Town City Council Electricity Department to

attend to the problem at the meter board. In this case there seemed to be some confusion as to where the responsibility of the Council (with respect to the meter board and the wiring) ended.

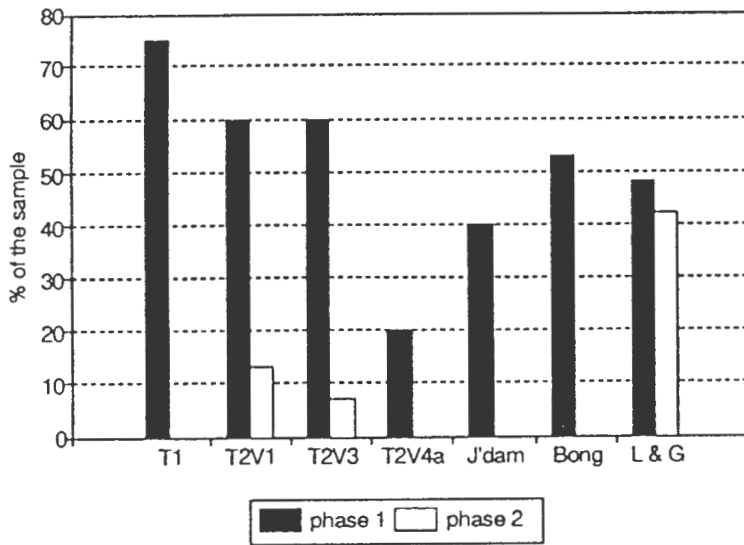


FIGURE 8.3: Electricity Department call-outs

8.3 Perceptions of the affordability of electricity

Figure 8.4 indicates responses to the question: 'is electricity affordable?', in different areas of Khayelitsha, and in Langa and Guguletu. In phase 1, perceptions that electricity was *unaffordable* were prevalent in Jonkersdam, Bongweni, Langa and Guguletu – all areas where credit meters are installed in households and where (as explained in Chapter 3) many households are deeply in arrears.

Phase 2 finds that in all areas other than Langa and Guguletu more than 90% of the sample believe that electricity is affordable. In Langa and Guguletu only 53% of the sample believe electricity to be affordable, despite the tariff being lower there than in Khayelitsha. Fewer households in the sample believe the tariff to be fair than believe electricity to be affordable. However, judging from the explanations as to why the tariff was not fair, the respondents' comments were aimed at the question of fairness of the *service* rather than the tariff. Amongst the comments were: that meters are not read, that consumption is estimated, or that the shop overcharges for the number of units that are bought on cards.

Affordability of electricity

**Affordability and Fairness
(households that say "yes")**

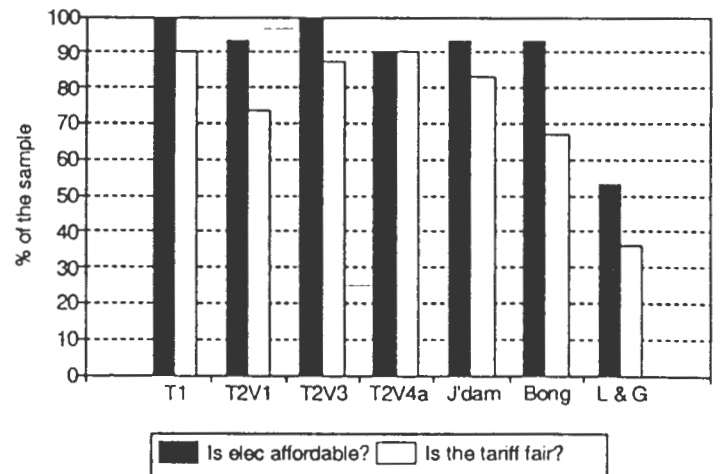
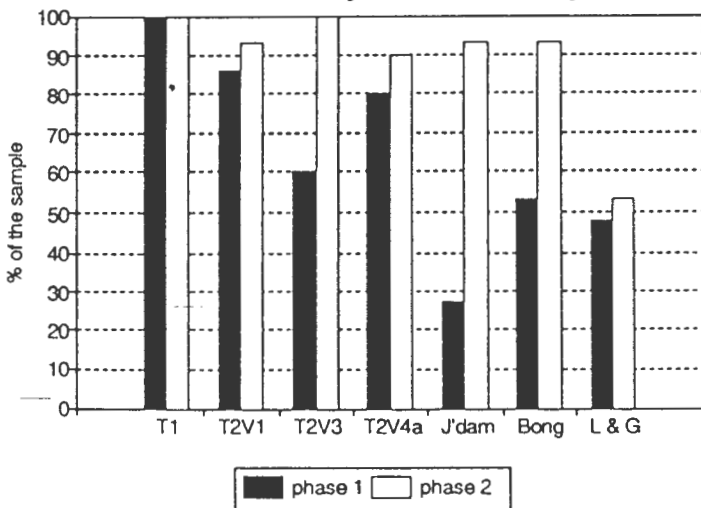


FIGURE 8.4: Affordability of electricity and tariff fairness

8.4 Area lighting systems

Area lighting in Khayelitsha Town 1 and 2 is provided by high-mast lights. In Langa and Guguletu and in Jonkersdam and Bongweni area lighting is by standard streetlights. Figure 8.5 shows the percentage of the sample that consider that there is sufficient light at night. In phase 1 attitudes towards high-mast lights were recorded and showed that 14% of respondents in areas with high-mast lights disliked them. In phase 2 households were asked whether high-mast lights provide sufficient light. The 49% of the sample who live in areas serviced by high-mast lights all suggest that they provide sufficient light. Phase 1 reported that 58% of respondents living in areas serviced by street lights dislike them. Phase 2 found that 51% of the sample in all areas suggest these lights provide sufficient light. The findings suggest that high-mast lights provide sufficient light, whereas only half of those living in areas serviced by street lights suggest that they provide sufficient light.

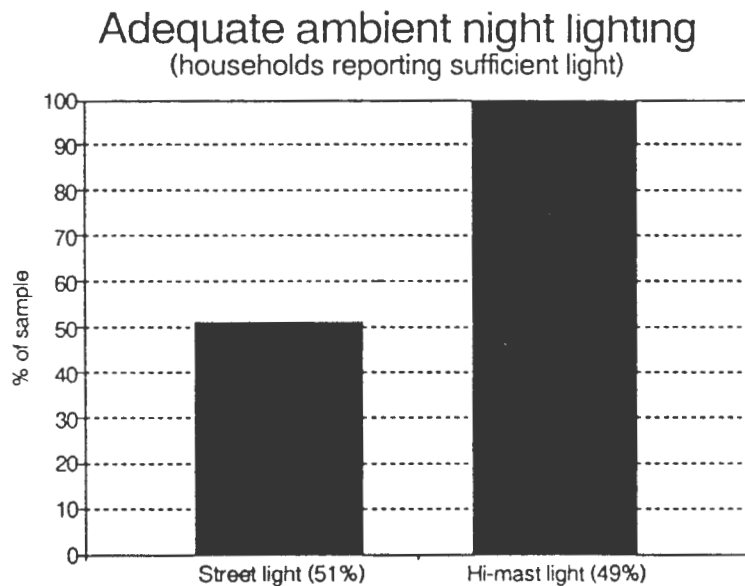


FIGURE 8.5: Ambient night lighting

8.5 Metering systems

Households were questioned on their attitudes towards their electricity meters. None reported that their households had any control over the location of meters. In this section information is provided on those with credit meters, and those with pre-payment meters (also known as budget energy controllers or electricity dispensers).

8.5.1 Credit meters

Figure 8.6 shows the percentage of those with *credit meters* who have experienced a meter failure. Percentages were very low in phase 1; however, by phase 2, the number of households that reported experiencing faults with their meters in Langa had grown from 13 to 55%; similarly, there was an increase in faults experienced in Guguletu from 6 to 11%, while in Jonkersdam and Bongweni no faults were reported.

In all areas there were those who reported that they had experienced disconnections of their electricity supply. 55% of the households in the Langa and Jonkersdam samples had been disconnected.

Figure 8.7 shows the number of those serviced with credit meters who would prefer pre-payment metering. Phase 1 showed that 49% of the sample disliked

Credit meter faults

Credit meter disconnections

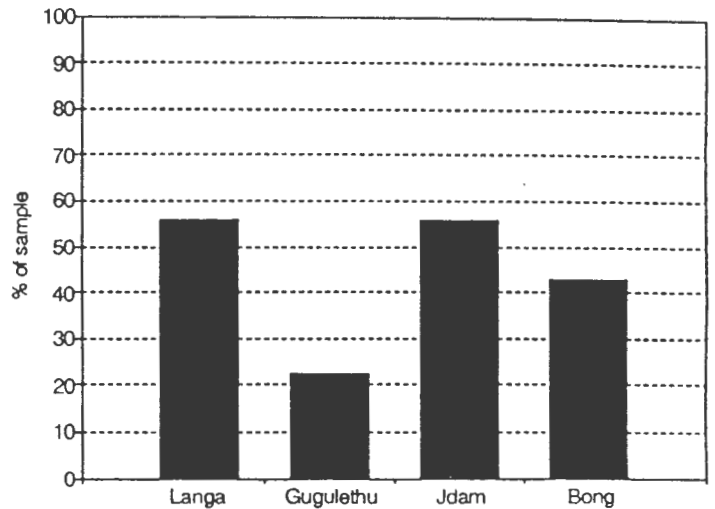
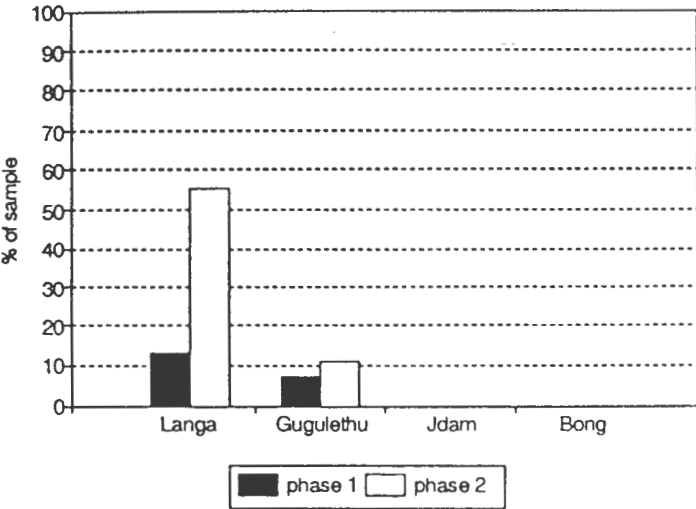


FIGURE 8.6: Credit-meter faults and household disconnections

Households preferring pre-payment meters

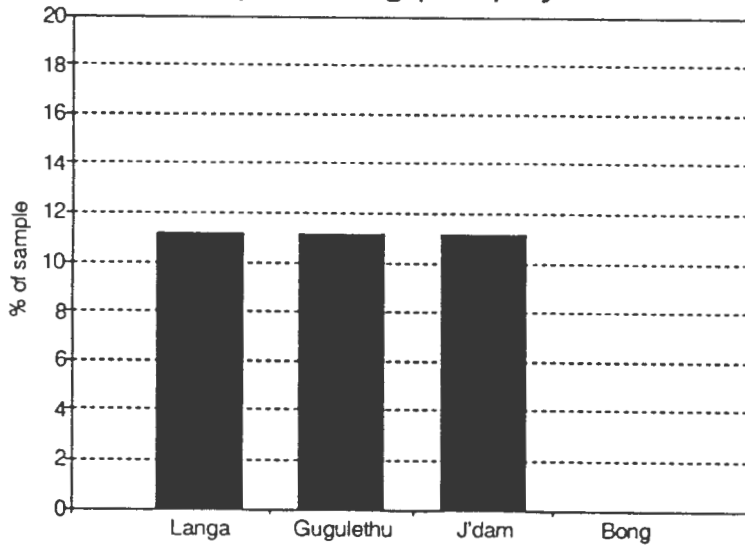
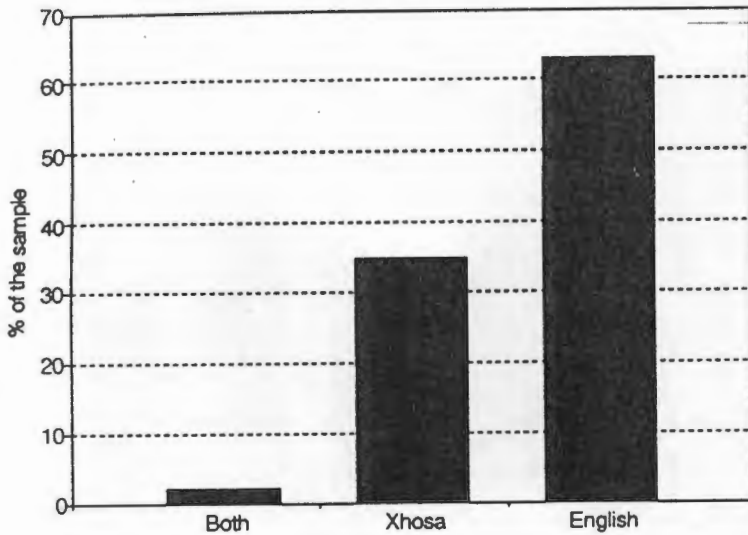


FIGURE 8.7: Metering preferences

credit meters. In phase 2, 11% of the households in Langa, Gugulethu and Jonkersdam suggested that they would prefer pre-payment meters. Lingeletu West City Council has had a policy of installing pre-payment meters when consumers in their areas have gone into arrears, which may be a reason for the decrease in the dislike of credit meters (or preference for pre-payment meters).

Figure 8.8 shows the percentage of the sample considering their bills to contain sufficient and/or correct information. In Langa none of the sample thought there was sufficient information, and all consider their bills to be incorrect. Amongst the Bongweni sample who are serviced by credit meters, 13% consider there to be sufficient information, and none believed the bills to be correct. The perceptions of the validity of the information on the bill is a result of irregular reading and billing. Figure 8.8 also presents the preferences for the language on the bills. 63% would like bills in English, 35% in Xhosa and the remaining 2% in both languages.

Preferred Language in bills



Information appearing on bills

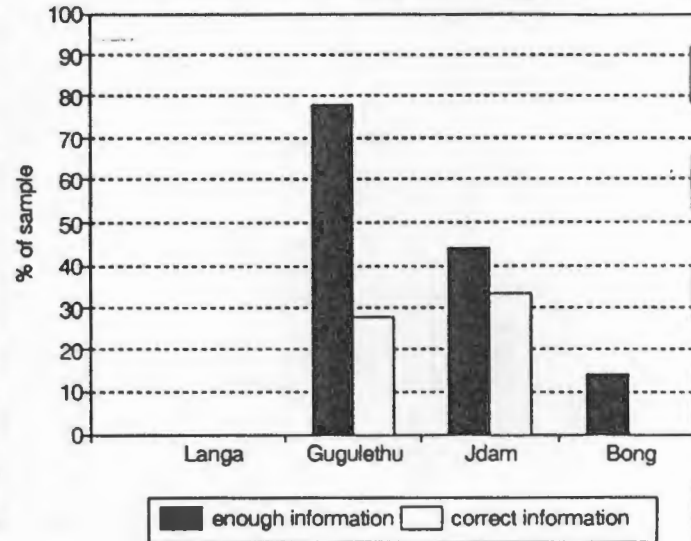


FIGURE 8.8: Information on bills

8.5.2 Pre-payment meters

Figure 8.9 shows the percentage of those with *pre-payment meters* who have experienced one or more meter failures. Failures were sorted into meter problems and card problems (a card not working when fed into the meter). Meter failures are evident in all areas of Khayelitsha. There has been a large reduction, however, in the number of households reporting meter failures. In phase 1, 80% of users in Bongweni had experienced problems with their meters; by phase 2 no-one reported problems. Only in Town 2 Village 4a was there an increase in the number of card-meter faults – from 10 to 20%. This confirms the seriousness of the initial problems in operating the pre-payment meter system in the area, and suggests that Lingelethu West City Council is in the process of correcting these problems.

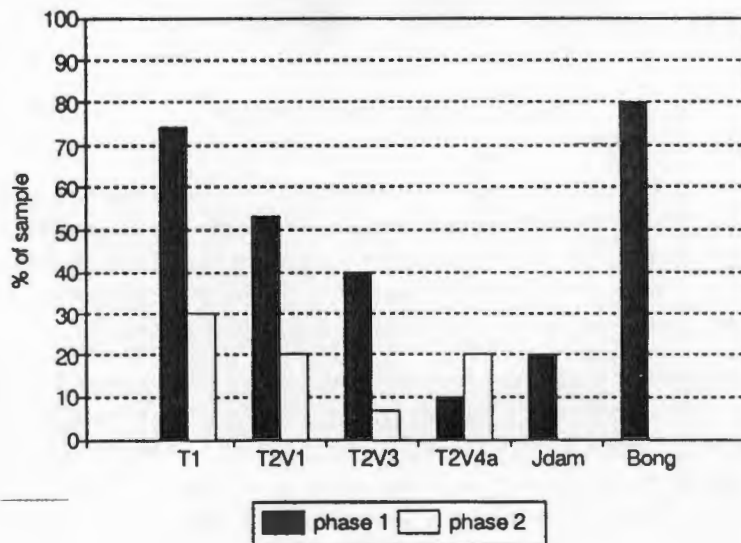


FIGURE 8.9: Pre-payment meter failures

Figure 8.10 shows the proportions of the samples experiencing problems relating to cards that have been purchased for use in pre-payment meters. As with meter-failure experiences, the number of households reporting card failures is greatly reduced. Only in Town 2 Village 4a has there been an increase from 10% to 30% from phase 1 to phase 2.

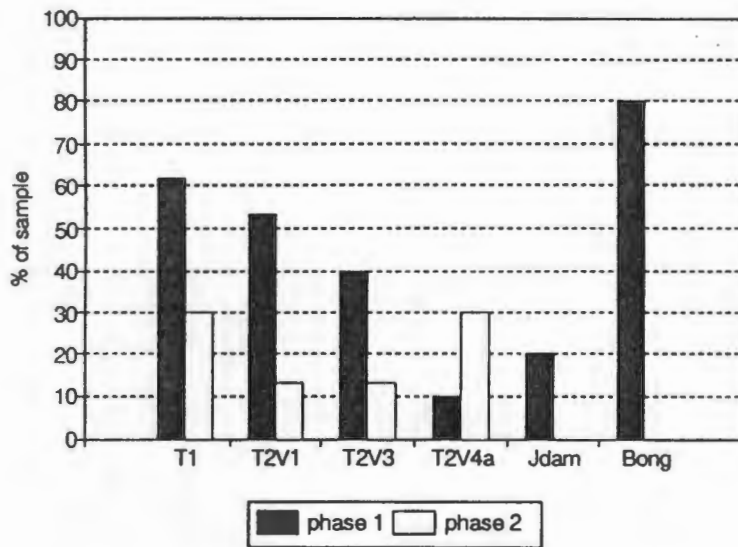


FIGURE 8.10: Households experiencing card-failures

Figure 8.11 shows three different pieces of information relating to the buying of cards for use in pre-payment meters. In all areas more than 80% say that the shops from which cards are bought are open for long enough hours. More than 50% of the sample keep spare cards in case their card runs out at an inconvenient time. In Town 1 and Town 2 more than 60% of households report that the place where the cards are bought is nearby. In Bongweni and Jonkersdam none of the sample reported this – in these areas pre-payment meters were installed to replace credit meters when households defaulted on payments but, as yet, there is no nearby access to shops that sell the cards. Distance from the card shop affects the size of the electricity purchase and the number of visits per month. As is to be expected, those who have the furthest to go visit the card shops the least.

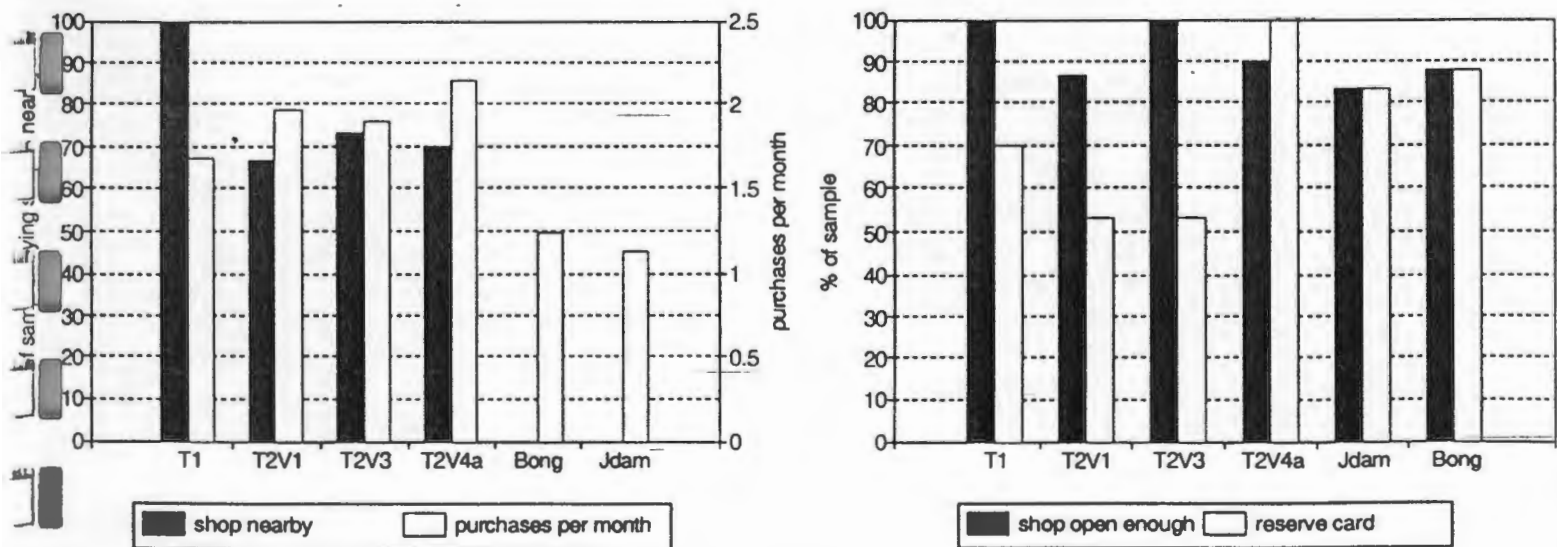


FIGURE 8.11: Card sales

8.5.3 Electricity and the environment

Figure 8.12 shows the perception of respondents to the environmental benefits of electricity. The figure shows an overwhelming improvement in the following, since getting access to electricity:

- the quality of air inside and outside the dwelling,
- the safety aspects of using electricity rather than other fuels, and
- lighting for reading, security etc.

All of the sample agree that the quality of the air within the dwelling has improved. In Figure 8.12 only the quality of the air outside the dwelling is presented.

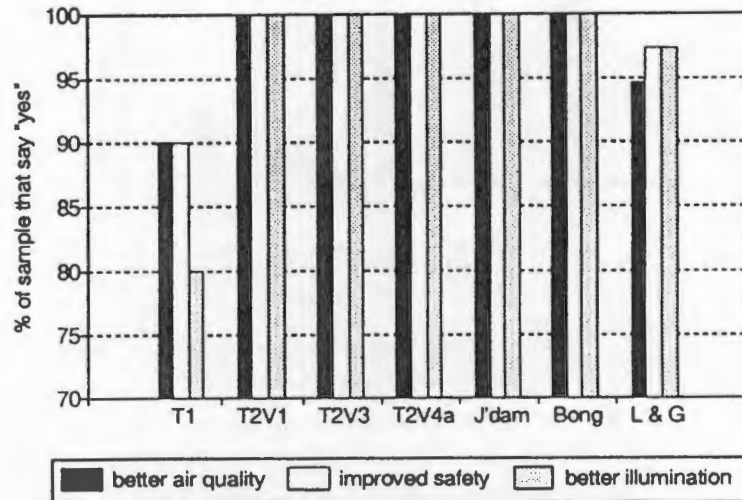


FIGURE 8.12: Environmental benefits of access to electricity

Figure 8.13 provides perceptions of health of the household and the ambient temperature within the dwelling. More than 75% of the households believe that their dwellings are cooler since gaining access to electricity. However, more than 60% of all areas report an improvement in health amongst the occupants of the household since gaining access to electricity. One respondent commenting on why the dwelling seemed cooler suggested that the flame heat-source for cooking contributed to space-heating. The result of using electric cooking appliances would increase the efficiency of cooking but decrease the utility of the cooking appliance. If this was previously gas, coal, wood or paraffin the heat 'wasted' in the cooking process would be used for space-heating. This multi-utility of appliance/fuel combinations is of particular importance for those living in dwellings with poor energy performance characteristics. The inside temperature is also affected by the decrease in the ownership of space heaters. It is interesting to note that even though the dwelling is cooler inside, in all areas more than 60% of the sample suggest that the household's health has improved, which could indicate that fumes, excessive humidity and particulates inside the dwelling are more of a health hazard than are lower temperatures.

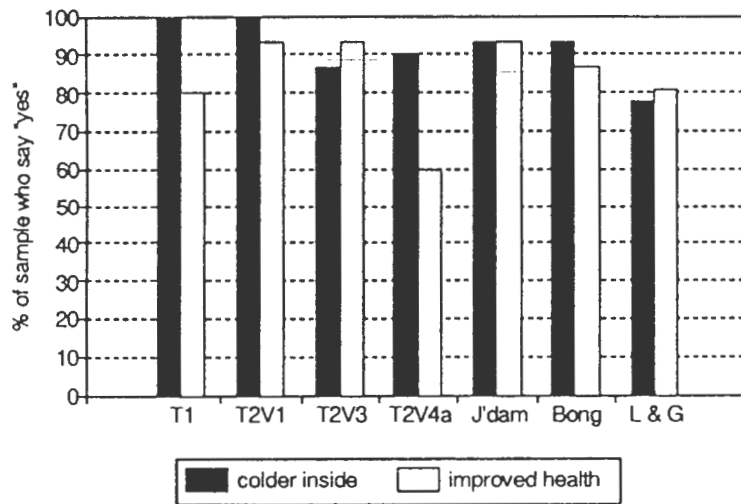


FIGURE 8.13: Warmth and health

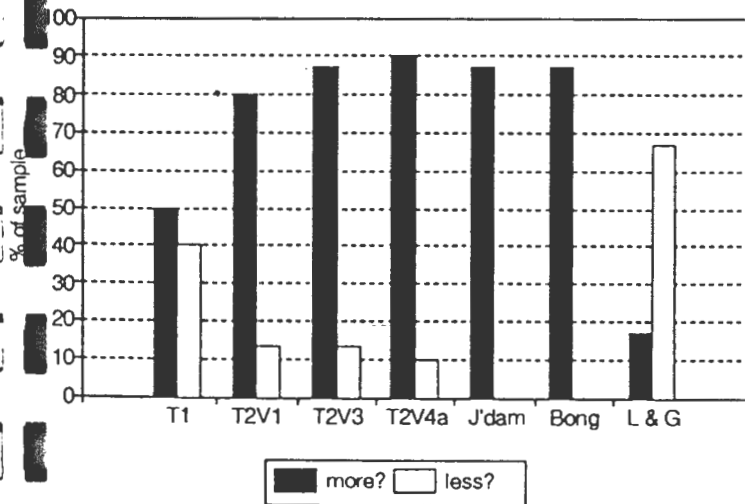
8.5.4 Aspirations related to electricity consumption

Figure 8.14 shows the proportion of the sample who would like to use more or less electricity. The respondents who wanted to use more electricity suggested that the lack of access to appliances reduced their ability to consume more electricity. Those who wanted to use less electricity were those who found electricity unaffordable – in Langa and Guguletu this was 66% of the sample. It should be noted here that Langa and Guguletu’s tariff is 20% lower than the tariff for card-meter users in Khayelitsha.

The respondents were asked whether they would consider buying electricity at a cheaper tariff if it meant that they could use none or very little at certain times. This question was an attempt to gather perceptions around the desirability of time of use (TOU) tariffs. The response to this question showed a high of 50% in Town 1 who would consider such an arrangement. In other areas there was little or no interest for such an arrangement.

The entire sample would find education around electricity usage useful.

Use of more or less electricity
(households that say "yes")



Tariff considerations

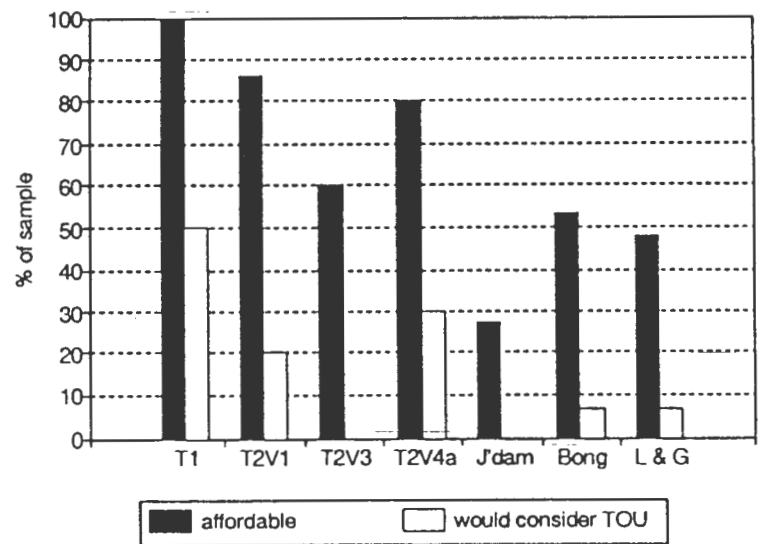


FIGURE 8.14: Use of more or less electricity

8.5 Conclusion

The following points have emerged from this chapter:

- The frequency of blackouts has increased, with 53% of respondents in Langa and Guguletu stating that blackouts occur often. The frequency of blackouts has been reduced in Khayelitsha.
- The most frequently stated reason for using fuels other than electricity is blackouts.
- On average, blackouts are perceived to last in excess of four hours.
- In all areas sampled there is a reduction in the number of times the electricity distribution authority has been called out. In Langa and Guguletu 40% of the households have recently called out officials of the Cape Town City Council's Electricity Department. Most were satisfied by the service that they subsequently received.
- Most people find electricity affordable. In all areas the perception that electricity is affordable has increased since phase 1. The people who perceive electricity to be unaffordable are in areas where households have credit meters. This could be a reflection of the arrears run up by many in these areas. Most people believe the electricity tariff to be fair.
- All households suggest that high-mast lights provide sufficient night light.
- About half of households claimed that streetlights did not give sufficient light.
- About half of those with credit meters are happy with this system of metering. About one-tenth of the credit-meter users would prefer a pre-payment meter. Most households maintain that their electricity bills do not have sufficient information, and even fewer believe that their electricity bills are correct.
- Pre-payment meters in Khayelitsha have a very poor record of reliability, though reliability does seem to be improving. In Langa and Guguletu, where the electrical infrastructure is old, credit meter faults are on the increase.
- The majority of pre-payment meter users like the control given them over the amount of electricity that they consume.
- None of the people in the sample had any choice as to where their meters were installed inside their dwellings.
- The environment of households has improved since they gained access to electricity. It has resulted in improved health, even though respondents believe that the dwelling is cooler.
- Most consumers would like to use more electricity, but access to appliances limits this.
- Few households would consider a time-of-use tariff. In Town 1, 50% would consider such an arrangement.
- All respondents would find education on how to use electricity useful.

Chapter Nine

CONCLUSIONS

This chapter draws on the findings of the previous chapters to list findings which may be useful to those involved in the electrification of poor areas. The chapter also suggests some of the areas in which further research would assist in understanding and quantifying the benefits of the electrification process.

9.1. Areas undergoing electrification

The second chapter of this report described some of the areas in the Western Cape that are in the process of gaining access to electricity. It considered the complexity of the electricity distribution industry, and then focused on Khayelitsha which is serviced by the Black Local Authority, Lingeletu West City Council (LWCC). Eskom has recently been given the opportunity to take over the electrification of this area. LWCC found that it could not electrify the whole of Khayelitsha, as it could not raise the capital and the return on the investment would be insufficient to finance the capital loans. However, LWCC did manage to marginally increase access to electricity in the area.

In December 1990 there was a consumer base of 1 865 (phase 1) and by June 1992 this had increased to 5 414 (phase 2). This implies that approximately 5% of the inhabitants of Khayelitsha have access to electricity. It is estimated that a further 60 000 households are still to be electrified in Khayelitsha. Eskom has promised to electrify all of these households within a three-year period.

For the sake of this study, Langa and Guguletu were treated as *one* area that has had access to electricity for over twenty years. However, of the formal houses in the two areas, only 73% and 89%, respectively, have gained access to electricity.

In both areas considered the interviews recorded that household sizes were decreasing. The figures dropped from 4.3 to 3.8 in Khayelitsha and from 7.7 to 5.8 in Langa and Guguletu.

9.2 Electricity consumption

Chapter 3 considered the consumption of grid electricity in *all* households in the areas. This data was provided by the electricity distribution authorities, from the reading of meters and the sales of electricity to pre-payment meter customers. Electricity consumption in Langa and Guguletu is higher than in Khayelitsha, where consumption of electricity has increased from 200 to 244 kWh/month from phase 1 to phase 2. In Langa and Guguletu the consumption for the entire consumer base has been available only from phase 2 onwards. In Langa the annual average during 1992 was 497 kWh/month and in Guguletu 523 kWh/month.

In Langa and Guguletu the Cape Town City Council provides electricity for nearly 10 000 households, which have credit meters and receive bills from the Council. 85% of these households with access to electricity are either not paying anything for their electricity or have arrears that have increased over the last

twelve months. On average, arrears have increased from R1 123 to R1 692 for each consumer in the area.

In Khayelitsha electricity is primarily provided through pre-payment meters. Those credit-meter households going into arrears have their meters replaced by card meters and their arrears recouped through an increase in the card unit tariff.

Samples of 80 households in Khayelitsha and 36 in Langa and Guguletu were chosen on the basis of area (the towns and villages within Khayelitsha) and stratifications of high (250), medium (100-250) and low (d kWh/month) electricity consumers.

9.3 Appliances

In Chapter 5 ownership and usage of appliances amongst the sample were considered. In all areas there was an increase in the larger appliances, such as stoves, geysers, fridges, and television sets. This contrasts with the small appliances such as irons, kettles and heaters, which have apparently decreased in incidence. The changing ownership of appliances needs further examination. There was a strong correlation between the total number of electrical appliances and household income.

9.4 Multiple fuel use

Chapter 6 considered fuel usage, concentrating on electricity, candles, gas and paraffin. The chapter considered some of the trends in fuel use on the basis of the two sets of interviews done in 1991 and 1992. The Khayelitsha sample was considered to be undergoing rapid changes towards greater dependency on electricity. Most households that were in the Khayelitsha sample have gained access to electricity only recently.

The Langa and Guguletu sample was thought to be a more stable user of electricity. This notion was dispelled during the study, as it was realised that these areas, as a result of arrears accumulation (and the response of the Cape Town City Council), the perceived decline in the quality of the service and, more generally, the imminent changes in local and national government structures, have all added to instability in electricity consumption.

In Khayelitsha the move has been towards greater reliance on electricity as the only fuel used on a daily basis. The increase was from 61% to 80% in Khayelitsha. In Langa and Guguletu the opposite has been observed – with a decrease from 72% to 66%. In Khayelitsha, increased dependence on electricity has been at the expense of gas. This is a result of more electrical appliances having been acquired, and improved quality of the electricity service, both in the case of blackouts and of improved performance of the card-meters. In Langa and Guguletu there has been increased dependence on a mixture of fuels, including paraffin and gas. The trend to a dependence on a mixture of fuels could be attributed to more frequent blackouts and the threat of disconnections.

In all areas gas and paraffin are used on a daily basis by a quarter of all those in the sample (in both areas). The use of fuels other than electricity occurs most commonly because of blackouts. Use of coal, wood and car batteries is minimal; candles have become the most common fall-back when electricity fails.

9.5 The cost of energy in the two areas

Electricity was shown to be more expensive than gas and paraffin. In phase 1 the reverse was the case, with electricity the cheapest fuel on a useful energy basis.

In all areas energy service costs including the hire purchase costs of electrical appliances are between 10% and 20% of household incomes (the cash expenditure on electrical appliances was not considered as an energy service cost here). This portion of costs was highest for those within the lowest income category. The lowest income category also showed the lowest dependence on electricity, and tended to use a mixture of fuels.

The cost of transport is roughly the same as the costs of all fuels and the hire purchase of electrical appliances. If this cost is included in the total energy service cost to households, then such costs are calculated to range between 18% and 36% of total household incomes for the different income groups within the different areas.

The per capita increase in the expenditure on fuels has increased in Langa and Guguletu, while it has decreased in Khayelitsha. Households that do not have access to electricity spend more money on fuels than those that do have access to electricity. In some unelectrified areas of Khayelitsha the amount spent was R127 per month (Macroplan), compared to R68 for fuels in electrified households in surrounding areas.

9.6 Determinants of electricity consumption

Chapter 7 considered the factors influencing the amount of electricity used, looking at a wide range of suspected determinants of electricity consumption. Discrete data was plotted and linear regression imposed on the scatter. Using the R squared statistical tool, correlations were quantified, and shown to be weak. A second method was then employed, whereby data was aggregated into groups defined by ranges in variables being tested. The observed trends were then reported. A further complication in the analysis reported in Chapter 7 was that electricity consumption is a function of many variables. To disaggregate these to make sense of the individual variables was beyond the scope of the project, and is an area requiring further research.

The major energy-consuming services from a household perspective were considered to be cooking, space- and water-heating (and to a lesser extent refrigeration). For example, it was calculated from a mixture of assumptions and the use of empirical and theoretical data that water-heating for ablution purposes could take as much as 50% of the household's energy usage.

The study examined the aggregated electricity consumption data against a number of suspected determinants, including: the size of the household, the years of access to electricity, the total number of electrical appliances (lights are considered as one appliance), the incidence of large appliances (like electric stoves, fridges and geysers), the seasonal trends and the perceived duration of blackouts. No access to water inside the house affected the electricity consumption of the sample in Khayelitsha Town 1.

In the Khayelitsha sample, the number of electrical appliances owned and the total electricity consumption yields a clear trend. The number of appliances owned by a household is related to the household income.

9.7 Attitudes to the electricity service

Most households consider electricity affordable; those that do not are generally in the areas where arrears are high. Most households believed the electricity tariff to be fair.

The majority of households with credit meters consider that there is not sufficient information on their bills and that the bills are incorrect. The overwhelming

perception of pre-payment meters is that households are pleased with the control it gives them over their rate of consumption. Some households complain that the card system is 'weak' and that it trips if more than two appliances are used simultaneously. 10% of households with credit meters would prefer to have pre-payment meters.

All those who lived with high-mast lights and 51% who live with streetlights suggested that they provide sufficient ambient night light, which is a major security priority.

Households overwhelmingly agreed that electricity has improved many aspects of their household environment and subsequent health of the household. Most households believe that their dwelling is cooler since getting electricity. This is possibly because other fuel/appliance combinations have a wider range of utilities – eg, cooking and space-heating simultaneously. Most households would like to use more electricity, but suggest that they are limited by the number of appliances they own. All households would like some education on how to use electricity more effectively.

9.8 The quality of the electricity service

Households in Khayelitsha report blackouts occurring less frequently than in phase , while in Langa and Guguletu the blackouts appear to be becoming more frequent. The duration of blackouts is, on average, in excess of four hours. In Khayelitsha the trend towards increased dependence on electricity as the only fuel used on a daily basis (with candles as a standby) reflects this improved quality of service. The reverse is true for Langa and Guguletu.

9.9 Areas for further research

The information from these two phases of the study will facilitate better understanding of household energy-use patterns and can be used to inform the planning and implementation stages of the process of electrification. An understanding of the initial period after gaining access to electricity seems to be the most critical and can assist in maximising the benefits to all parties concerned in the process. For example, an understanding of the determinants of electricity consumption can inform the type of interventions that will achieve desired goals, such as increasing electricity consumption, designing demand-side management strategies, or the type of metering.

Specific areas that emerged as requiring greater understanding are, firstly, the factors affecting changing appliance-ownership. This is particularly relevant, as the number of appliances owned appears to be one of the most important determinants of electricity-consumption levels. From the consumer's perspective, there is a demand for particular energy services, which then imply various fuel/appliance combinations. The most energy intensive of these services are cooking, space- and water-heating (and refrigeration to a lesser extent). The research outline has proposed that phase 3 of this study should investigate individual household load monitoring, to add to the understanding of individual electricity loads within households.

An important motivation for continuing a longitudinal study such as this is that it monitors changes in energy-use patterns over time. It provides quantitative information on electricity consumption that will, in turn, inform the rate of return on investments in the electrification of similar areas. It provides data on the impact on the quality of life, environmental and other socio-economic issues. This information is useful because it gives an indication of the sustainability of providing electricity to poorer areas.

This study is well placed to advise the process of electrification in Khayelitsha. Eskom has undertaken to electrify 60 000 households there over the next three years (Eskom).

Finally, a study such as this will refine the methodologies for monitoring the electrification process.

9.10 Relevance of the findings for the electrification of areas

This study has revealed a number of important issues which have general bearing on the electrification of poor areas. A central question affecting electrification planning relates to expected electricity-consumption levels. This study has provided clear quantitative evidence that consumption levels in newly-electrified areas will rise in time. Further tracking of this trend is necessary, but the much higher levels of consumption in Langa and Guguletu (despite the limited use of geysers) suggest that it will continue. A key question is the rate at which electricity consumption will increase, as this impacts decisively on the economic viability of electrification.

The variable associated with higher electricity consumption is the number and size of electrical appliances owned. The study examined the impact on electricity consumption of the ownership of stoves, geysers and refrigerators, finding that higher consumption levels will result from the acquisition of more and larger electrical appliances. An intervention to increase the ownership of such appliances would represent a win-win situation with households enjoying greater convenience and lower useful energy costs, and the distribution authority having increased electricity sales and therefore a better return on capital investment. The purchase of appliances may cause total household energy costs (including the cost of the appliances) to rise for a period. Yet the longer-term benefits for the household and the electricity distributor are clear. The HP payments for electrical appliances in Khayelitsha are evidence that the purchase of appliances is already a priority for newly-electrified households.

What steps can be taken to increase market penetration of large electrical appliances? Both appliance manufacturers and electricity distribution authorities stand to gain from producing and marketing lower-cost electric stoves. Non-profit schemes to market and distribute appliances have been used with much success all around the world (including in white municipal areas, in the past), and need to be actively explored for use in areas such as Langa, Guguletu and Khayelitsha. Alternatively, access to credit facilities for the poor being limited, it may well be in the interest of distribution authorities to consider innovative financing methods to allow easier access to these appliances. The comparison between the amounts being spent on the fuels in non-electrified areas adjacent to electrified ones reveals a compelling argument for credit facilities to assist in the acquisition of electrical appliances. This may present an opportunity for manufacturers and retailers of appliances, electricity distributors and consumers, to the benefit of all.

Improving the reliability of the electricity service provided in poor areas should be a priority. Besides being necessary for reasons of equity – consumers have a right to equal standards of service in all areas – consumption levels will probably rise if quality improves. Many households retain, and continue to use, non-electrical appliances because of the frequency of blackouts. Dependence on electricity will rise if the service is dependable.

However, introducing innovative appliance-marketing schemes and improving the quality of supply in poor areas can only be undertaken by professionally run, service-oriented distribution authorities. Very few township areas – and certainly not Khayelitsha, Langa or Guguletu – have such authorities. The distribution

sector of the South African electricity supply industry has evolved within the paradigm of apartheid. Fundamental restructuring will be necessary to create a more workable situation.

Electrification in South Africa has reached a stage where it is seen as a necessary strategy for increasing living standards and promoting economic growth and equity. It is to be hoped that the information gained from micro-level studies such as this one will help to maximise the benefits of the electrification process for all concerned.

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Appendix One

Literature review of background reading for the phase ii project entitled: Electricity use in low-income areas of the Western Cape.

1. A Review of Electrification Programmes in Six Countries, C. E. Dingley.

This report covers the visit in mid-1988 of the author and a representative of Eskom Mr. Douwe van Wyk to six countries; USA, Thailand, Costa Rica, Brazil, Hong Kong and Greece. In the six countries, organisations that deal with electrification were visited. The purpose of the visits '... were to study electrification programmes in other (mainly developing) countries.' It was hoped that '... the findings of the visit would contribute to the planning and implementation of a programme to electrify the underdeveloped urban and rural areas of South Africa.'

The report presents information in five subdivided parts; electrification policy, organisational structures, capital costs and financing, technical aspects and commercial aspects.

The role of government is crucial to electrification. Dingley cites the role played by governments and their agencies in electrification programmes, in for instance, the setting up of supply authorities, financing of projects, target setting and project prioritisation in accordance with national, social and economic objectives. In the countries visited government worked closely with the ESI's and in the case of the USA intervened to assist in the formation of rural supply co-operatives. State rather than regional support was found to encourage national interests rather than regional ones. The example of the Rural Electrification Authority, established by Roosevelt's intervention was a model worth studying. In general government intervention was seen as significant in stimulating or steering electrification programs.

The benefits suggested looked mostly at rural areas, these included, domestic ease, infrastructural betterment (health, education), increased agriculture output, employment, greater national integration, less urbanisation, greater access to information and reduced consumption of imported fuels. Electrification of shanty areas was studied in Brazil, Hong Kong and Costa Rica. In Brazil shanty areas are seen as permanent, and the government sees to their upgrading in terms of services eg. telephone, sewerage, water and electricity. The same happens in Hong Kong, and Costa Rica though these areas are not seen as permanent. These services are seen as important for 'stability' and fire prevention.

In all the countries the rates of connection were between 11-13 connections per 1000 people in the total population. Outside of USA these are mostly established houses, and not new ones or holiday homes. In USA there is a policy of making available electricity available for all households in an area of supply at a cost regardless of distance from established network. In most cases there was financing available at easy terms and little cash up front was needed. In the areas

covered the principle driving the electrification process are concerned with the benefits of electricity and people's right to it. This is opposed to the economic side of the argument. In all the countries mentioned electrification is going ahead whether deemed as 'economic' or not.

Section B covers the organisational structures providing electricity (distribution and not necessarily generating) in these areas were 1. quasi-governmental supply authorities (Brazil, Costa Rica, Thailand and Greece), 2. privately owned supply authorities (Hong Kong), 3. rural electrification co-operatives (USA, Costa Rica). Attention was paid to the co-operatives as they were seen as a model beneficial for many reasons. Not least because they were owned by their members (regional accountability) and recruited their workforce locally. They also have the ability to build electricity generating facilities. There are 1000 co-ops that supply to residents in 75% of the land area.

The consumer to employee ratios ranged from 293 in Costa Rica (distribution only) to 173 in Brazil (distribution and generation). These figures were compared to a ratio 89 in the Cape Town City Council (generation and distribution).

Part C covered capital costs and financing. There was a wide variation in costs, they depended on population density, distance, power to be used, and maximum demand, however the rural electrification costed from \$340 in Thailand to \$3000 in USA. All the distributors benefitted from low interest loans and varying degrees of subsidy. Other facts that emerged were that the financing in Brazil was 50% World Bank, 50% consumers payed back over 1 year. In Costa Rica, 33% Local financing 67% Inter-America Development Bank repayable over 30 years. In the USA the co-op movement have established a financing institution, repayment is over 35 years. In Thailand there is a wide mixture 45% is foreign loans, 9.5% village, 8.5% government, 7% domestic and 30% from distribution authority, in Thailand priority was given to the villages able to raise 30% of the electrification, but normally the customers were not required to cover costs.

Part D covered technical aspects of electrification. The range of end users/consumers per kilometre of medium voltage line were assessed. They ranged from less than 2 in Brazil to 75 in Greece, Cape Town has 92). The After Diversity Maximum Demand (ADMD), after making some assumptions Dingley presented figures for the upper-bound ADMD per household, that range from 472 in Thailand to 3120 watts in the USA. (The figure for the Cape Town City Council of 3283 watts was presented for comparison).

At this point Dingley then went on to discuss the single phase distribution networks. These networks are operational in Brazil, Costa Rica, the USA and Thailand and could cost as little as \$1500 per kilometre to install. These he compared to the SA system of using 3-phase. The techniques of hooking the single phase spurs to a 'backbone' 3 phase feeder was technically assessed. A method called, 'Earthed Centre-Tap Low Voltage Systems' was described. Though this did not have any applications in the countries visited its merits as far as safety is concerned, was discussed.

House wiring kits and electrification techniques for shanty towns were finally discuss in this part. The electrification seems to be done bearing in mind aspects, such as safety and illegal tapping. The process is normally done cheaply and quickly with the normal wiring standards being overlooked. The most common method of distribution seemed to bring the high voltage line as close as possible and then from a pole mounted transformer distributed to free standing meters and distribution boards inside or outside the house or through insulated ducts into the shanty in a maypole configuration. The configuration in Costa Rica was slightly different where sub-mains were metered for about five houses. The five houses decide amongst themselves on how to split the bill.

The final part of the report, part E, deals with commercial aspects. Appliance usage in rural USA is 100% fridge, cooker and TV. 60% of households have air-conditioners. In Brazil LPG is encouraged for cooking, TVs and fridges are common though. In Costa Rica 22% use electricity for cooking and in Thailand wood is predominantly used for cooking, however electricity is used for lighting and TV. The consumption of electricity varies from an average of 724 kWh in Thailand to 9240 kWh in USA, Brazil is low at 1420 kWh. This has something to do with the tariffs and the availability of competing fuels. Interestingly the domestic tariff structures in Brazil, Costa Rica, Thailand and Greece are structured to encourage conservation of energy. The block increases in electricity become more expensive as more is consumed. The aim is to give poorer households the access to electricity for low power applications like lighting, TV and to some extent refrigeration. In all cases there is cross-subsidisation of urban to rural users which is widely accepted. Greece was the only country to have a level of time of use (TOU) tariff structures. The metering was done in all cases on credit meters. There were no cases of prepayment (as in SA). In Brazil and Costa Rica use is made of a network of agents eg. shops. None of the institutes visited mentioned bad-debt.

2. A possible Household Electrification Program in South Africa, The World Bank, 1992.

The World Bank reviews its 'fact-finding' mission to SA in January 1992. It evaluated the much debated idea of electrifying 3 million households as a means of 'kick starting' the economy and the ESI. Attention is given, as a background, to the proposed household electrification program.

Initial attention is paid to the socioeconomic backdrop of South Africa. The range of household fuels are listed alongside the areas in which these fuels are utilised. Their analysis points to access to electricity amongst urban blacks as being related to increasing income. The number of households with electricity are 2.4 million or 35% of households. However, '... 200 000 new households are established. In 1989 125 000 new connections were made so the proportion of electrified houses is rising slowly, but so too is the numbers of households without electricity.'

In rural areas wood is the predominant 'traditional' fuel. Demand is outstripping sustainable supply creating scarcity, deforestation and desertification. Electricity in these areas is low % as most cannot afford it. The emphasis in these areas are for improving wood supply and looking into stand-alone photo-voltaic systems. In peri-urban areas 'modern' fuels (eg. paraffin, LPG and coal account for 90% of the fuel used. In the Transvaal and OFS even where electricity is available, coal is used mainly for cooking, space and water heating. This is because coal and coal using appliances are cheaper than electricity.

In urban areas 'modern' fuels are used. About 25% of low income households have electricity, those that do not in the Transvaal and OFS use coal. Near the coast paraffin is used as the dominant fuel. Two studies in recently electrified townships reflect a 27 and 36% saving on energy spending. It is therefore concluded that electricity is the cheapest fuel.

There is no subsidy on paraffin, LPG or coal, though there is less tax on paraffin. The World Bank calculate that the cost of providing electricity (marginal cost) to a 350 kWh/month household would be R22/kWh in 1990 because of Eskom's excess capacity this is set at 17c/kWh, 40% above the then domestic rate of 12.4c/kWh. From these calculations the World Bank assert that electricity is the cheapest fuel (in economic terms) in the short to medium term where cheap coal is not available.

The Bank then assesses the socio economic benefits of electrification suggesting that after housing it is seen as one of the priority basic needs. The convenience and amenity of domestic availability is then listed and particular note is taken of its convenience for women. It promotes educational endeavours, public safety, etc. It is popular. Electrification will provide employment through installation, appliance manufacture and through establishing small enterprises. The job multiplier is 1.5 and can mean one job per 4-20 connections over the duration of a program ie. 50 000 to 250 000 per million connections.

The environmental impact has not been assessed, but electrification is thought to reduce winter low level smog in Transvaal townships. The increased demand would increase high level sulphurous emissions from thermal power stations. The retrofitting of desulphurization equipment has been estimated to cost R8 billion.

The ESI is next described. Eskom is responsible for 97% of generating capacity and has the capacity to supply 33 843 MW, peak in 1990 was 21 863 MW. Eskom has 5 000 MW overcapacity, 7 700 MW of coal fired capacity on order and is contracted to order 1 450 MW from Cahora Bassa. The capacity is made up of 29 673 MW coal based, 1 940 MW hydro, 1 840 MW nuclear, and 390 MW is gas turbine. Over the last five years consumption growth has increased at 3.4% per annum. Industry and commerce use 52%, mining 26%, households 15%, transport 5%, and agriculture 2%. Generation costs are 6.5c per kWh, generation plus transmission 10c/kWh. Eskom's marginal cost of supply is 1.5-2.0c/kWh, giving a marginal bulk supply of 5-5.5c/kWh. Eskom is currently offering municipalities supply at 5c/kWh for incremental demand from consumers using less than 350 kWh/month.

55% of electricity distributed in South Africa is by Eskom, this includes industry, mining and 150 000 households half rural and half peri-urban. The remaining 2 million are handled by municipalities and local authorities, of which there are 600 nationally (only 7 have more than 50 000 consumers). 85% of consumers are supplied by 'white' (white, coloured or Asian) local authorities, 10% by black local authorities and 5% by Eskom.

The sale of electricity is a major source of income for white local authorities. The R1 billion in total revenue per year is used to subsidise other municipal services. The revenue is mostly generated by sales to commercial and industrial consumers, priced at 18% above cost. Black local authorities have only 2% of this category of user (white municipalities are at 58%). Their low base load/high peak load, small demand consumers (high service cost per unit) and their high bulk purchasing cost (often at the white municipality's higher bulk industrial tariff). Because of the structure of getting electricity to the end user expansion financed by loans to black local authorities has been limited. These loans were often unserviced. The black local authorities being viewed as a creation of apartheid came under political pressure voiced through rent and electricity boycotts. With funds being low, equipment and skills have been in short supply. The result have been many disconnections from bulk supply for non-payment.

An outcome of much debate has been the proposal of an 'Electrification Forum' representing various political and community groups, white local governments, the ESI, development banks and the academic community. The aim of the forum would be to explore the possibilities for accelerating electrification and reorganising a more efficient distribution industry. This would likely involve regional distribution authorities (similar to Eskom's 12 region proposal) and expanded municipal authorities and new regional authorities covering rural areas. These would be independent of local government. For rapid electrification

Eskom and larger municipal electricity departments could be maintained for the interim.

Proposed programs include the ANC's 3 million connections in the next 3-5 years. This would double connections from 35 to 70%. The benefits would be:

- reduced present inequalities and access to a 'basic, valued and generally affordable community service.'
- increased employment in installation, material supply, appliance and distribution service industries.

The advantage of this service provision has not yet been compared to other service provision eg. housing, water, sewerage, health, education or roads.

Electrification is judged to be both technically and financially feasible. At R2500 per household the R1. 5 billion combined revenue of Eskom and municipal electricity departments could cover the costs of 500 000 new connections per year. This could be increased by cross-subsidisation and/or borrowing. Technically Eskom and departments have proved themselves, and are capable, in conjunction with private contractors, of the necessary work. This presupposes that they will be maintained and enlarged in a new democratic order. There is doubt over whether local appliances will compete with foreign ones.

Eskom perspective is one of 'electricity for all' motivated by social and economic factors. They want to aggressively correct the inadequate access to basic services and accelerate job creation. They have the idea of using their surplus generating capacity to 'kickstart' economic recovery. Eskom reckons it can electrify 700 000 over a three to five year period using its own staff and supervised contractors.

Durban wants to electrify 160 000 households in five years using its Capital Development fund. In the Transvaal the RSC has arranged for Eskom to take over from the black local authorities managing electricity supply to Soweto and Alexandra. They have been asked to strengthen the administration, improve quality of supply and accelerate connections. Also established there is the Central Witwatersrand Metropolitan Chamber made up of white local authorities with community organization's input. Their role is '... to recommend and implement improvements in access to basic services in the black townships, including electricity.'

The issues to be addressed and which would have to be agreed to by all parties involved include, according to the World Bank 'Fact-finding Mission' delegation; (Here close adherence to the Bank's proposed agenda is maintained.)

1. The size of the program.

Consideration should be taken of funding availability taking into account other competition for public funds, borrowing constraints and limits on cross-subsidisation within the ESI. Program priority related to other needs, here also taking cognisance of the national economic objectives of low cost provision to industry and mining. The ability of the implementation, materials and appliances should be checked – imports, would they be able to fill the gap in opposition to the policy of job creation?

2. Geographic focus.

Will it be a urban/peri-urban focus where financial viability is better because of concentration or nationwide?

3. Choice of technology.

Single phase supply and the 'ready board' are acceptable. The pre-payment meter less so. This could influence decisions of communities to electrify.

4. Degree of Cost Recovery.

The idea of charging low income households a tariff rate to cover the short term marginal cost of increased capacity is equivalent to a short term subsidy. It is hoped that this is sufficient, as cross subsidisation could affect other consumers (particularly import/export competing industry and mining. The cost of reticulation would be recovered over a longer time through the tariff rather than the connection fee.

5. Selection of Implementing agencies.

There is widespread acceptance that the ESI has to be restructured. While this is happening would it be acceptable to use Eskom and larger municipalities facilities to get the program underway in the meantime?

The ANC's electrification conference in February 1992 agreed on the formation of a household electrification forum with representatives of political, community and industrial interests.

'The primary objective of this forum would be to agree on the major parameters of the household electrification program and, in so doing, to address the issues outlined above. . . . The World Bank is supportive of this initiative, and if invited would be willing to assist in the work of a Household Electrification Forum.'

The Bank then moves on to make its initial recommendations on the issues raised when they recommended areas to be addressed.

The program should be large enough to have '... significant impact on the present unequal access to electricity. . .', but should be technically and financially feasible. It should bear in mind community priorities for services, available finance from surplus electricity revenues, cross-subsidisation and responsible borrowing, and the implementation capacity. The financial and implementation implications should be assessed before any plan is announced.

The focus should be urban and peri-urban where electricity is the least cost fuel. Agreement with community groups should be a precondition to implementation. Technology should be 'low cost but safe'. Prepayment meters may be preferable if they are presented at a lower connection fee. Costs may be partially recovered by using the low marginal cost of generation [and distribution]. The costs of connection can be recovered over a long period – in the process subsidising initial years after electrification. The existing distribution industry should be used. Their active participation in the program should be secured during the restructuring of this industry.

The Bank concludes a dense paper of information by recommending the next steps. They suggest the formation of a planning, finance and implementation body such as the proposed National Electrification Forum, is an important first step. On this forum the Bank reiterates its availability and willingness to '... assist in the work of this body.' This body should then address;

1. Geographic concentration, Financial and implementation capacity of the ESI for household electrification should be worked out before announcing the extent of a program.
2. The appropriate technology, degree and methods of cost recovery should feed into planning and evaluation methods.
3. Environmental impacts of electrification should be reviewed and mitigating measures advised.

3. The domestic electrification process: a strategic perspective, R. Viljoen, May 1991.

Viljoen introduces his paper by presenting in global terms the electricity usage trends. He refers to electricity as a 'commercial fuel'. This is described in a graph that displays 'the process whereby the energy consumption patterns of fuels change over time.' He goes on to define electrification and explains how this process is both demand and supply driven. He puts the drive to electrify down to the socio-political changes, Eskom's overcapacity and the distribution authorities' desire to derive greater profits. Viljoen then analyzes the electrification process in terms of it being an energy transition process. The complete replacement of biomass fuels via transitional fuels to complete reliance on electricity. This process is driven by amenity and household economy, this is also described as 'modernization'. In a diagram Viljoen reduces the domestic energy transition to 6 phases; from biomass dependency, via rural transition, to three urban stages before the final electricity dependency stage is reached.

Domestic electrification is governed by Town Planning Ordinances in the various provinces, whereby electricity is seen as an essential service and is installed at the development stage of white residential areas. Black townships in contrast have been developed in an ad hoc manner with rudimentary services, and been complicated by informal developments. Viljoen then lists differing domestic electrification processes and population characteristics, between the whites and blacks. He points to the electrification process in black townships being one of 'up-grading' replacement of other fuels dependent on grid access, affordability, and choice. On the supply side electrification has to make economic sense.

To allow accessibility to electricity, the grid has to be extended. Size of communities, distance from the grid, rate of uptake in use of electricity are therefore critical to planning grid extensions. In rural areas, techniques such as single wire earth returns are reducing the costs and photovoltaics for stand alone applications, hold promise. These areas, unlike urban areas, look to technical and economic solutions in planning access to electricity.

Affordability of the end user/consumer's transition to electricity is defined as the ability to bear the cost of the connection, appliances to make use of the electricity and the cost of electricity to power these appliances. He points out that there is a wide range of incomes among black people and suggests that below a certain cost for electricity it loses its utility as a fuel. 250 units per month is a minimum for household use in lighting cooking and small appliances. Only in houses earning more than R1300 per month is there an increase above 300 units.

Viljoen then compares the cost and cost components of five case studies from 1986 to 1990 with a hypothetical middle income white family. The presentation of this information shows a dramatic increase in energy spending as the electrification process takes place. Viljoen points out that appliance costs can become larger than the costs of the energy used and could be a further impediment to electrification. The matter of choice in transition fuels is explored. This, Viljoen explains, depends on the phase, preferences, and affordability. The early phases include emphasis on needs that would assist survival. Electricity as an option becomes appealing once there is 'discretionary' income available. The process of modernization places great emphasis on amenity. Politics which Viljoen equates to aspirations, affect preferences and priorities and have a positive affect on transition, however these same influences, he notes, have led to the non-payment of accounts.

It is noted that Eskom is now run on the profit principle. Slow take up of the service and low consumption rates affects the decision making process around electrification. He suggests that through subsidies some of these problems could be alleviated. A quarter to a third of the income of black local authorities come

from electricity sales, should this be tampered with rates and the costs of other services may go up. The new local and regional governments structures may well end up redefining the supply industry to their benefit.

One of the apparent benefits that has not been tested is the improvement in quality of life through the transformation of domestic activities. Here he quotes various authors who point to little time saving. However, Viljoen admits that the process may have substantial affects on the stimulation of the economy. He concludes his analysis of the benefits of electrification by proposing that modernization stimulates electrification

The strategic implementations of electrification Viljoen lists as;

1. Because of the costs involved better understanding of the process of electrifying Black areas is necessary
2. Models for electrification must be sought. White model is of little relevance.
3. Accessibility and affordability are linked. The drive is on the former
4. Mechanisms to reduce the costs of appliances must be found
5. Strategies to influence choice when relating to fuels. Establishment o. energy and electricity information centres are needed
6. Profitability is influenced by take up and consumption rates. There is no understanding of these rates in informal areas that would allow potential customers to be identified
7. Electrification is part of an energy transition. The benefits of electrification on a national basis need to be weighed

Viljoen concludes his paper by stating the electricity is universally desirable but selectively affordable. Whether a broad based electrification process is successful depends better understanding of the energy transition process and the program the ESI launches

4. Energy profile on the Western Cape, Mark Borchers and Anton Eberhard, 1991

The aim of this paper is to express the energy use patterns in the Western Cape in terms of total energy used, presenting the total Electricity, Coal, Oil, and Gas usage per sector (oil, here, includes petrol, paraffin and diesel). The sectors covered include Domestic, Agricultural, Mining, Transport, Commercial and Industry. These quantities of fuel/energy source are compared to the total amounts consumed in South Africa as well as those produced in the Western Cape and those imported from the rest of South Africa to the Western Cape. It is mentioned that because of the Petroleum Products Act (1977) that it was not possible to publish data on some petroleum products.

Figures that relate to the phase II of this project show that the in 1988 the domestic sector uses the largest fraction of electricity 11. 42 *10⁶ this 38% of all electricity usage and electricity being 83. 5% of all domestic energy used. The 3. 0 *10¹⁰ MJ of electricity consumed in the Western Cape is 22% of the total energy used in the Western Cape and this is approximately 75% of the electricity produced in the Western Cape in the year 1988/89.

The paper then explores the sources of the different energy sources, pointing out that the installed the electricity generating capacity in the Western Cape is 2975 MW of which 10991 GWh were sent out. A capacity factor of 6. 1%. This figure is

extremely low, and is a result of Eskom paying the Cape Town City Council to keep its 450 MW of capacity out of production. This low capacity is further complicated by the fact that two of the generating facilities are pump storage facilities and used in load factor modification. These two facilities have a combined capacity of 580MW.

The paper moves from the consideration of the generation side to the distribution side of the electricity scenario and presents the background to the set of circumstances that exist in the Western Cape today.

The point that the paper proves is that the access to electricity is skewed, between the enfranchised and disenfranchised. White municipalities undertook electrification to white, coloured and indian areas within, however it was only in the 1970's that black urban townships were considered permanent. In 1982 Black Local Authorities (BLAs) were created to take responsibilities for services, that until then had been at the barest minimum. For various reasons, including limited of staff inadequate access to finance, political pressure (eg. non-payment of electricity bills), the type of customers (not industrial and few commercial) etc. BLAs were seen as an inadequate vehicle for electrification. Whereas the Cape Town City Council made a profit of R 40. 5 million in 1989, BLAs were bankrupt.

Eskom has begun a campaign with the slogan of 'electricity for all' as a result of widespread attention, and have started to move from bulk supply to the supply of individuals and settlements. The paper suggests that

'Adequate electricity supply for all is recognised as an effective means of increasing welfare on a domestic level as well as being a stimulant of productive activity. In addition it is the preferred energy supply.'

The suppliers within the Western Cape are Eskom, who supply the different municipalities, black local authorities, other supply authorities such as Western Cape Regional Services Council (WCRSC), larger industries (eg. railways), and a small number of domestic settlements. These authorities supply the domestic markets, commercial, industrial and other smaller authorities

'The Electricity Act (1987) specifies that local authorities have prior right to electrify areas within their jurisdiction, but particularly in the case of black local authorities this is often ceded to other authorities. Ikapa Town Council for example is supplied by CCC and Eskom.'

The report goes on to present the 1989 population, house, and the number of houses using electricity in the region. The total, per capita and monthly household consumption figures are presented for the areas covered by the different local authorities. Significant figures are that 368517 houses are using electricity. That the low income areas have very few electricity uses. Crossroads and new Crossroads 2%, Khayelitsha 5%, and Nyanga 22%. The case of Gugulethu and Langa are not clear, as they fall within the greater CCC area which shows 82% of houses using electricity.

The 1989 consumptions of the municipalities in the Western Cape in a tabulated form as is the sector by sector consumptions, including; traction, industrial and commercial, rural, domestic and street lighting, mining and Bulk. The point that Eskom has a 48% overcapacity and yet 600 000 people are without electricity was made. This increase of 200MW would not stretch the present capacity of 32 403MW. The authors state that the problem is, however, one of the availability of finance. The 100 000 households needing electrification would cost R 250 million.

The limited access to electricity in low income households has resulted in a range of transitional fuels being used. A table presenting these domestic energy use patterns shows, % of house and the % contribution of various transition fuels

(candles, dry-cell batteries, car batteries, paraffin, gas LPG, wood and electricity) is presented for the low income households. It was calculated that up to 20% of the low income households income is used on energy. Limited nighttime activity, increased fire and health hazards and inadequate and unaffordable access to appliances were listed as problems associated with lack of access to electricity in these areas.

Comments pertaining to electricity are rounded off by the author's point that;

'In response to the demand for electricity Eskom has designed tariffs (the 'S1' tariff) and metering systems (pre-pay meters) suited to low income households. Pre-wired 'ready boards' are available which minimise the cost of house wiring. Increasing attention is being given to rationalisation of supply authorities to overcome existing barriers to the effective implementation of new electrification schemes.'

The paper goes on to review the other fuel's consumption sector by sector. Coal, gas, LPG distribution, paraffin, petrol and diesel. Finally the estimated future growth trends of these fuels are projected in % per annum. It was calculated the electricity would increase at 4.2%.

5. Proposals for a Consultative Process on Electricity Provision in the Western Cape, Zille Shandler associates, public affairs consultants, April 1991

In a memorandum the problem was stated as one where 800 000 people, mostly black residents of informal houses, are dependent on more expensive and less convenient energy sources. There has been a demand for electricity from a wide range of political groupings. This demand has been blocked primarily by institutional problems, that are mainly a hangover from apartheid's racially separated regional governments. There were two supply systems in 1989 one large (234 546, white, coloured and Asian, well-staffed (2500) and profitable (R528 million) and the other Lingeletu West City Council small (4120 in 1990) black, understaffed (35) and poor (R3 million revenue from sales). The latter are unable to provide further electrification as they survive from 'bridging finance' from provincial authorities.

5% of Khayelitsha has been electrified, whereas some formal parts eg. Town 1, built in 1980, have had no access to electricity as BLA's cannot raise the capital, neither do they have the administrative nor technical resources to manage the project. No informal housing electrification is available nor is there electricity in site and service provision

6. Electricity use in Low Income Areas of the Western Cape (based on the report; Analysis of new Electrification schemes in the Western Cape, Phase I) by Paul Theron

'A central question affecting electrification planning relates to expected electricity consumption levels.'

This is the central theme of Theron's work, which serves as the basis for this current study. Based on a large bank of socio-economic information around electrification, Theron uses a number of arguments to prove that the for low income households consumption of electricity increases with time. For this he uses bulk and sample (109 household's) data comparing Khayelitsha (a large black township to the east of Cape Town, which has had limited access to electricity over last 4 years) to Langa and Gugulethu (older more established townships who have had access to electricity for many years).

Theron suggests that although the electricity usage is lower in more recently electrified areas, it will reach a level comparable to the greater Cape Town average. His findings point to electricity, connections fees and appliances hire purchase costs being consuming between 10 and 20% of household's income. In this way he suggests that electricity is both affordable (it is the cheapest fuel) and a desired fuel. There is information presented which suggests that the electricity service may not be reliable in low income areas. This, it is speculated, could further complicate an already cluttered transition fuel and respective appliance terrain. Here attention is drawn to exploring options to install larger appliances, such as geysers and stoves so as to affect a more rapid electricity take up rate. Attitudes to outside night lighting and metering methods (credit versus prepayment) are explored.

In this report a deluge of information that includes brief histories of the areas targeted by the survey, the spectrum of appliance ownership, household fuel use (with seasonal fluctuations), the affordability of electricity, attitudes towards electricity, the quality of the service provided by the electricity service and contributors to the increase in electricity consumption. Much of quality of life type of information is unquantified and subjective but gives some valuable pointers.

Theron concludes his paper suggesting that 'Electrification in South Africa has reached a stage where it is seen as a necessary strategy for increasing living standards and promoting economic growth.'

It was suggested in the conclusion of paper that further information should be gathered in more regions to add to the database on which planning can be based. The present piece of work, of which this literature survey is part, is a continuation and broadening Theron's work. As verification and comparisons to extract trends is part of the scope of the current work, continual reference will be made to Theron's work which will serve as a building block. The author of the current work therefore feels that an in-depth analysis of Theron's work is not necessary at this stage.

Appendix Two

List of institutes and individuals who responded during the pre-survey consultative process

1. Mr. J. A. Basson – Energy Branch, DMEA
2. Tony Hugo – Electricity Department, Town Council of Sandton
3. D. L. W. Krueger – Energy Technology, CSIR
4. J. W. Theron- Executive Committee, CPA
5. Reg Munro – Old Mutual
6. Mark Gandar
7. Charles Dingley
8. Phillip Geerdts – TATU
9. R. M. Friedlander – EXCO, Cape Town City Council
10. Jeanne Anderson – Independent Development Trust
11. C. A Anderson – Office of the Town Clerk, City Council of Pretoria
12. Zav Rustomjee
13. Clive Forster – Built Environment Support Group, University of Natal
14. R. S Anderson – Altech Industries
15. Izak van Gass – Research, Eskom
16. Tim Hart – Urban Policy, Urban Foundation
17. W. Loots – Town Clerk, Lingeletu West City Council
18. Ian Lane – Centre for New Electricity Studies, University of Pretoria
19. H. R. Whitehead – Durban Electricity
20. Rolfe Eberhard – Palmer Development Group
21. Reinhold Viljoen – Energy and Development Group
22. Douwe van Wijk – Marketing and Electrification, Eskom
23. C. E. McCarthy – Cape Chamber of Industries
24. Yuriko Sakairi – World Bank

Appendix 3

Report by interviewer, Mr. Lizo Ntloko

1. Introduction

Firstly I would like to thank the EDRC for allowing me to conduct this survey. The questionnaire was very long. Some of the questions I found repetitive. For example the two questions;

“When do you buy electricity?”

“How often do you buy prepayment meters in a month?”

2. Field Experience

There were complaints about the electricity service from the different areas such as the core houses in Khayelitsha and the up-market houses in general. These complaints centred around the blackouts which were felt to be an aspect of the poor electrical service and communication problems in general.

Accounts for the electricity used are delayed some times as much as three months. Almost all people with credit meters were in arrears. One head of household who was interviewed recounted the story that he was away with his family for a month. During that time no one was living in the house. Surprisingly at the end of the month on his return the bill he received was the same as the bills of the previous months, when the family was at home.

The houses with pre-payment metering suggested that their supply was weak. People said that they could not use 3 appliances simultaneously. eg: refrigerator, iron and stove or refrigerator, stove and television.

I must mention that some people are uncooperative. I had to apply my skills and experience to handle some people. Others complained about the length of the interview.

Most people complained about the several interviews which have been conducted without any further implementation of results. They therefore demand a program of further implementation. I would like to stress again that I had to apply my skills to address this issue, since this was an expectation uncovered by the questionnaire.

3. Recommendations

In the light of the experience i have mentioned above'

1. I hereby strongly criticise the use of untrained or unskilled interviewers to conduct any survey or pilot project.
2. Field workers need to be trained, equipped with communication skills and need to understand the meaning of the questionnaire, and the answers required.
- 3.

Field-workers should work in the evenings and report every morning to the co-ordinators, so that if there are any errors they can go back and do some corrections. Meanwhile they will be proceeding with their individual survey tasks. This can also minimise the delays of the current survey project.

4. Conclusions

As we are all aware that one of the objectives of this survey is to acquire relevant information through the questionnaire, it is important that the gathering of this information is adequate or the survey's validity will be in question.

Therefore, in the light of the above, the current political and socio-economic changes and the democratic transformations in the country, the masses of this country are highly mobilised for change and are therefore aware of what they need and when the things go wrong. However, they may not be aware of the technicalities, such as why the townships are like they are at present.

Therefore, I hereto kindly appeal to be granted an opportunity to capitalise on this positive strength of our people, with this experience to serve my community to my best ability.

Signed by Lizo Ntloko

Appendix Four



Final questionnaire


WESTERN CAPE ELECTRIFICATION PROJECT QUESTIONNAIRE


I'm, and I'm doing a follow-up survey on the fuels used by people living in houses with electricity. The first round of the survey was conducted in July 1991. As with the first round, this survey is for the "Electricity Transition Project" being run by the Energy for Development Research Centre at the University of Cape Town.


The people and houses to be surveyed have been chosen at random from all the electricity consumers in the area. The information collected will be kept in confidence, and will be used with other questionnaires to prepare a research report. This report will be used to propose improvements in the system of electricity provision in all urban areas around the country.


I would like to interview the person in the household who makes decisions regarding the buying the different fuels that this household uses such as electricity, wood, coal, charcoal, gas and paraffin.

Questionnaire Code Number:  

Area: 

Date: 

Time: 

Interviewer: 

Introductory remarks by interviewer:

.....

.....

A: INTRODUCTORY QUESTIONS

1. Name of respondent:

Male	Female
------	--------

2. Were you the person interviewed when we last conducted the interview?

3. Is this the same household that was interviewed in 1991?

If the answer is no, ask where they are now.

3. Are you the head of the household?

Yes	No	If no, who is?
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4. Do you make the decisions regarding the buying of fuel?

Yes	No	If no, who is?
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5. How long have you been at this address (in years)?

***B: SITE AND HOUSEHOLD INFORMATION**

*1. How many people are there living on the property? Even if the shacks are just used for sleeping in please fill in the table and note that fact:

	Number of people	Do they eat together?		Do they add to the household income?		Do they use the same electricity?	
		Yes	No	Yes	No	Yes	No
Main house :							
Shack 1:							
Shack 2:							

2.1 Descriptions of buildings:

When we interviewed you last we asked about your house what it was built of, whether it had a ceiling and so on. Have you changed anything since we saw you last?

if yes what?

why?

4. Estimates of other income: fill in the following table:

	Estimated money every month
Sent by family living away:	
Pensions:	
Rent from tenants:	
Other (specify):	

5. Estimates of household expenditure: fill in the following table:

HOUSEHOLD ITEM	Estimated money every month
Food:	
Clothing:	
Transport:	
School fees and books:	
Remittances sent to family elsewhere:	
Umgalelo/ Stokvel groups:	
Rates:	
Water:	
Rent/ bond:	
Other (Specify):	

5.1 Do any of the items above vary every month by large amounts?

Which ones?

5.2 What contributes to these variations?

6. Hot Water Supply (tick the right boxes)

6.1 Hot water for washing?

Does your house have tapped water inside?	cold	hot		
Do members of the household use hot water for washing themselves?	yes	no		
In what do members of the household bath themselves?	bath	basin	shower	other ?
How often do members bath themselves?	once a day	twice a day	others?	
If bath or basin, is this water only used for one person?	yes	no	how many?	

6.2 If your house has a geyser or electrical water storage heater please fill in the following table.

where is it positioned?	inside	outside
is it switched on?	yes	no
if it is off, is it always off?	yes	no
why do you turn it off?	too expensive	others?
if on, when is it on?	always	sometimes?
if sometimes, when?	in winter?	others?
do you alter the temperature setting?	yes	no
What does it cost to run?		Rands per month

C. ENERGY USE.

Which of the following fuels are used in the household? Tick where appropriate.

FUEL TYPE:	Frequently (Daily)	Seldom	Never
Electricity - generator:			
- car battery:			
- mains:			
Paraffin:			
Gas:			
Coal/ charcoal:			
Wood:			
Candles:			
Other (specify):			

If you have access to electricity why do you use other fuels?

too expensive	do not have appliance	electricity too weak	electric service blackouts	better value	other fuels give better quality service	Others?
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2. Electricity.

*2.1 How long have you been living with electricity? Please fill in the following table:

Places lived:	Approximate date arrived:	Approximate date left:	Had electricity?	
			Yes? since when?	No
Present house:				

2.2 Use of Electricity.

Please fill in the following table. Tick owned appliances and give written information.

ACTIVITY	APPLIANCE TYPE (fill in brand name where possible)	DETAILS (for example, is it new or old, brand name)	NUMBER OWNED	REASON FOR USING ELECTRICITY (only fill in where electrical appliance is used)
Cooking:	Electric stove: number of plates oven warming drawer'			
	Hot plate: number of plates			
	Microwave oven: convection oven			
	Electric frying pan			
	Toaster/TV-braai			
	Electric kettle			
	Other kitchen appliances			
Heating house:	Bar heater:			
	Other type:			
Heated water on tap	Storage Geyser			
	other geyser			
Lighting: general				
for cooking				
for reading				
for socialising				
for safety				
Refrigeration:				
Deepfreezer:				
Washing machine:	Hot water			
	Cold water			
	Tumble Dryer:			
Dish washer:				
Ironing:				
Entertainment/ communications: (specify whether batteries or mains)	Television:			
	Hi Fi:			
	Radio:			
Cleaning:	Vacuum cleaner:			
	Polisher:			
Electric tools				
Others (specify):				

2.3 Which electrical appliance

is the most useful/ wanted in the house?		
does your household have one?	yes	no
did you get first?		
which appliance did you buy/get last?		

2.4 Are you still paying off on appliances? List in order purchased, most recent purchase first.

APPLIANCE	Cost	Description	Where purchased from whom?	Monthly payment

2.5 Are you planning to get any other electrical appliances? List in the order of greatest priority.

APPLIANCE	Cost (est.)	Description	Where will you get it	How will you pay for it:
1.				
2.				
3.				

2.6 Who replaces elements, bulbs and spare parts?

.....

2.7 Who repairs your appliances when they break down?

a friend?	family member?	business in the township?	other? explain . .
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2.8 **Businesses**

2.8.1 Do you run a business from home or in the area?

None	from home?	not at home, but in the area?	What sort of business?
			What tools or appliances do you use?
			How much do you pay for fuel in your business?
			Has having electricity made it easier to run your business? Give reasons:

2.8.2

Business type?		(a)	(b)
At present?	Planned for the future?	fuel used in business.	Preferred fuel type?
		Coal	Coal
		Gas	Gas
		Fuelwood	Fuelwood
		Electricity	Electricity
		Others?	Others

After filling in the above table...

iii) If there is preference for electricity as an fuel, then state why?

.....

2.9 What can you say about the following aspects of your home environment since you got electricity?

	<i>Better</i>	<i>Worse</i>	<i>Not sure</i>
<i>Dirty air <u>inside</u> your house (caused by burning wood, paraffin, gas or coal)</i>			
<i>Dirty air <u>outside</u> your house, from your neighbours' houses</i>			
<i>Getting burnt, or having fires from accidents with paraffin or candles</i>			
<i>The temperature inside the home in summer</i>			
<i>The temperature inside the home in winter</i>			
<i>Light for working/reading</i>			
<i>Sore throats, runny noses or coughing</i>			

3. Wood

ACTIVITY	Reason for using wood, not electricity:
Daily cooking:	
Cooking traditional meals:	
Slow simmering	
Roasting	
Baking	
Brewing:	
Heating water:	
Heating house:	
Drying clothes	
Braaing	
others? (specify)	

3.1 How many bundles of wood do you use in a month?

How much wood is there in pieces or weight are in a bundle?

3.2 If wood is used special occasions how often do you have these special

occasions?

3.3 Do you buy it?

No	Yes	From where?
		What does it cost (per bundle)?

3.4 Do you collect it yourselves?

No	Yes	From where?
		How long does it take to collect a load?
		Who collects it?
		Who goes along?

4. Paraffin

(if paraffin is used for cooking and heating at the same time with the same appliance, tick both activities.)

ACTIVITY	APPLIANCE TYPE (fill in brand name where possible)	DETAILS (where appropriate)	NUMBER OWNED	REASON FOR USING PARAFFIN, NOT ELECTRICITY (only fill in where paraffin appliance <u>is</u> being used)
Cooking:				
Heating water: for drinking				
Heating water: for bathing?				
for warming food?				
Heating house:				
Lighting: General read/working				
Heating iron				
Other (Specify):				

4. How much do you use? Fill in the table:

Size of bottles/ cans normally bought:	Cost per bottle/ can:	Length of time these bottles/ cans usually last:	Can I see one of the cans/bottles you buy. (What is the volume of the bottle in litres) ?:

4.2 Where do you get it from?

4.3 Who gets it?

4.4 Who fills heaters/ stoves/ lamps?

4.5 How many times per day/week do you go to buy it?

5. Coal / Charcoal

ACTIVITY	APPLIANCE TYPE (fill in brand name where possible)	DETAILS (where appropriate)	NUMBER OWNED	REASON FOR USING COAL/ CHARCOAL, NOT ELECTRICITY (only fill in where coal/ charcoal appliance <u>is</u> being used)
Cooking:				
Heating water:				
Heating house:				
Other (Specify):				

5.1 How much do you use per week?

5.2 Where do you get it from?


5.3 Where do you store it?

5.4 Who gets it?

5.5 What does it cost? 

6. Car Batteries

ACTIVITY	APPLIANCE TYPE (fill in brand name where possible)	DETAILS (where appropriate)	NUMBER OWNED	REASON FOR USING BATTERIES, NOT ELECTRICITY (only fill in where batteries <u>are</u> being used)
Entertainment:	Television:			
	Hi Fi:			
	Radio:			
Other (Specify):				

- 6.1 How often do you recharge them?
- 6.2 Where do you recharge them?
- 6.3 Who takes them to be re-charged?
- 6.4 What does it cost? 
- 6.5 How many have you got?
- 6.6 How long does one last before you get a new one?

7. Gas

(if gas is used for cooking and heating at the same time with the same appliance, tick both activities.)

ACTIVITY	APPLIANCE TYPE (fill in brand name where possible)	DETAILS (where appropriate)	NUMBER OWNED	REASON FOR USING GAS, NOT ELECTRICITY (only fill in where gas appliance is being used)
Cooking: Frying				
Simmering				
Baking				
Heating water: Geyser on tap Vessels				
Heating house:				
Lighting:				
Heating iron				
Other (Specify):				

7.1 How much do you use? Fill in the table:

Size of bottles normally bought:	Cost per bottle refill:	Length of time these bottles usually last:	Number of bottles used per month:

7.2 Where do you refill gas bottles?

7.3 Who goes to refill bottles?

7.4 How do you transport the bottles.

8. Candles

ACTIVITY	Reason for using candles, not electricity:
Lighting: General	
Reading	
working	
cooking	
Socialising	
Safety	
Outside	
Other (Specify):	

- 8.1 How many do you use per month (packets)?
- 8.2 How many candles per packet?
- 8.3 Where do you buy them?
- 8.4 Who buys them?
- 8.5 What do they cost?
- 8.6 How many hours do you use candle light each night?

D. ELECTRICITY SERVICE

This part of the questionnaire is designed to get information and opinions about the electricity service available in your area.

*1. Type of lighting system in area: (tick one box):

High mast lights	Street lights
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1.1 List advantages and disadvantages of the system ticked above only:

	yes	no
enough light?		
too much light?		
better security?		
outside light saves using lights inside?		
others?		

1.2 Where street lights are mounted on poles, is there a light on every pole?

1.3 Where the street lighting is on poles is there enough light?.....

1.4 Does the light shine your yard? In the street?In the window?

2. Type of electricity network in the area: (Tick one box):

Underground cables (like most of Khayelitsha):	Cables visible on poles (like in Langa):
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2.1 List advantages and disadvantages of the system ticked above:

	yes	no
is it safe?		
does it look better?		
makes a noise?		
breaks often?		
more difficult fix?		
others?		

*3. Type of metering system: (Tick one box):

Credit meters (bill at end of month)	Card (pre-payment) meters
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3.0 How much did you pay to get electricity?

When the meter was installed, did you have any choices?

- of the type of meter?

- where the meter was installed in the house?

- when was electricity installed in you house?

If respondent has a card meter, skip question 3.1

3.1 Credit Meters:

List advantages and disadvantages of credit metering system:

	yes	no
is it safe?		
does it look better?		
makes a noise?		
breaks often?		
more difficult fix?		
easier to budget?		
others?		

- 3.1.1 Has the electricity to your house only (not a black out) ever been disconnected?
 For how long?
 Why?
- 3.1.2 How often is your meter read?
- 3.1.3 *Is there sufficient information on your bill?*
- 3.1.4 *For bills, which is your preferred language?*
- 3.1.5 Do you think that your bills are correct?
- 3.1.6 How often do you receive bills?
- 3.1.7 Are you in arrears on your electricity payments? if so by how much? ..
- 3.1.8 How much was your last electricity bill?:
- 3.1.9 Where do you usually pay your account?
- 3.1.10 *Would you prefer a card meter? Why?*
- 3.1.11 Other comments:

If respondent has credit meter, and question 3.1 has already been answered, skip question 3.2.

3.2 Card Meters:

List advantages and disadvantages of this card meter system:

	yes	no
is it safe?		
does it look better?		
makes a noise?		
breaks often?		
more difficult fix?		
easier to budget?		
others?		

3.2.1 Has your meter ever stopped working?

Why?

3.2.2 When do you usually buy cards?

3.2.3 Access to cards

How much worth of electricity do you buy at a time?	
How often do you buy electricity?	
How much did you spend last month on electricity?	
How many times have you bought a card that did not work when you got home?	
What time of the day do you usually buy cards?	
Are the card sales points open enough?	
Is there a card sales point conveniently situated near you?	
do you keep a spare card?	
Who usually buys the cards?	

Would you prefer a credit meter system? Why?

4. Type of housewiring in the house: (tick one box):

Plugs, lights in each room	Readyboard
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4.1 List advantages and disadvantages of the system in the house:

Advantages:

Disadvantages:

4.2 If you have a readyboard, which room is it in?

Would you prefer it in another room? Which?

Did you have any say where the ready board was installed?

5. Perceptions about electricity tariffs:

5.1 Do you find electricity affordable?

Yes	No	If no, why?
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5.2 *Would you consider buying electricity at a cheaper rate if it meant that you could use none or very little at certain times?*

5.3 Do you think that electricity tariffs are fair? If not, why?

5.4 *Would you like to use less electricity? How?*

5.5 *Would you like to use more electricity? How?*

6. Electricity Blackouts

6.1 How often does electricity in the area (not only in your house) go off?

Often	Seldom	Never
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6.2 For how long at a time is electricity off?

6.3 Does this cause problems?

6.4 What kind of problems?

