FINAL PROJECT REPORT

PREPARED FOR THE DEPARTMENT OF MINERAL & ENERGY AFFAIRS BY:

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

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TITLE : Analysis of new electrification schemes in the Western Cape - Phase III

AUTHORS : S J Thorne and V Qangule

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EXECUTIVE SUMMARY

Project objective

The project entailed the examination of electricity and other fuels used in newly electrified, poor urban settlements in Cape Town. The project has been monitoring and analysing energy consumption data and relevant socio-economic information for three years. An important aim remains to understand factors which affect the movement from multiple fuel use to greater electricity consumption. The intention of the project is to provide detailed information which would be of use to those involved with the process of electrification.

The project involves a longitudinal study of changing energy use patterns over time. The first phase of the project began in 1991 and the second was conducted in 1992. This report covers phase three, which was predominantly conducted in 1993, while it draws from information gathered in previous phases.

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 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 (currently about 10 000) and from a record of all pre-payment meter electricity purchases in Khayelitsha (there are currently about 10 000). This information was obtained from the distribution authorities serving these areas (the City of Cape Town and the Lingelethu West City Council/Pambili Nombane/Eskom respectively.)

Secondly, a survey of 115 electrified households was carried out. 79 households in Khayelitsha were surveyed. A further 36 households in the older electrified areas of Langa and Guguletu were also surveyed.

A stratified sample of households were selected on the basis of having high, medium and low monthly electricity consumption levels. In addition the sample in Khayelitsha was spatially distributed between towns 1 and 2 (the initial "core" housing area), and Jonkersdam and Bongweni (the newer up-market formal housing areas), to cover different housing types and income levels.

The households surveyed have remained essentially the same as those interviewed in the previous two phases of this project. Due to 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 were new additions to the phase 2 sample. In phase 3 a further three households either withdrew or had moved - these were dropped from the sample.

As far as possible, data from phase 3 (1993), is compared with phases 1 and 2 (1991 and 1992) to determine trends.

Background

The two older areas studied, Langa and Guguletu, were initially chosen as examples of more established low-income (sub-economic) areas that have enjoyed access to electricity for a considerable time - on average more than 20 years. These areas have a high level of access, with 72 and 90% of households using electricity respectively, despite high levels of disconnections being reported (18 000 per month). However, while access has remained at a high level, the use of electricity, and energy services in general, has been erratic. The high level of arrears (and the vacillations of Council policy to address it), and the alleged poor quality-of-service have contributed to uncertainty, and the provision of stand-by fuel alternatives. Arrears owed by residents in these areas stand at R21 million. The August 1994 announcement of the Regional Premier, that there is to be a moratorium on prosecutions for service arrears means that the scrapping of payment arrears, as advocated by the civics, is one step closer to becoming a reality. The Cape Town City Council has applied to the State for R12 million in assistance to upgrade the service in Langa and Guguletu. Meanwhile the Council's electricity trading surplus was R63 million for 1992/93.

In Khayelitsha, the level of access has been revolutionised in the past 12 months. Until recently only 5000 of Khayelitsha's 70 000 households have had access to electricity. The right of electricity supply to Khayelitsha was passed from Lingelethu West City Council to Eskom in 1993 and subsequently to their agents, Phambili Nombane (a French, British and South African consortium, called "Forward with Electricity"). Their mandate is to electrify all the remaining households within 3 years at the lowest possible cost. The level of access to electricity had nearly doubled by March 1994. Eskom's electrification effort has so far concentrated on completing the electrification of the formal houses, while Phambili Nombane has been making a start on town 3 village 5 and site C residents, who live in planned informal dwellings (site-and-service). Phambili Nombane is confident of reaching their connection goals, employing an aerial bundle conductor overhead system and pre-payment metering. The labour based/intensive construction methods have created opportunities for local labour and subcontractors.

Electricity consumption

The household electricity consumption data records from Council and Eskom only approximates actual electricity use. In Langa and Guguletu the electricity consumption data is taken from the records of monthly bills, and in Khayelitsha pre-payment electricity sales. Neither of these sources are entirely accurate reflections of actual use. In the former case, the reading of meters does not necessarily occur at exactly monthly intervals and the consumption is occasionally estimated when access to the meter is denied. In the latter case, the monthly purchases overlap so averages and particularly frequency distributions could be inaccurate. In addition, Eskom and Phambili Nombane refer to a high

degree of electricity theft. This observation is apparent when the pre-payment meter purchases are compared with the bulk electricity supplied to the area. This is apparent from the Khayelitsha data used in phase 3 where only 20 to 30% of bulk electricity fed to the area could be accounted for in electricity sales. The phase 3 study did not manage to get the consumption of the credit meter customers in Khayelitsha, which although few in number do consume considerably more electricity than their pre-payment meter neighbours. However, all credit meters will soon be replaced with pre-payment meters.

In all the areas studied, the average electricity consumption of the universe has decreased from phase 2. The decrease in the universe is mirrored in the samples in all three areas which show similar trends. In Khayelitsha, the trend is attributed to the large and rapid increase in the number of households which have been electrified during phase 3. This increase and the extent of theft (or meter faults) may account for the 15% of consumers who recorded no electricity purchases in February 1994 and the 50% who consume below 100 units per month. In Langa and Guguletu the improved collection of arrears, and the threat of disconnection, appear to have affected the consumption of electricity.

In all areas the consumption and seasonal trends of the sample are reflected in the universe. In Khayelitsha during phase 3 the gap between the sample and the universe has broadened following an average monthly decrease in the electricity consumption of the universe from 200, 244 to 209 from phases 1 through to 3.

The 50% of consumers who buy electricity in amounts equal to, or less than R5 and the 70% who purchase electricity more frequently than one a week, provide compelling evidence that the pre-payment metering systems allows for frequent small purchases of electricity, and electricity becomes affordable to end-users with small and irregular incomes. In both Langa and Guguletu there are increases in the categories of electricity users who have not paid anything for electricity in 1993, and those who have reduced their arrears in 1993. The category of those paying, yet whose arrears have increased, has been reduced.

In an effort to treat all customers equitably the Council has announced that their entire 250 000 domestic customer base are to have pre-payment meters installed. They have also announced that customers in arrears will have the opportunity of paying half this month and half the next or accepting pre-payment metering now and paying an extra 14% to recoup arrears over and above the standard domestic tariff. The latter proposal could equitably resolve some of the tensions surrounding the arrears issue in the council area of supply. The result would be a higher tariff in Langa and Guguletu, but which is still lower that the standard Eskom S1 tariff used in Khayelitsha!

Household energy services

Chapter 5 is the heart of the report. It attempts to understand household energy services from the end-user's perspective, uncovering firstly which energy services are employed in the household, the appliance and fuel combinations utilised, how these appliances were acquired, and why these combinations are used.

The chapter did reveal some inconsistencies when the data in this section is compared with that from previous phases. This was particularly relevant to ownership of electric space heaters, washing machines, and hire-purchase allocations. Whether these variations are as a result of real movements or enumerator/data capture changes/discrepancies needs to be tested against an acceptable margin of error.

Between 80 and 100% of all respondents used the following household energy services: lighting, cooking, ironing, refrigeration, entertainment, water heating, and clothes washing.

Fuels in use

Only 3.5% of the sample use electricity exclusively, most use 2 (56%), others use 3 (35%) and 4 (5%) fuels. In Langa and Guguletu, respondents considered electricity to be as reliable as paraffin (70%). In Khayelitsha few (35%) considered paraffin to be reliable and nearly all (95%) considered electricity to be reliable.

Fuel and appliance mixtures

There has been a decisive move towards electric stoves (77 and 66% for Langa/Guguletu and Khayelitsha respectively). In Khayelitsha there is increasing use of electric bar heaters (66%), and a reduction in paraffin heating. In Langa and Guguletu space heating with paraffin (57%) is higher than heating with electricity (24%).

Geysers are utilised for water heating by most Khayelitsha households (70%), while only a few have electric geysers in Langa and Guguletu (less than 10%). Here water heating is achieved using cooking stoves and kettles. Kettles are owned by the majority of households (55 to 65%).

All households in the sample use electricity for lighting, and most (more than 80%) use candles, and some paraffin (8 to 20%) as a back-up. All entertainment "appliances" are electrically powered. In Khayelitsha, these include TVs (90%), hi-fis (50%) and radio (40%), while in Langa and Guguletu these include TVs (90%), radio (70%) and hi-fis (40%).

Almost all households wash clothes by hand (85 to 90%), with only a few owning washing machines (10%). The majority of households use electric irons (more than 95%). The ownership of refrigerators is increasing in Khayelitsha (90%), the proportion of households own refrigerators in Langa and Guguletu.

Energy service preferences

Households using paraffin and gas for the heavier thermal energy services (such as cooking, water and space heating) prefer them because of the cheapness of fuel and appliances. However, electricity users prefer its cleanness and safety in use. All fuels are considered similarly reliable, gas is favoured above paraffin in terms of cleanness, and paraffin is a favoured multi-purpose fuel.

The higher cost appliances (refrigerators, stoves and geysers) are commonly purchased new on hire-purchase terms or bought second hand for cash, while small, less expensive items, tend to be purchased new on cash terms.

Energy consumption

Net and useful energy consumptions have declined in both Khayelitsha and Langa and Guguletu, with the exception of the latter where useful energy increased slightly to 2100 MJ per household per month. The corresponding figure for Khayelitsha is 900 MJ, mainly because of smaller household sizes.

Importantly, the proportion of household energy contributed by electricity has increased over the period of the study. In Langa and Guguletu, paraffin has remained stable and in Khayelitsha gas has made way for electricity. In Langa and Guguletu electricity accounted for 74% of the energy used in the household; in Khayelitsha this was 78%.

Cost of energy services

In Langa and Guguletu the cost of fuels required for cooking using electricity or paraffin is similar - nearly 6 cents/MJ, while gas costs more, at 8.6 cents. In Khayelitsha, the cost of cooking using electricity, gas or paraffin is between 6 and 7 cents/MJ.

In 1991 Rands the amount spent on energy services in phase 3 was R143 for Langa and Guguletu, of which 50% was on electricity, 39% hire-purchase instalments and 10% paraffin. During the same period in Khayelitsha R113 was spent on energy services. 55% of which was hire-purchase on appliances, 37% on electricity, and 5% on gas.

In all areas the amount of money spent on energy services increased from that spent in phase 2, while the fraction of income used to cover the provision of energy services has grown for the poorest category of households (income category less than R1000) to a high in phase 3 of between 20 and 22%. For the highest income category of households earning more than R2000, the fraction spent on energy services has decreased to 4% for Langa and Guguletu and 8% for Khayelitsha. Generally, energy consumption has declined, but the poorest are spending larger factions of incomes on energy services.

Determinants of electricity consumption

Various methods were used to consider whether electricity use was "dependant" upon a range of "independent variables". A linear regression was applied to and is shown on the data scatter plot, and an R-squared variance, and an Pearson Product-Moment Correlation (r) calculated. When this revealed low correlations a second method was applied which included dividing the independent variable into ranges and averaging the electricity consumption of all sampled households within that range. This method did yield some trends, though they were not tested statistically, neither was there any attempt to combine the multiplicity of determinants.

The study observed that increases in income, household size, and the period of access to electricity are all considered as determinants of electricity consumption, all lead to increases in electricity consumption. There were only

5 electricity consuming businesses run from home in all areas surveyed. These used considerably more electricity than households without these activities.

Households headed by women, despite earning less than their male headed counterparts, use considerably more electricity. Also the greater the variety of fuels used in a household, the lower the amount of electricity consumed. Likewise, households that perceive the duration of blackouts to be the longest consume the least electricity.

Finally, the seasonal changes of ambient temperature effect the use of electricity. The lower the average minimum temperatures the higher the average for all consumers.

Perceptions of the electricity service

The main negative perceptions of electricity are that blackouts occur often. This perception is increasing in Langa and Guguletu, where on average, these are considered to have a duration of 15 hours. In most areas of Khayelitsha the perceived frequency of blackouts is down, while in all areas the average duration of the blackouts is considered to be in excess of 4 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 received.

The overwhelming majority of respondents considered electricity affordable and the tariff fair. In all areas the perception that electricity is affordable has increased since phase 1. Those who perceive electricity to be unaffordable are those households serviced with credit meters. This could be a reflection of the arrears run up by many in these areas.

Only 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. The majority of pre-payment meter users like the control that they provide in managing electricity consumption. There is an increase in the number of respondents who would like to use less electricity, and a significant decrease in those who would like to use more. All respondents would find education useful on how to use electricity.

Recommendations

The recommendations of this report are of two sorts; the first relate to the recommendations for phase 4 of the study and other policy research activities, and the second are those which may apply to the electricity distribution industry.

Research recommendations

The most obvious recommendation for continued research is to extend the longitudinal data collected in the first three phases of this study. In other words

continued tracking is at the heart of this project, and should remain so. The research techniques which have been employed have improved over the phases and similar, but better and more reliable data is being collected.

It is recommended that the study, while continuing to gather the longitudinal data, also attempts to probe the energy service decision making process in order to get a firmer grasp of why decisions are made. Participatory research methodology may facilitate this process, and certainly provide a more textured research product.

Specific to the question of determinants is the gender dynamics within the household and how this affects energy use patterns. Phase 3 tested the relationship between household electricity consumption and the gender of the household head. Women headed households were shown to have a higher electricity consumption, although they were poorer. This area should be pursued - the implications for electricity distributors are that women headed households, though poorer than their male headed counterparts, may be stronger candidates for early electrification in the case where "electrical" uptake is all important. This is an example of the type of information which would make this study of greatest use in maximising the benefits of the process electrification. Another area that the study has failed to explore adequately is the level of energy poverty (or suppressed demand) that exists. The question of whether energy services are being fulfilled, for example would indicate the level of energy poverty.

Finally, there are two areas which are arguably outside of the scope of this study, and they include: electrification and employment potentials (both up and down stream) and the process of electrification and democracy. The negotiating procedure, and the employment aspects of electrification are both areas which need refining if the key programmes and basic principles of the Reconstruction and Development Programme are to be met. The process of delivery should promote democratic exchange and build technical capacity amongst recipients of electricity, and understanding and trust between distributors and their clients. This is all the more important when one considers that it is the customer of electricity who at the end of the day directly or indirectly pays for the service, the poles, the power stations and the salaries of the staff of the distributor. The authors contend that this process of service delivery should also contribute to a model of good practice. It is possible that professional facilitation mandated to bring stakeholders to the table, and to ensure effective communication process would assist in the development of such a model, which could be relevant to the provision of other services.

Conclusions for distributors

The first major conclusion for electricity distributors is that the growth in consumption does not appear to be continuous as expected despite the rapid penetration of electrical appliances. Electricity in Khayelitsha appears to have levelled off although this conclusion might be tempered by the fact of increased new consumers. It appears unlikely from the Khayelitsha data that the level of consumption that would result in a breakeven at the figure of 350 units per month will be reached soon. The cost of electrification, and the electrical service therefore, needs to be reduced, failing which the tariff needs cross-subsidy. The

one area of uncertainty is the alleged level of meter by-passing in Khayelitsha which may severely affect this conclusion.

A conclusion which needs to be emphasised is that even in areas which have been electrified for a long time, there is multiple fuel use. This need not mean that there is competition for electricity which needs to be (or even can be) brushed aside using saturation marketing. It may mean that people have settled on preferences, which suit their energy service needs within income constraints. It is even possible that a mix is desirable to the distributor, particularly if the heavier thermal loads like cooking, water and space heating are being fulfilled by other fuels, thus reducing peak demand for their product. Encouraging a fuel mix could in fact be an effective demand-side management strategy.

The next conclusion for distributors relates to the perceptions of fuels and appliances. From the responses to the question of why the different fuels and appliances are used, it is clear that electricity enjoys priority in terms of cleanness, safeness and so on, but in terms of cheap fuel and appliances, and the multiple utility of the fuel and appliance combinations, it is not as popular as paraffin, and to a lesser extent, gas. With decreasing household incomes and energy consumption, and a large fraction of income already being spent on hire-purchase instalments, clearly there is a role for reducing the perceived affordability barriers of electric energy services.

The pre-payment meter and the S1 tariff structure appear to be effectively reducing the barrier to the affordability of electricity, but electrical appliances are still expensive. It is realised that there are considerable problems with pre-payment metering and the associated rate of theft of electricity, but it may be possible to consider using the tariff as a collection mechanism for the purchase of appliances. For example, an incremental payment on the tariff could facilitate the purchase of an efficient and durable (possibly labelled/marked) appliances, which would provide benefits for the end-user and the electricity distributor.

The number of "out-of-use" electric appliances appears to indicate opportunities for appliance repairers. Distributors could play a role in facilitating the learning of this skill.

Finally, there is a recommendation for the distributor in relation to the issue of arrears. When it is considered that in Langa and Guguletu the average household level of arrears is over R2000, it is apparent that this cannot be just paid back in two months. It is likely that some of the poorest households carry the heaviest arrears burdens. Yet arrears have to be reduced, and if there is a culture of non-payment for services this too must be addressed. To write-off arrears, if this is the plan, will be to give a signal that non-payment in the past is condoned. To some extent it could be argued that the quality-of-supply to some of the areas where service arrears are the highest was so poor that they were not worth paying for. Yet households continued to consume these services, despite the quality-of-supply, while some paid and others risked disconnections and prosecutions by not paying, or paying just enough to stay connected, while promising to pay debt collection agencies regular amounts. Changes in collection policies and the mistrust of electricity bills and collection processes have contributed to a muddled situation which needs clarity.

The choices are that if you want households to pay for services directly, to write-off arrears will not affirm that aim in the long term. The suggested policy of installing prepayment meters and adding surcharge makes more sense, but, recognition must be taken by distributors of the quality-of-supply in the past and the political protest element of arrears in reaching an equitable solution.

ACKNOWLEDGMENTS

Without the assistance of many people this project would not have been possible. Some people deserve special mention and thanks.

Special thanks to Anton Eberhard and our colleagues at the EDRC who workshopped and advised on aspects of the study, notably Victor Thamaga and Mark Davis, who manipulated data. Lizo Ntloko and Christina Vuso who conducted the interviews; Paul Northrop, Brent Hampton, Peter Klein, Jannie Ehlers, Willie Holtz and Dixon Kulani and all the respondents who informed the project from an end-user perspective.

The electricity department of Cape Town City Council, ESKOM, and Phambili Nombane who gave assistance in understanding the problems associated with the supply side.

And finally, to the Energy Branch of the DMEA who financially supported the project.

Steve Thorne and Vuyo Qangule

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Chapter One

INTRODUCTION

1.1 Project objective

The project entailed the examination of the use of electricity and other fuels in newly electrified, poor urban settlements in Cape Town. The project has been monitoring and analysing energy consumption data and relevant socio-economic information for three years. An important aim is to understand factors which affect the movement from multiple fuel use to greater electricity consumption. The intention of the project is to provide detailed information which would be of use to those involved with the process of electrification.

The project involves a longitudinal study of changing energy use patterns over time. The first phase of the project began in 1991 and the second was conducted in 1992. This report covers phase three, which was predominantly conducted in 1993, it also draws from information gathered in previous phases.

1.2 Context of the project

This study aims to contribute to current debates on the viability and effect of electrification on poor areas. Levels of electrification are on the increase in South Africa, and the Reconstruction and Development Programme effectively commits the new government to 2.5 million new electricity connections within the next 5 years. High up on the priority list of those involved in the electrification process are urban townships. This study focuses on Khayelitsha and compares it to two older townships within the Cape Town metropole; Langa and Guguletu.

The staff of electricity distribution authorities need information on the effects of electrification. Potential recipients of electricity also need information which will assist in negotiating access. Distributors need information about trends in electricity consumption and what determines these. High levels of consumption imply better returns on the capital invested in the development of electrical infrastructure and affects the viability of these schemes. End-users and community structures request knowledge of how to maximise the efficient use of electricity, to maximise the employment of local labour and to decide on different electrification technologies.

Phase 3, as with previous phases of this study, hopes to meet some of these information needs by providing data based on the perspectives of energy end-users. Phase 3 takes the commitment to observe energy services from an end-use perspective one step further than previous studies by probing the reasons for the various choices made in selecting fuels and appliances. It continues the longitudinal tracking of electricity consumption, while providing a third "snap shot" cross-sectional analysis of energy behaviour amongst the households sampled, making the study longitudinal in both the electricity consumption

tracking and the monitoring of the sample. As in phases 1 and 2 of the study, it attempts to uncover socio-economic and other determinants of electricity use.

It is important to note that the study examines electrified households only, presenting electricity consumption data for all electrified households in Khayelitsha, in some instances from the time of initial access to electricity onwards. The study has, in phases 2 and 3, also managed to obtain monthly consumption in Langa and Guguletu for all households. The study excludes unplanned informal (shack) and planned informal (site-and-service) settlements, which are presently being electrified.

Background is provided by similar studies carried out previously by the Energy for Development Research Centre. In particular, the work of Viljoen (1989) had indicated the importance of looking at multiple fuel use, including multiple fuel use amongst households with access to electricity. It also draws on the work of the Palmer Development Group (1993, 1994), which provides a context within which to view electricity consumption in urban townships nationally. The work of Morojele (1994), which provides the first comprehensive attempt to consider determinants of electricity consumption and demand, has informed this phase.

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 is dependant on a range of inter-related factors. Data from this project will hopefully contribute to the development of such a model.

1.3 Project Methodology

There were two main data sources:

Firstly, all available information was collected on electricity accounts of households in Langa and Gugulethu (currently about 10 000) and from a record of all pre-payment meter electricity purchases in Khayelitsha (there are currently about 10 000). This information was obtained from the distribution authorities serving these areas (the City of Cape Town and the Lingelethu West City Council, Phambili Nombane and Eskom.)

Secondly, a survey of 115 electrified households was carried out. 79 households in Khayelitsha were surveyed. A further 36 households in the older electrified areas of Langa and Guguletu were also surveyed.

A stratified sample of households were selected on the basis of high, medium and low monthly electricity consumption levels. In addition the sample in Khayelitsha was spatially distributed between towns 1 and 2 (the initial "core" housing area), and (the newer up-market formal housing areas) Jonkersdam, and Bongweni, to cover different housing types and income levels.

The households surveyed have remained essentially the same as those interviewed the previous two phases of this project. Due to 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 Gugulethu were new additions to the phase 2 sample.

The questionnaire for the second phase was compiled after a process of consultation with institutions and individuals prominent in the electrification debate. They were asked to comment on the findings of the first phase of the study and requested to recommend additions to the questionnaire. In phase 3 a further step was taken to obtain information from an end-users perspective. A new questionnaire was workshopped internally within the EDRC and is attached as appendix A.

The interviews were conducted by experienced field workers, all of whom were first language Xhosa speakers. They were managed by research assistants, firstly Victor Thamage and later co-author, Vuyo Qangule. Interviewers were paid on a pro rata basis for completed questionnaires and any transport costs incurred were reimbursed. The interviewers returned questionnaires on a regular basis. Where the questionnaires were found to be incomplete, and where information was contradictory or very different from phase 2, field workers were asked to return and repeat the relevant parts of the interview. A number of revisits to households were made to verify data. Respondents received an electrical extension cord, which was a gift recommended by enumerators.

The information was captured in a database designed by Victor Thamage, and the data manipulated in a Quattro Pro spreadsheet. All figures and graphs presented were generated through Quattro Pro.

As far as possible data from phase 3 (1993), has been compared with phases 1 and 2 (1991 and 1992) to determine trends.

1.4 Structure of the report

The report of the work done in phase 3 is presented as an update of the phase 1 and 2 reports. An attempt has been made to follow closely the structure of the phase 1 and 2 reports, although there are some alterations. While the third phase report includes some new data it also leaves out some of the previous phases' data which is considered not to have significantly altered, such as the materials of construction of the house. In this regard, the report is not intended to entirely supersede previous reports.

In the chapter following this introduction, poor/low-income/sub-economic areas in the Western Cape, in particular Khayelitsha, Langa and Guguletu, are described including the extent and operation of electricity supply systems.

In chapter three, electricity consumption data for the areas is presented. Consumption levels of all consumers in selected areas are shown, and contrasted with consumption levels of the households surveyed.

Chapter four describes the survey sample, using basic socio-economic information which was gathered in the interviews in Langa and Guguletu and Khayelitsha.

Chapter five examines how and why various fuel and appliance combinations were chosen to meet the various household energy service needs. It also examines the cost of these energy services to the household, and calculates the net (delivered) and useful energy used by households.

Chapter six analyses the key factors influencing electricity consumption levels.

Chapter seven explores the attitudes and perceptions of households with regard to their electricity service.

Finally the concluding chapter, chapter eight, draws together the findings of the project, and considers topics for future research. Implications for electrification programmes in poor urban areas are also discussed.

Chapter Two

LOW INCOME AREAS IN THE WESTERN CAPE[1]

2.1 Introduction

This chapter describes firstly, the character and origins of low-income/poor/sub-economic areas in the Cape Town metropole, namely Khayelitsha, Langa and Guguletu. Secondly, it describes the provision of electricity in Langa, Guguletu, and Khayelitsha.

2.2 The character and origins of low income areas

During the period of segregation, African people living in various parts of the city were forcibly removed to Ndabeni (1901) and later Langa (1922). During the early apartheid years, population growth led to severe overcrowding and eventually the construction of new housing in Nyanga and Guguletu. This was carried out by the Cape Town City Council between 1948 and 1972.

The Coloured Labour Preference Policy, applied increasingly after 1964, led to the cessation housing construction for Black African people after 1972. The repeal of the Coloured Labour Preference Policy and the system of influx control in 1986 has resulted in a more tolerant attitude towards the settlement of African people in Cape Town. New land for formal settlement by black Africans was made available in Khayelitsha in 1983. The abrogation of responsibility for housing by the state in 1979 which left the construction of low-cost housing to private companies has contributed to the slow pace and high cost of housing construction. This, in combination with the increasing number of job seekers leaving areas with failing rural economies, has led to severe housing shortages.

There are now a considerable number of informal housing areas in Cape Town. Backyard shacks have been constructed on the properties of most formal houses in the older townships, as well as in a large number of free standing squatter camps. 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 million people. Of these, about 850 000 (28.7%) were Black African (Bridgeman et al, 1992:28).

This project is concerned with the use of electricity and other fuels in these low income formal housing areas. As few of the informal areas have currently access to electricity, focus is thus directed to three areas where households have access to electricity; namely Khayelitsha, Langa and Guguletu. In most instances in

[1] Since the project began, the geographical area of the Western Cape has taken on a political dimension. It is now a region. The original intention was to consider areas in the Cape Town metropolitan area.

this study, Langa and Guguletu are dealt with together, as an example of townships that have had access to electricity for a long time (over 20 years).

Langa, Guguletu and Khayelitsha and their relationship to the Cape Town metropole are shown in figure 2.1.

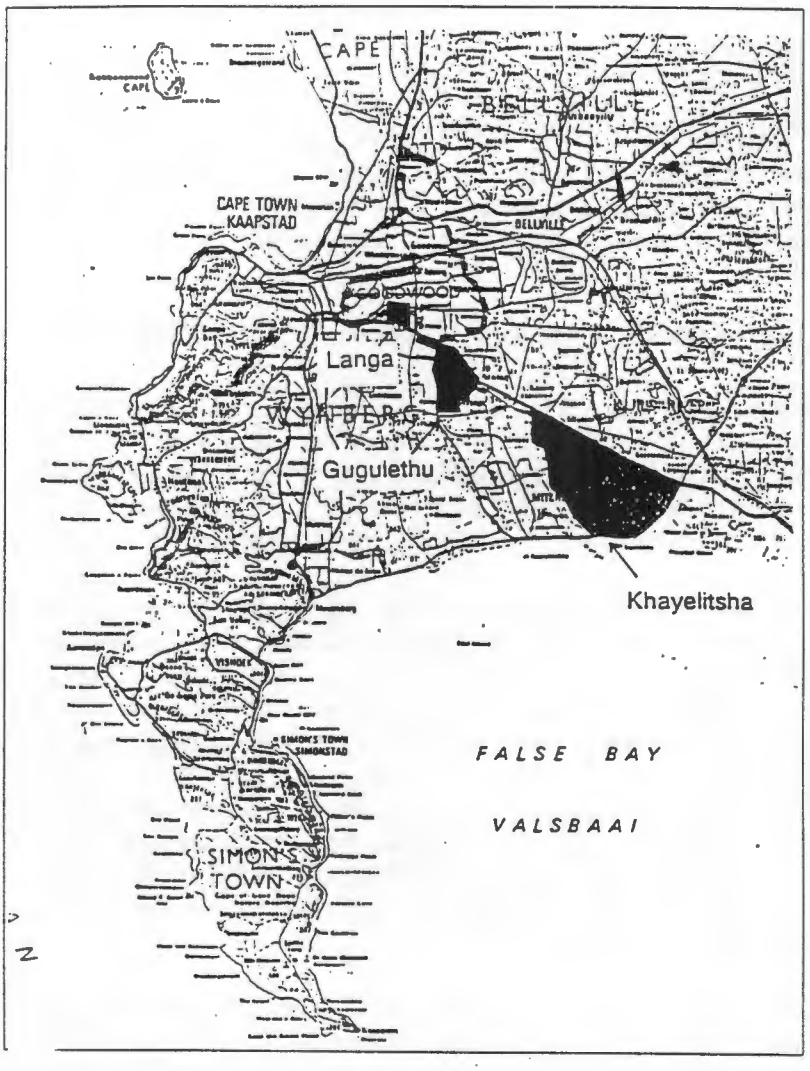


FIGURE 2.1 Low Income areas studied

2.2.1 Langa and Guguletu

Langa and Guguletu are representative of the 'older generation' of poor areas in the Western Cape. They emerged as temporary accommodation for Africans and were characterised by single sex hostels and small box-like housing units. These units were available on a rental basis only. No permanent forms of tenure were permitted.

Guguletu was founded to house an overflow of people from Langa and an emergency camp in Nyanga. Small family units were constructed by the council for rental. A standard design, 'NE 51/9', was used: three roomed, 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 Guguletu area. "Squatter" communities were subject to frequent demolition. In the 1980's surrounding "squatter" camps grew in Nyanga Bush, Tambo Square and KTC.

2.2.2 Khayelitsha

Khayelitsha was created on a 3 200 hectare site on the sand dunes of the eastern 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 up-market developments. Private developers constructed housing there between 1989 and 1991. A number of site-and-service schemes are currently being developed in Town 2 Village 2a and 2b, as well as new areas in Town 3 and 4. These serviced sites have not been provided with electricity, although plans for Town 5 include the provision of electricity.

The total population of Khayelitsha is difficult to estimate, since there is a continual influx of people to the area. Estimates of the population of Khayelitsha range from 350 000 (by the Lingelethu West City Council, (LWCC)) to 600 000. For the sake of this study a figure of 400 000 will be used.

2.3 Electricity supply

The areas of supply of different electricity distribution authorities in the Western Cape are shown in figure 2.2.

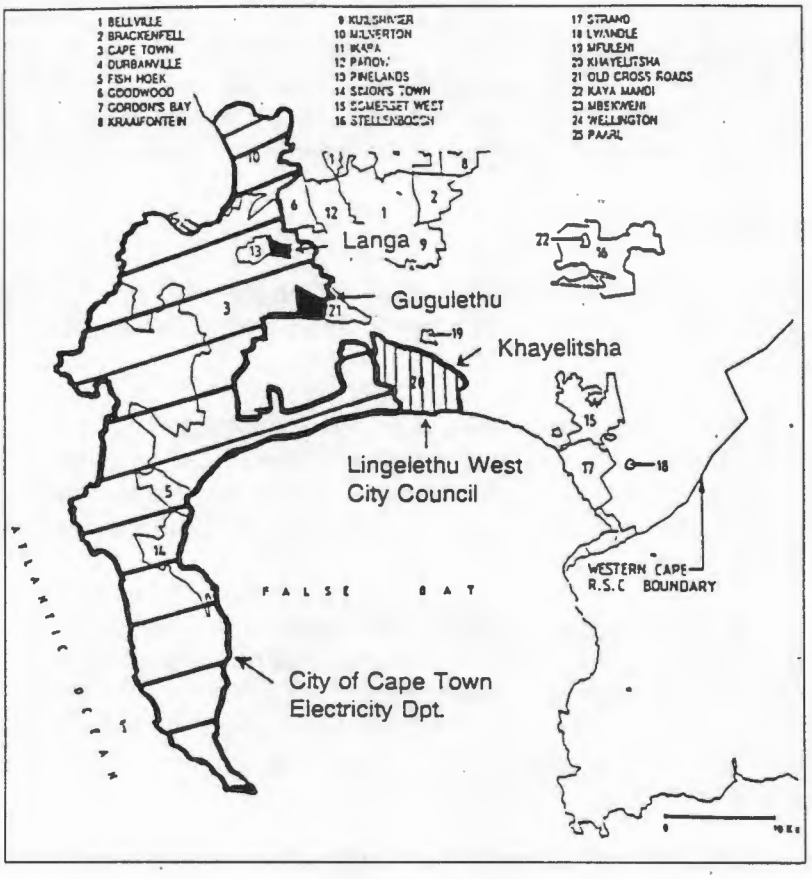


FIGURE 2.2 Areas of electricity distribution authorities

The City of Cape Town is by far the largest electricity distribution authority in the area. Estimates of the extent of electricity provision in different areas is shown in table 2.1.

TABLE 2.1 Extent of electricity provision

Access to electricity - the extent of provision by March 1994.					
Area		Formal	Shacks	With Access	% Access
Khayelitsha	Town 1	5000	0	4604	92
Khayelitsha	Town 2 Village 1	3477	0	1026	30
Khayelitsha	Town 2 Village 2	0	3900	0	0
Khayelitsha	Town 2 Village 3	4465	0	2340	52
Khayelitsha	Town 2 Village 4A	264	0	264	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	-	2527	72
Guguletu		8300	-	7459	90

In the two areas the electrification process is going through two quite different stages. In the case of the older areas the electricity infrastructure is decaying, and a large proportion of 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 a local level, the possibility of future rationalisation of the electricity distribution industry and the goals, principles and programmes of the Reconstruction and Development Programme add further ingredients to the heated debate around electricity. It has been into this environment that a joint operating company, Phambili Nombane ("Forward with Electricity") have begun a third phase of electrification (after LWCC and Eskom), promising to complete the electrification process there in 3 years.

At present provision of electricity in Langa and Guguletu is in crisis as a result of the poor service and high arrears. In addressing this problem, the City of Cape Town Electricity department has changed their strategy to address their problem with arrears a number of times. There appears to be a constructive long term view emerging on how to resolve the situation despite the fact that under the present local government arrangements the residents of Langa and Guguletu have no formal control over the provision of electricity. However, disconnections in these and other areas in the Cape Town City Councils's area of electricity distribution are proceeding.

The issue of equitable treatment between electricity consumers has recently arisen. A customer of the council compared her disconnection after being 13 days late for her payment, to areas where customers have enjoyed greater tolerance (Cape Times August 12 1994). The Council has been quick to respond to defuse the situation, with yet another policy alteration, suggesting that all 200 000 plus domestic consumers will receive pre-payment electricity over the next 3 years. Council spokespersons also suggested that consumers in arrears will have two choices, to pay 50% this month and 50% next, or to accept a pre-payment meter and pay 14% on top of the normal price per unit of electricity (Weekend Argus 13/14 August 1994). To add to the debate the regional premier, Hernus Kriel, has announced a moratorium on prosecutions for about R300 million in unpaid service fees an rentals in the region (Cape Times August 17).

In Khayelitsha the LWCC Electrical Engineer's Department could not substantially increase the number of electricity connections. The limited expansion of electricity provision there materialised in a climate of inadequate access to funds and low credibility of the Council. After pressure from the local residents, the transfer of the electricity distribution rights from LWCC to Eskom for the entire area of Khayelitsha was successfully negotiated. However, while finance raised by Eskom is being used to complete the job, Phambili Nombane have taken over the management of the project with the expressed mandate to use their expertise learned elsewhere to electrify as cheaply as possible.

2.3.1 Electricity Provision in Langa and Guguletu

The City of Cape Town Electricity Department is the licensed supplier of electricity to Langa and Guguletu, although these areas fall within the boundaries of the Ikapa Town Council, a Black Local Authority. Ikapa is supposed to provide the rest of the services in these areas. The department buys most of its electricity in bulk from Eskom. It owns power stations, but these are

very seldom operated. It also has a pumped storage facility at Steenbras which is in regular use. It purchased on average 358 million kWh/month in 1992/93. Its maximum demand during that year was about 827 MW.

The trading surplus generated by the electricity department in 1992/1993 year was R63.446 million. This represented a surplus on trading of 10.2% (Highlights from the Annual Report of the City Electrical Engineer 1992/1993).

The department is one of the largest distribution authorities in the country. It had 2 369 staff members servicing 249 381 customers in 1992/1993 (a staff to customer ratio of 1:105 down from 1:99 in 1991/1992). Of these, 86% were household consumers with an average consumption of 671 kWh/month, up from 662 kWh/month in 1991/1992 and 643 kWh/month in 1990/1991. Of the total electrical energy sold, 47% was consumed by households. The rate of new connections in 1992/1993 was 1707, down from 4859 during the previous year. This represents an increase of about 0.7% per annum. The distribution efficiency of was 94.2%, and an annual load factor has decreased from, 58.7% in 1991/1992 to, 56.6% in 1992/1993.

Electricity arrears owed to the Cape Town City Council are R50 million, of which R21 million is reportedly owed by residents of Langa and Guguletu. The monthly rate of disconnections for late payments has risen steadily. These were at 8 000 in 1991 and increased to 12 000 in October 1992. The most recent threatened rate is 18 000 disconnections per month.[2]

The Council has appealed to national government for R12 million to upgrade electrical infrastructure (Argus August 1994). While this request is pending, pre-payment meters are being installed throughout the area of distribution (Weekend Argus 13/14 August 1994).

Langa

In Langa there are currently approximately 2 527 electricity consumers. This is about 72% of the 3 500 formal houses in the area. Some houses without electricity were disconnected after running up arrears. In other cases electricity is not available due to the supply network not having been extended into the area. Electrified houses are fully wired and have credit meters. The infrastructure is old, unreliable and in some cases, dangerous. In phase 2 all respondents in Langa suggested that the overhead wiring was unsafe. During this same phase one respondent requested the inspection of her mother's house, which had recently burned down allegedly as a result of a fire which started at the metering board.

Guguletu

About 7 459 of the 8 300 formal houses (90%) in Guguletu are electrified.

[2] This rate if maintained throughout the year would result in 216 000 disconnections. If maintained for 5 years this figure would be equivalent to 1.08 million. or 43% of the Reconstruction and Development Programme's 5 year target!

2.3.2 Electricity Provision in Khayelitsha

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

The LWCC Electricity Department was established in 1988. Prior to that there was only street lighting in place. In 1989 electrification of households began. The LWCC was responsible for the ongoing maintenance and operation of the electrical networks. The last connections which were carried out by LWCC were by their nominated contractors namely FROG and De Villiers and Moore. Capital was usually provided by the National Housing Commission for the street lighting. The Independent Development Trust has also provided funds for the service connections. 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). This amount is supposedly repayable by the Council.

The total staff complement of LWCC at the end of 1992 was 36 people. (This implies staff to customer ratio of 1:150). The electrical department was understaffed and under equipped. As a result very little attention was given to planning and organisational development.[3] The Council had a vacancy for the post of City Electrical Engineer for a number of years. This post was finally filled in April 1992.

The LWCC used to buy all of its electricity from Eskom, who fed supply through two points. In 1991/92, electricity consumption was about 3 million kWh/month (about 0.9% of Cape Town's consumption). Between January and June 1994 this ranged from 3.07 to 5.78 million kilowatthours. In 1992/1993 the maximum demand was about 15.7 MVA. In 1994 demand for electricity in Khayelitsha has ranged between 8.1 and 15.7 MVA. The load factor was therefore between 0.42 and 0.6 and appeared to be increasing slowly, but evened out between 0.48 and 0.56. In Khayelitsha, approximately 20 to 30% of electricity consumption is purchased through pre-payment sales (Holtz 1994).[4] Figure 2.3 plots the capacity factors for Khayelitsha from mid 1990 to mid 1994 (the break is as a result of faulty metering).

[3] Although access to consumption data was considerably easier with the LWCC than with Cape Town City Council and subsequently, Eskom.

[4] This is a surprisingly low figure considering the low level of industry and commercial activity there, as compared to the area supplied by the Cape Town City Council, where 47% is consumed by domestic consumers.

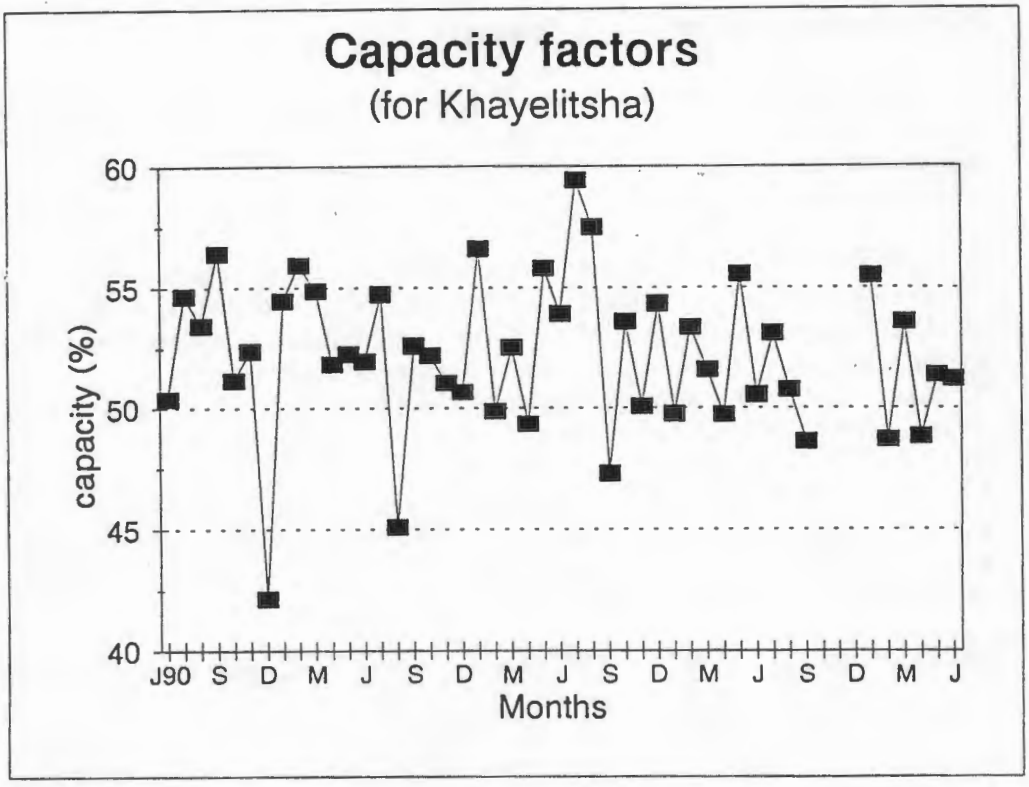


FIGURE 2.3 Capacity factor of bulk electricity supply to Khayelitsha

(source: Holtz 1994)

The electricity supply authority has changed in Khayelitsha between the second and third phases of this project. The original supply authority, LWCC, ceded the right of supply to Eskom, who after completing a further 4000 connections amongst the core houses, passed on the responsibility for electrification to the newly established Joint Operating Company (JOC) named Phambili Nombane. The JOC is a coalition between Electricite de France (EDF), East Midlands Electricity (England) and Eskom. The programme to electrify has moved swiftly since the transfer of the Khayelitsha rights of supply to Eskom.

Eskom electrified the remaining unelectrified core houses, using labour based methods, this implies that the community gaining access to electricity is requested to provide the labour and tender for some of the work. This was the first time this method had been utilised in the Western Cape. In this phase the beginnings of underground reticulation were competed and extended. The JOC aims to connect the remaining 40 to 50 000 households within the next 2 to 3 years; their first connections were turned on at the end of May 1994. The JOC is involved in electrification using slightly different labour practices[5] and using aerial bundle conductors (ABC) and underground service connections from the road reserve to dwelling. The negotiation process undertaken by the JOC utilised less community participation than Eskom's first phase - a mistake which was partially rectified when the process was temporarily brought to a halt by

[5] Whereas Eskom employed a consulting engineer (De Villiers and Moore), with the brief of training sub-contractors who would then employ local labour, the JOC employed three main contractors who in turn sub-contracted out the work to Khayelitsha based sub-contractors. In both cases Eskom provided the materials.

residents in town 3 village 5, who complained of lack of consultation with respect to the electrification technology.

It has been interesting to note the extent to which the political environment has forced new codes of practice, particularly with respect to efforts deliver more to create more employment. The process has not always been easy, and both the suppliers and the Khayelitsha community representatives have learned much about each other. While the process of negotiation has not always been balanced, the job has been done. The process of delivery which maximises the benefits of electrification to all parties is in urgent need of some independent research.[6] It is likely that the Reconstruction and Development Programme (RDP) will insist on this.

At the end of May 1992, the total number of domestic consumers in Khayelitsha was about 5 414. Of these, about 422 had conventional credit meters, and 26 were non-domestic consumers, mostly schools, clinics and churches in the areas where domestic electricity is not supplied. By March 1994 the number of connections had reached 9 511.

The consumer base in the area is growing very rapidly in absolute terms, but with an estimated 50 000 connections to go, the level of domestic electrification is still very low. Based on the assumption that 4.3 (from chapter 4) people live in each electrified household, some 41 000 people live in electrified homes. Using a population estimate of 400 000, this would imply that about 10% of the population of the area have access to electricity.

Figure 2.4 shows the layout of Khayelitsha.

[6] The authors feel that more could be done to encourage democratic practices and up- and down-stream employment potentials. Both democratisation and job creation are basic principles and key programmes of the RDP.

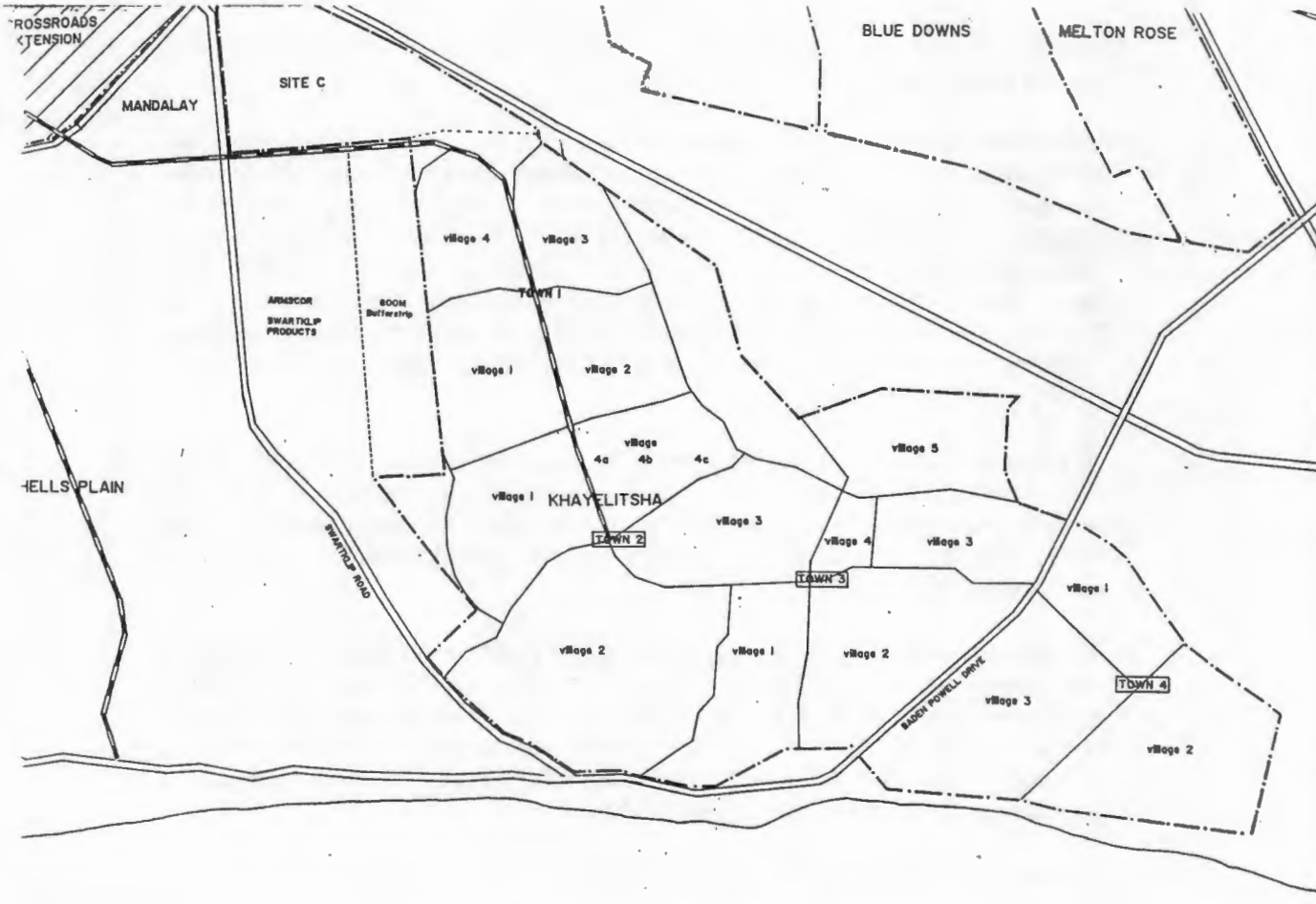


FIGURE 2.4 Towns and villages within Khayelitsha

Khayelitsha Town 1

Most houses in Town 1 were not electrified at the time of their construction in 1985. 811 of the 5 000 (about 16.2%) in the area had been electrified by June 1992. In November 1992 "oil reserve" money channelled through the National Housing Fund paid for further reticulation. This increased to 1473 electrified households in Town 1 by November 1992 (about 29%). At the end of March 1994, 4604 houses had been electrified (about 92%). Houses are generally fully wired, and have 60 amp supplies with pre-payment meters. The reticulation technology is mixed with some above ground and some underground.

In 1992, there was a last attempt by LWCC to maintain control of electricity supply in Khayelitsha. 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 LWCC, The South African National Civics Organisation (SANCO), the Development Bank of Southern Africa (DBSA), the community services branch of the CPA, Eskom and the Western Cape Regional Services Council (WCRSC) commissioned consultants, De Villiers and Moore to draw up a proposal that covered technical, institutional, socio-economic and financial aspects of the electrification process. The proposal, drafted by the consultants suggested that this project would not be viable. The proposal was based on average household incomes consumption reaching 350

kWh/month and that a loan of between R6 and 7 million would be forthcoming from the DBSA via the WCRSC, who had agreed to guarantee the loan.

The failure of the KESB, and pressure exerted by the local civics who had campaigned for access to electricity, left the way open for Eskom to gain access to Khayelitsha and the promised DBSA loan. At that stage Eskom suggested that they would be in a position to electrify all of Khayelitsha in three years. This process began in the second half of 1993, and the first phase targeted Town 1.

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

Houses in these areas were electrified at the time of their construction. There are currently 3477 households in Town 2 Village 1, of which 1 025 used electricity by November 1992, 2 405 of the 4 465 in Village 3, and 219, or nearly all households 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. Only some houses have geysers and stove points. Most houses have pre-payment meters but some of the residents of Village 1 have credit meters. All of the 94 formal households of Village 4b, and none of the 500 shacks in Village 4c nor the 3 900 shacks in village 2 had access to electricity by November 1992. The next phase of electrification, targeting the remainder of Khayelitsha, was passed on to a joint operating company, Phambili Nombane (Forward with Electricity) which is intent on keeping to Eskom's promise of complete electrification within the three year period.

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

Jonkersdam, Bongweni and Tembani

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

2.3 Conclusions

The description of Langa and Guguletu and of Khayelitsha provides 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 with electricity use in Langa and Guguletu.

The main conclusions of the chapter include:

- between phases 2 and 3 the proportion of households with access to electricity in Khayelitsha increased from 5 to 10%. Electrification is proceeding rapidly with a further 50 000 connections anticipated over the next three years;

- there are approximately 10 000 electricity consumers in Khayelitsha, and an equivalent number to those in Langa and Guguletu
- the arrears in Langa and Guguletu are growing and at present total R21 million (this is equivalent to R2 100 per household);
- the Council has committed itself to installing electricity pre-payment meters for all customers in its area of supply;
- in 1994 the capacity factors for Khayelitsha were between 0.48 and 0.56 as compared with 0.58 for 1992/1993 in Cape Town City Council area of supply;
- the trading surplus of the Cape Town City Council for 1992/1993 was R63 million, the same as that documented for 1991/1992.

Chapter Three

ELECTRICITY CONSUMPTION IN LOW-INCOME AREAS OF THE WESTERN CAPE

3.1 Introduction

This chapter provides the month by month average electricity consumption for households which enjoy access to electricity within the towns and villages of Khayelitsha, and within Langa and Guguletu. The data is provided in figures which have been recorded for all domestic electricity consumers including new consumers their first full month of electricity use. The records are presented in figures which begin in phase 1 (November 1990) of this study to the end of phase 3 (February 1994), that is, covering a period of 40 months. The number of electricity consumers are annotated in the figures (Figure 3.1 to 3.15b), and give an indication of how the consumer base has changed over time.

The chapter also compares the universe (or all electricity consumers) to the survey sample in all three areas and considers the extent of the arrears problem in Langa and Guguletu.

The raw data in this chapter was sourced from the Cape Town City Council (in the case of Langa and Guguletu), and Eskom (Khayelitsha). In the former case, the data was that which appeared on bills sent to customers and in the latter the information corresponded with pre-payment meter sales of electricity. Both of these sources of data are problematic in providing the absolute monthly consumption of electricity. The billed amounts are sometimes estimated if access to the property was limited and the reading of meters often occurs at intervals, not exactly a month apart. In the case of Khayelitsha, the pre-payment sales of electricity were assumed to approximate electricity consumption. With pre-payment metering this is not a bad assumption, as the interval between sales of electricity pre-payment tokens is on average less than one week (see 3.2.9).

Sales and billed amounts do not exclude the possibility of theft or technical losses (which are often higher in unloaded systems, as in Khayelitsha (Holtz 1994)). However, for the sake of the study, this information is adequate in approximating month by month electricity consumptions.

Throughout this chapter "households" are referred to. While it is acknowledged that this is a complex concept (Ross 1993), in this instance the term is used as shorthand for domestic electricity supply points. From chapter 4 to 8 the inhabitants of the house, their energy services and other socio-economic features of these households are considered.

The data in the chapter includes:

- the monthly averages for each of the areas within Khayelitsha, averaged over the entire consumer base from the first full month of access to electricity onwards;
- the electricity consumption patterns of the residents of Langa and Guguletu with respect to the arrears status;
- the electricity consumption pattern of the survey sample with respect to the universe in Langa and Guguletu from December 1991 to December 1993 and in Khayelitsha from November 1990 to February 1994;
- the number of electricity consumers connected to electricity in each of the areas;
- a table of month by month electricity consumption of each of the households sampled from the beginning of phase 1 to the end of phase 3;
- the average electricity consumption per household per month for three phases of the study;
- some comments relating to observed trends;
- the size and frequency of electricity purchases in Khayelitsha; and
- summaries of the average consumptions of the different areas.

In the case of Khayelitsha, the figures for July 1992 were unavailable. In the case of Langa and Guguletu the same was true of December 1992.

3.2 Khayelitsha

3.2.1 Town 1

Town 1, the oldest part of Khayelitsha, has been targeted for increased electrification for some time. In the last few months of 1993, and the first of 1994, the number of new connections increased sharply which corresponded with declining average electricity consumptions. Figure 3.1 illustrates the trend which is likely to have reached its lowest point in February 1994, as a result of almost 100% of the houses having been connected to grid electricity by that time. The number of houses connected to electricity by March 1994 were 4 604, a nearly 600% increase on the 773 connected by June 1992. The average electricity consumption per household per month over 1993 was 168 kilowatthours, which was lower than the 194 and 229 kilowatthours, which were the averages recorded in the first two phases.

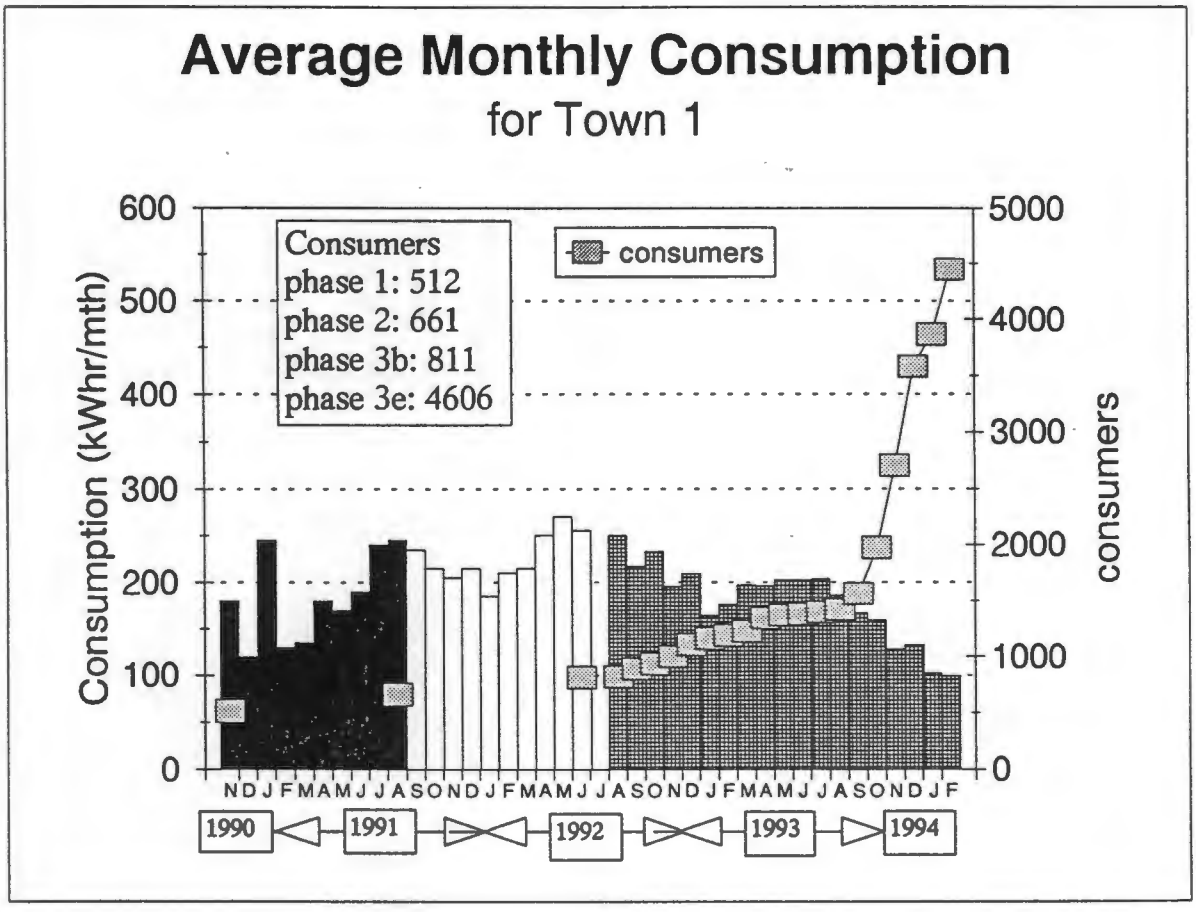


FIGURE 3.1 Average electricity consumptions in Khayelitsha Town 1

While it is likely that the sharp decline in electricity consumption can be attributed to the large numbers of newly electrified households who have yet to gain access to electrical appliances (the connection trends are indicated by the the shaded boxes), the decline could also be attributed to the economic situation of the new consumers. Prior to the ceding of electricity distribution rights, Lingelethu West City Council (the original distribution agency) required a significant contribution towards the electricity connection costs. Eskom, in contrast, reduced the contribution to a nominal amount, thereby reducing the economic barrier gaining *access* to electricity. This would have allowed even the poorest households to gain access to electricity even though they may not be able to afford to buy electrical appliances or much electricity.

The tacit exclusion of poorer categories of consumers in the past, because of first (access) cost barriers would not only apply to areas of Khayelitsha, but the entire country. It is likely that distribution agencies when considering where to provide electricity, would in the past have explicitly selected areas where consumers are most likely to pay for electricity and repay the investments in infrastructure. This prioritisation process in itself could account for the exclusion of households which would be likely to use little electricity, the same households which are currently being electrified. The new political dispensation, the historic demand for better quality services and the goals of the RDP, are already changing the patterns of access to electricity.

3.2.2 Town 2 Village 1

The number of households with access to electricity in town 2 village 1 increased less rapidly in the third phase than over the previous phase of study. This would explain the relatively constant electricity consumption. What is noticeable is that the winter peaks in this area are dropping from the 1991 high of nearly 350 kWh to 300 in 1992 to 264 in 1993. The average electricity consumption for 1993 was 208 kilowatthours per household per month, which was lower than the 248 and 252 units measured in the previous two phases. The numbers of consumers have increased from 667 to 1 026, a figure which has remained constant over the period since the end of phase 2. Figure 3.2 indicates the average trends over the period of study.

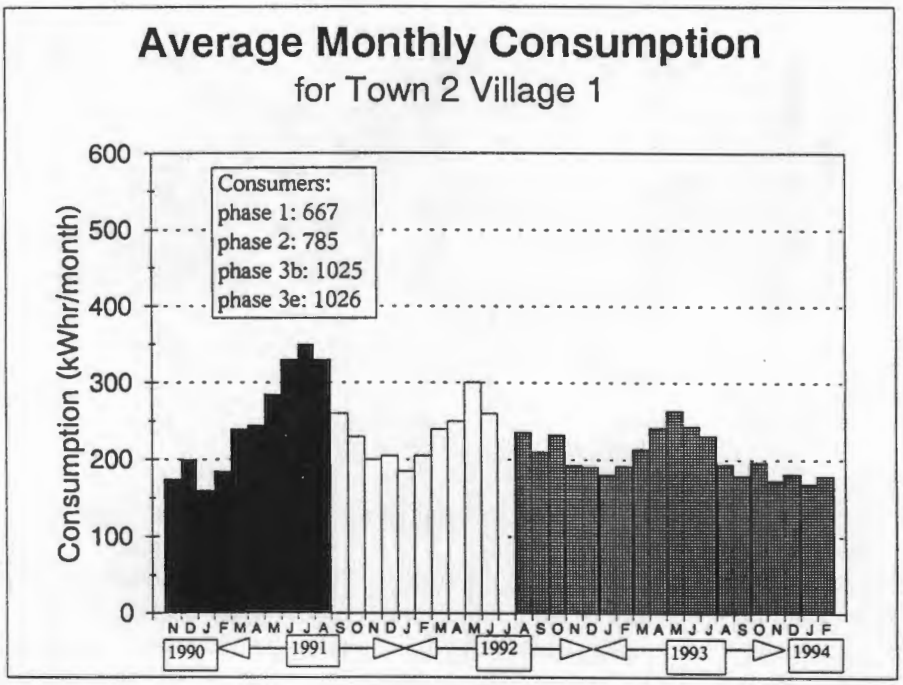


FIGURE 3.2 The average electricity consumption in Khayelitsha town 2 village 1

3.2.3 Town 2 Village 3

The electricity consumption in town 2 village 3 has grown over the three study phases. The growth in consumption has been slow, but this has been balanced against the number of consumers which has remained comparatively level during phase 3 (at 2 340). The winter peak in 1993 rose to nearly 220 units, which was 50 units higher than the peak in 1991.The average electricity consumption per household per month over 1993 was 211 kilowatthours, which is an increase since 157 and 185 units in phases 1 and 2. Figure 3.3 shows consumption trends.

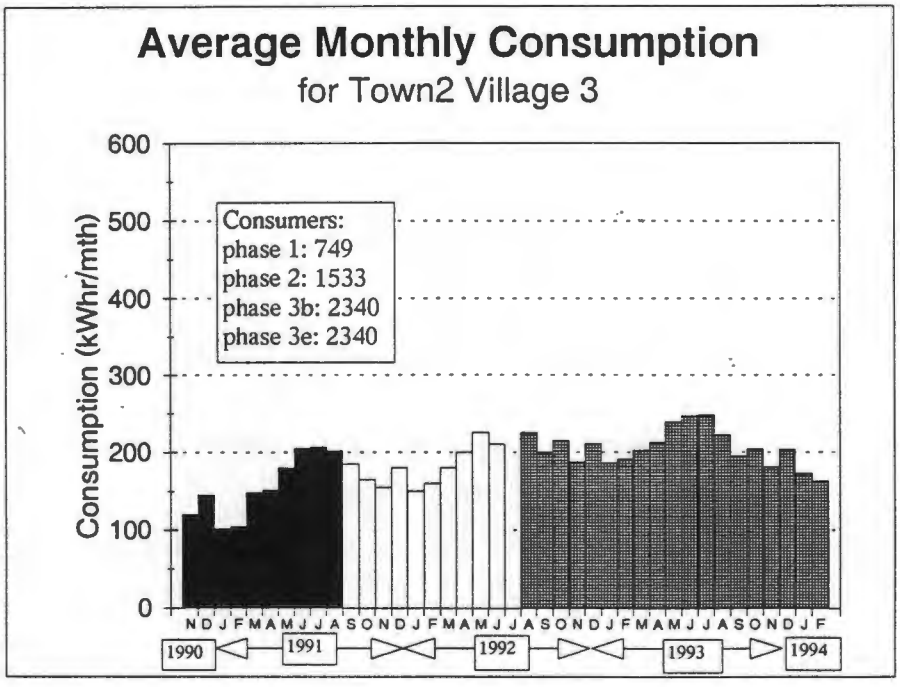


FIGURE 3.3 The average electricity consumption in Khayelitsha town 2 village 3

3.2.4 Town 2 Village 4a

The electricity consumption of town 2 village 4a appears to have remained quite constant. This is despite the number of consumers having grown from 121 at the beginning of phase 1 to 264 at the end of phase 3 and has resulted in the average level of electricity consumption being relatively constant. The average level of consumption in phase 3 was 280 units, down from the 304 and 286 measured during phases 1 and 2 respectively. Figure 3.4 describes the trends.

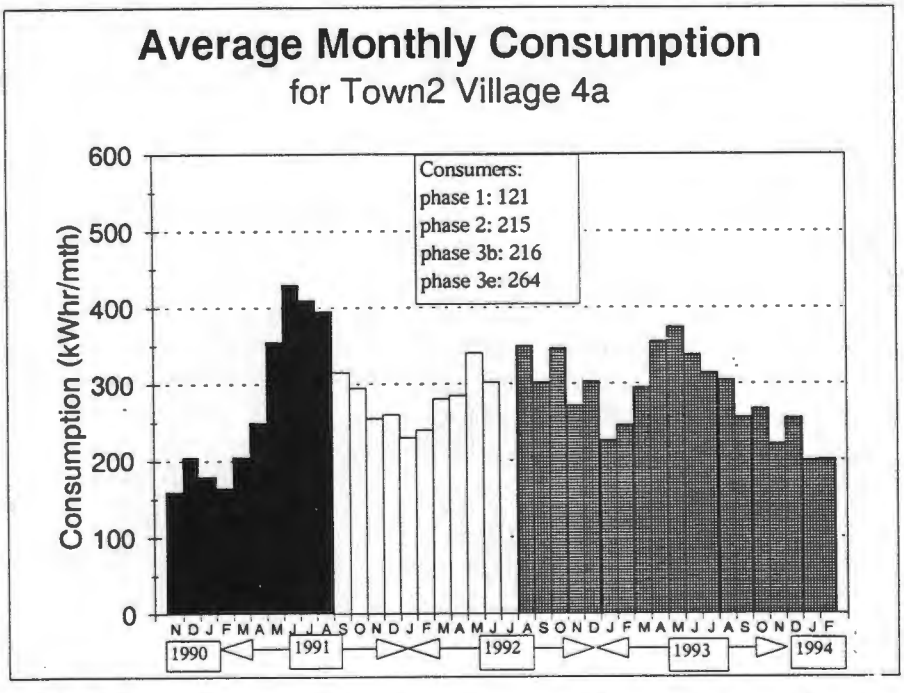


FIGURE 3.4 The average electricity consumption in Khayelitsha town 2 village 4a

3.2.5 Jonkersdam

The number of electricity consumers in Jonkersdam has increased from 37 at the beginning of phase 1 through to 335 at the end of phase 3. This large increase has had an effect on the consumption of electricity which has slowly reduced consumption from nearly 300 in the winter of 1991 to a low of nearly 200 units in the winter of 1993. The average electricity consumption in 1993 was 201 units, which is a decrease from phases 1 and 2 where the averages were 216 and 247 units respectively. Figure 3.5 shows these trends.

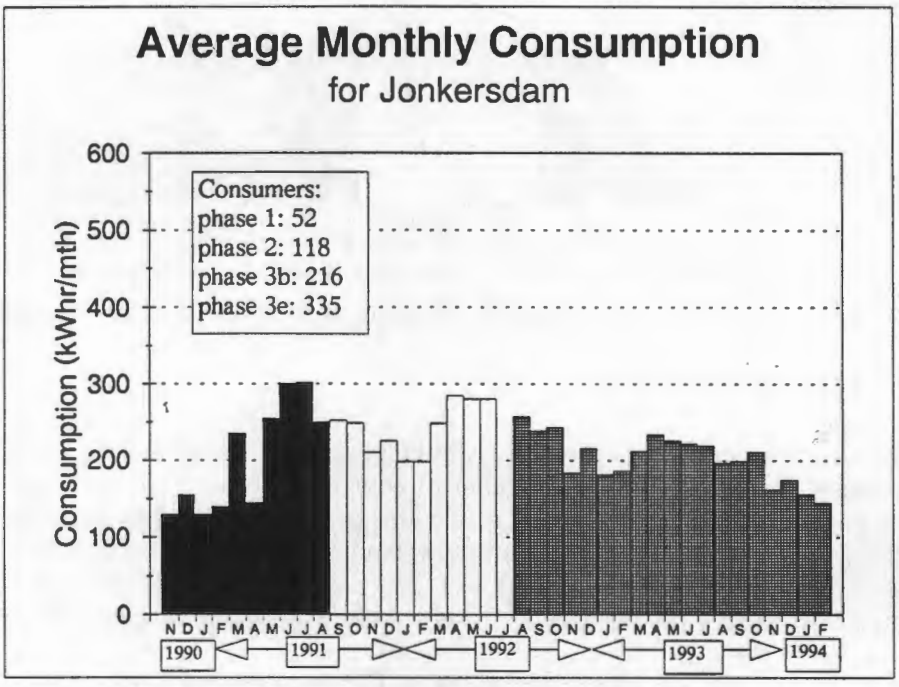


FIGURE 3.5 The average electricity consumption in Jonkersdam

3.2.6 Bongweni

Bongweni has seen an increase in electricity consumers from 71 at the beginning of phase 1 to 149 at the end of phase three. This implies a nearly 100% increase in consumers over the three phases. While this is a lower than average increase in consumers over the period, the trend observed in most of the other areas is repeated here. The high consumption of 1991 and 1992 of nearly 500 units was not repeated in 1993, where winter consumption barely reached the 400 unit mark. The average for 1993 was 311 units, which was lower than the 342 and 396 units measured in phases 1 and 2. Figure 3.6 describes the trends.

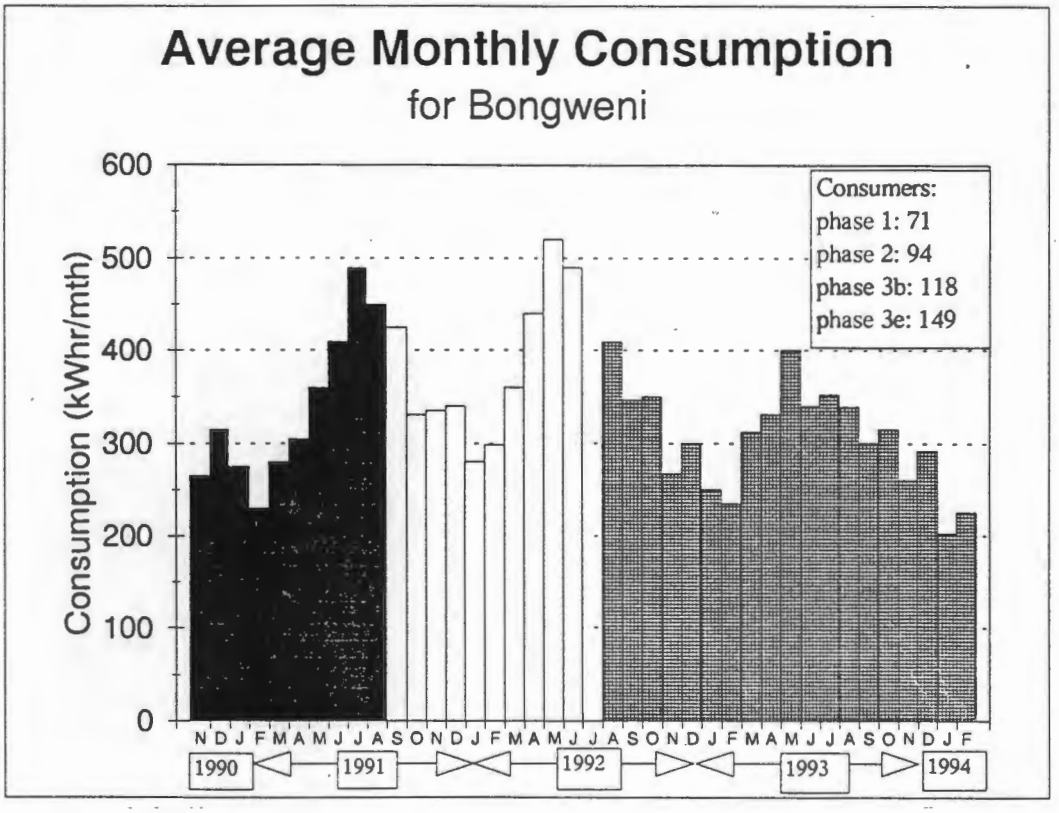


FIGURE 3.6 The average electricity consumption in Bongweni

3.2.7 Other areas of Khayelitsha

The other areas of Khayelitsha which have access to electricity are Tembani, Town 2 Village 4c, and other scattered households. This does not include the 422 consumers, located in phase 2, who are utilising credit meters. The number of consumers in this category was 210 at the beginning of phase 2 and by the end of the third phase was 371. During this phase the average consumption of this group stood at 322 units, a level higher than the 210 and 266 units reported in phases 1 and 2. This figure was the highest for 1993 in Khayelitsha and indicates that those in this category are high electricity users, within otherwise unelectrified areas. Figure 3.7 describes the trends.

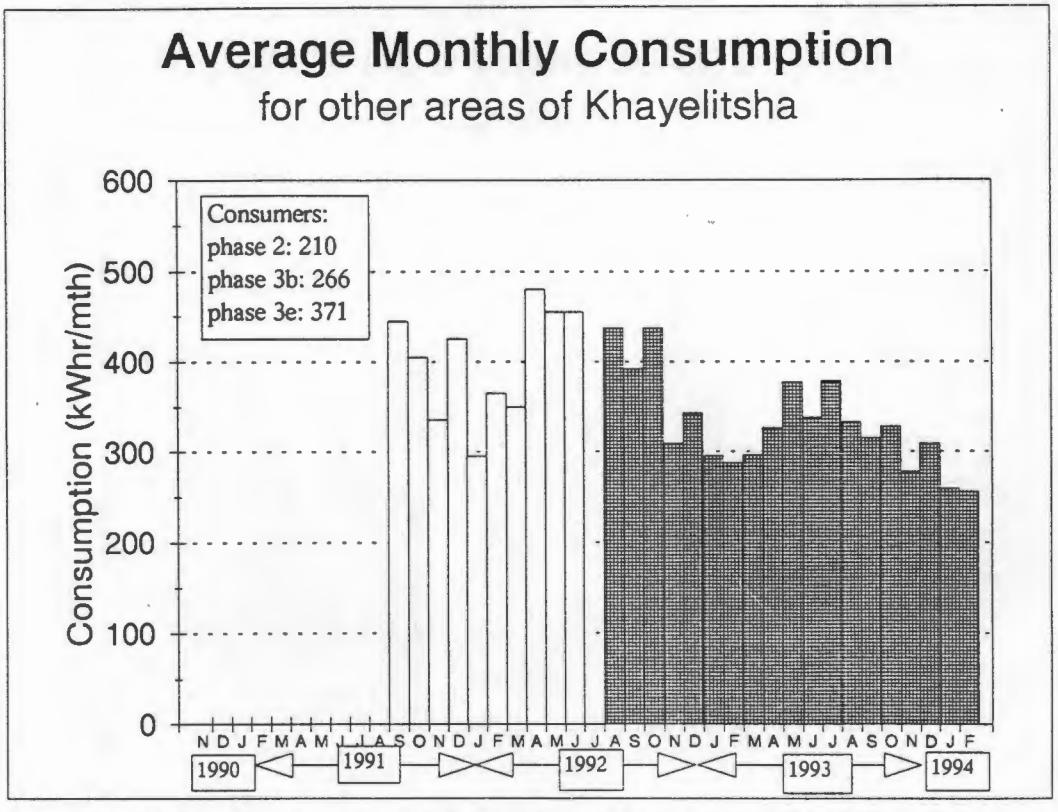


FIGURE 3.7 The average electricity consumption in other areas of Khayelitsha

3.2.8 The sample and universe in Khayelitsha

The electricity consumption over the past 40 months for the survey sample in Khayelitsha, with a few gaps, is presented in table 3.1.

TABLE 3.1 Electricity consumption by the sample in Khayelitsha, Langa and Guguletu

1992						1991												1990								
JUN	MAY	APR	MAR	FEB	JAN	DEC	NOV	OCT	SEPT	AUG	JULY	JUNE	MAY	APRIL	MARCH	FEB	JAN	DEC	NOV	OCT	SEPT	AUG	JULY	JUNE	MAY	APRIL
826	695	1030	896	716	801	950	972	1134	1066	1189	1258	1037	467	513	457	662	400	318	388	494	1064	500	450	513		
663	654	582	372	267	416	450	447	528	549	366	415	387	357	320	310	564	350	322	312	383	365	308	400	400		
571	480	416	275	274	297	360	369	478	486	613	678	479	293	326	283	314	234	234	238	258	191	350	350	324		
179	198	249	273	140	150	140	150	172	184	173	293	298	284	351	332	351	200	196	236	259	263	340	200	300		
578	492	542	572	612	680	487	590	591	705	595	550	624	536	460	418	696	504	475	546	577	580	640	600	616		
1090	941	736	549	533	589	700	699	958	1477	1525	1873	1301	685	632	619	748	760	602	826	1182	3235	760	700	700		
347	251	326	282	285	371	260	286	285	191	195	292	254	317	299	261	222	351	320	360	376	393	450	400	351		
443	297	327	217	373	386	290	308	381	279	296	336		285	255	214	266										
565	644	552	610	633	670	600	591	635	563	623	725	716	438	398	540	146	700	611	1021	1097	2309	720	700	480		
506	471	460	436	458	852	420	424	467	451	342	381	303	334	375	420	513	362	363	366	453	477	460	400	124		
1307	380	289	1089	1094	1646	993	1130	1300	1130	1230	1469	1773	1000	2805	728	2015	513	980	88	1154						
1239	724	822	606	623	774	605	644	729	662	729	765	577	1534			514	986	600	570	641						
1655	2074	2296	1909	1833	3020	1705	2085	2082	1463	3278	2286	2974	2129													
2379	1819	1698	1479	1448	1780	1030	1570	1933	2092	2558	2757	1988	2000	1710	704	2150	2095	1600	1650	1917						
899	707	765	696	700	899	707	765	953	851	826	915	639														
856	844	997	811	741	1165	701	733	1090	1021	1019	1289	1083														
75	71	44	45	47	73	50	56	74	58	69	92	59														
650	587	533	206	281	389	304	357	383	404	531	477	603														
930	802	839	566	592	848	500	582	904	963	988	1065	827														
100	88	92	63	63	100	40	50	72	69	76	111	123														
603	498	713	400	420	465	501	632	689	578	941	1189	400	689	576	430	645	250	344	305	410	416	332	335	674		
532	604	331	302	330	371	346	384	435	499	528	209	720	594	524	446	487	283	519	477	522	650	760	500	631		
1120	768	642	513	546	642	522	565	603	695	740	1064	850	711	765	1011	570	508	780	880	956	959	703	750	840		
535	483	468	418	403	399	422	434	494	507	564	554	560	422	400	312	380	334	377	401	504	526	494	601	463		
1503	990	825	740	642	672	802	874	952	1150	1277	1715	950														
0	567	354	458	471	525	504	568	630	685	682	640	438	337	344	320	356	247	394	375	486	677	752	500	375		
241	229	214	193	59	275																					
329	264	257	149	230	454	355	358	355	383	488	531	406	346	399	400	372	405	274	365	352	488					
410	405	381	334	339	311	301	414	426	443	246	241	313	253	106	218	218	220	82	360	350						
686	650	618	647	559	565	300	409	662	761	833	509	625	539	701	676	676	948	506	794	714	1190					
335	314	373	291	282	477	304	314	333	213	0	0	0	374	300	435	254	315	243	356	337	462	468	380	390		
300	274	198	214	300	307	302	336	444	475	387	400	400	344	425	384	335	544	320	478	366	513	482	667	275	303	
596	585	482	445	438	425	411	429	498	666	757	377	380	189	159	247	275	256	200	217	254	281	258	300	297		
231	351	323	283	292	325	307	371	411	438	461	465	313	164	99	83	160	124	173	184	494	28	93	230	260		
156	117	108	161	128	170	101	104	118	181	58	111	100														
779	792	421	241	216	136	312	342	1045	557	2133	1595	790														
172	142	149	148	167	211	150	166	158	115	170	157	180														
630	517	496	393	435	484	406	459	477	497	693	702	563														

TABLE 3.1 Electricity consumption by the sample in Khayelitsha, Langa and Guguletu

No.	NAME	ADDRESS	AREA	OTHER ID	1994		1993												1992					
					FEB	JAN	DEC	NOV	OCT	SEPT	AUG	JULY	JUNE	MAY	APR	MAR	FEB	JAN	DEC	NOV	OCT	SEPT	AUG	JUL
1	N.Jack	NY53:72	Gugulethu	172-372-902	546	558	477	475	563	488	717	884		680	672	449	377	515	600	629	786	665	594	759
2	L.Sanqela	NY89:18	Gugulethu	172-543-707	530	657	710	599	595	782	717	917		513	548	411	349	433	501	514	497	463	504	467
3	M.Qobo	NY91:2	Gugulethu	172-187-005	226	249	230	226	220	380	144	298		400	276	223	211	255	334	291	349	506	510	604
4	A.Mbinda	NY89:40	Gugulethu	172-656-102	120	128	149	132	153	253	179	198		249	273	140	150	140	150	128	149	132	153	253
5	A.Kgasi	NY83:5	Gugulethu	172-021-700	594	605	662	674	723	863	746	868		700	726	620	666	716	600	628	714	615	681	759
6	S.Ntloko	NY78:7	Gugulethu	172-119-905	377	411	386	382	434	907	746	834		501	475	355	344	322	449	385	503	625	949	1152
7	S.Sontica	NY84:29	Gugulethu	172-156-304	339	386	300	288	349	234	287	384		440	432	291	276	471	200	373	423	458	368	364
8	A.Makhuluma	NY53:8	Gugulethu	172-700-403	564	468	428	420	390	448	430	531		500	503	436	400	526	350	204	336	112	253	448
9	N.Mqala	NY89:82	Gugulethu	172-048-102		682	637	762	689	861	517	693		756	683	505	531	645	501	540	595	523	593	618
10	V.Lethabiko	NY56:128	Gugulethu	172-468-209	382	408	477	486	309	147	660	609		230	256	426	423	460	378	403	381	486	478	446
47	N. Tsoli	NY57:22	Gugulethu	172-241-107																1136	1242	1462	933	340
48	V.Tshabe	NY138:40	Gugulethu	172-134-408	591	750	666	593	786	1092	1291	1521		900	909	595	621	815	520	538	760	780	1431	1518
49	Ndimande	NY119:6	Gugulethu	172-263-100	1392	2000	2979	2580	2105	2149	2269	2673		2200	2108	2001	1880	2328	2500	2348	2724	2517	2259	2160
50	B.Mngxunya	NY49:39	Gugulethu	172-322-816	0	1104	2016	1478	1443	827	2554	2534		850	1779	1374	1398	3054		1570	1913	2168	2413	2363
51	B.Bam	NY108:51	Gugulethu	172-099-513	249	243	293	296	371	405	402	528		400	378	328	416	769	994	766	666	798	696	700
110	Mrs Mfiki	NY153:12	Gugulethu	172-025-404	523	382	710	522	609	1149	488	677		523	516	345	309	206	511	500	837	882	991	1052
111	Mrs Mjolly	NY153:40	Gugulethu	172-717-608	686	752	842	765	789	1143	1091	1300		942	768	629	894	774	744	776	93	97	26	135
112	G.Nrwana	NY148:76	Gugulethu	172-566-006	457	570	504	509	868	1328	545	660		648	594	310	157	23	544	547	646	389	392	475
113	Mrs Macwili	NY148:81	Gugulethu	172-045-618	531	604	777	696	750	1097	746	1092		999	926	651	617	713	851	881	1043	703	840	1032
114	Miss Lugalo	NY147:63	Gugulethu	172-642-306	117	167	140	145	127	178	144	176		150	171	154	158	228	140	60	144	125	121	134
11	B.Mhlawuli	14 Sandile Ave	Langa	134-038-306	360	499	507	285	675	1306	1062	1000		700	659	497	500	781	613	670	504	687	528	566
12	H.Mabe	26 Sigcawu St	Langa	134-062-819	0	0	0	0	0	0	0	0		0	0	0	0	0	0	54	174	219	283	516
13	P.Mathole	2 Mqhayi St	Langa	134-041-838	522	734	640	608	691	784	660	898		800	758	573	690	761	620	630	861	908	1159	1070
14	S.Nhamatashe	27 Jungle Walk	Langa	134-232-417	183	540	482	371	496	506	488	374		600	608	443	391	506	400	438	605	536	496	434
15	Thembeka	25 Jungle Walk	Langa	134-232-900	683	830	802	835	1187	1868	1665	2024		1200	1203	830	759	919	900	956	1208	1268	1568	1475
16	J.Sitsila	1 Rose-Innes St	Langa	134-058-544	310	373	366	392	428	433	775	874		584	564	329	262	590	0	0	0	120	703	438
17	Ndobini	10 Mdolomba St	Langa	134-266-902	201	225	183	148	193	299	201	240		200	206	169	168	96	237	297	283	295	271	279
42	N Magodla	51 Jungle Walk	Langa	134-027-703	244	332		215	288	300	287	319		300	369	290	208	291	200	228	269	235	305	273
43	Y Myeni	30 Church St	Langa	134-066-482	263	280	289	280	721	250	360	250	295	1699	2134	411	430	292	311	261	0	0	560	561
44	C.Tetyana	Zone 11 No. 6	Langa	134-082-100	487	657	427	649	577	781	804	947		900	810	764	734	689	307	304	489	792	700	672
45	T.Ntenetya	25 Moshesh Ave	Langa	134-063-319	266	339	326	331	366	354	344	403		394	381	275	272	234	300	261	380	381	506	429
46	M.Mbizela	6 Haarlem Ave	Langa	134-011-912	448	523	359	626	552	693	459	500		600	595	478	377	511	450	492	359	363	408	320
52	Edwin	25 Sigcawu St	Langa	134-061-324	324	472	339	340	336	330	316	440		560	545	341	290	269	400	361	393	417	536	228
53	Sylvia	4 Rose-Innes St	Langa	134-058-285	328	386	302	385	496	638	545	792		487	461	350	316	342	300	302	342	471	551	608
115	L.Ngoma	5 Mdolomba St	Langa	134-231-408	187	169	172	174	178	184	144	170		201	210	180	169	106	142	68	125	118	126	141
116	L.Gabuza	40 Bhunga Ave	Langa	134-074-906	226	281	249	348	481	352	890	778		300	349	231	243	246	213	229	412	1155	709	2357
117	Mrs S. Ngayi	19 Mvambo St	Langa	134-214-708	210	235	175	210	224	232	172	212		200	205	190	185	248	166	163	226	177	158	152
118	Mildred Nojilana	7 Bhunga Sq	Langa	134-210-400	448	484	565	493	581	738	545	676		552	641	498	423	639	544	552	700	670	790	570

TABLE 3.1 Electricity consumption by the sample in Khayelitsha, Langa and Guguletu

No.	NAME	ADDRESS	AREA	OTHER ID	1994		1993											1992					
					FEB	JAN	DEC	NOV	OCT	SEPT	AUG	JULY	JUNE	MAY	APR	MAR	FEB	JAN	DEC	NOV	OCT	SEPT	AUG	JUL
18	E.Mapete	31106	Jonkerdam		220	180	207	184	254	184	161	253	230	207	207	192	192	240	120	72	216	144	196	
19	M.Mdzula	31083	Jonkerdam		321	40	185	69	223	240	232	208	93	93	93	48	48	72	241	48	96	240	144	
20	F.Gcwele	31168	Jonkerdam		192	120	120	46	23	92	92	278	139	272	139	96	192	120	120	96	192	48	432	
21	F.Matthys	31102	Jonkerdam		160	80	93	93	93	139	139	115	185	121	348	216	216	216	121	151	180	33	259	
22	N.Dubisiko	31054	Jonkerdam		120	193	93	386	186	93	409	232	464	232	696	482	241	193	193	386	193	506	409	
23	J.Wondo	18669	Bongweni	18669	236	531	72	84	559	529	579	216	216	301	279	964	236	531	72	84	559	529	579	
24	D.Fink	18517	Bongweni	18517	402	402	465	465	465	465	930	442	930	465	651	434	483	483	483	241	483	724	483	
25	N.Moni	18485	Bongweni	18485	24	60	333	121	332	192	288	93	277	451	46	373	24	60	333	121	332	192	288	
26	E.Liwani	18484	Bongweni	18484	80	545	727	1212	1212	1272	1798	488	744	581	646	675	1062	545	727	1212	1212	1272	1796	
27	C.Mose	18616	Bongweni	18616	60	578	93	325	232	232	93	92	46	93	60	192	60	578	338	385	241	385	66	
28	L.Noyi	19716	Town 2 Village 3		152	188	185	185	323	473	510	533	555	485	393	240	240	363	289	201	144	336	288	
29	S.Motsumai	19722	Town 2 Village 3		120	144	186	241	144	465	232	193	464	121	232	240	121	144	241	241	144	193	193	
30	K.Zenzile	19620	Town 2 Village 3		242	362	481	96	240	240	168	384	144	180	99	181	242	362	481	96	240	240	168	
31	E.Louw	21618	Town 2 Village 3		96	-26	144	185	322	138	323	253	276	346	161	216	96	143	144	144	192	192	216	
32	B.Mhlolo	19723	Town 2 Village 3		240	160	184	208	184	115	162	253	277	139	326	264	168	24	96	166	192	48	72	
33	T.Mangxola	19709	Town 2 Village 3		180	213	300	184	185	278	231	302	278	327	234	192	120	144	264	192	216	192	288	
34	Priscilla	19726	Town 2 Village 3		140	120	186	92	138	208	161	139	138	92	189	241	144	121	482	271	193	385	168	
35	Mrs Sibeko	22293	Town 2 Village 3		48	201	116	0	232	0	133	93	193	121	96	66	48	66	96	0	96	0	133	
36	Mr Ngqombo	19622	Town 2 Village 3		260	248	325	230	312	489	675	464	720	462	472	288	264	288	385	244	364	336	288	
37	Mrs Sigoba	21632	Town 2 Village 3		200	160	115	161	207	115	161	322	300	299	186	144	216	144	144	192	144	96	312	
38	Mrs Mbolekwa	19197	Town 2 Village 3		48	96	168	23	168	168	92	370	69	150	46	120	48	96	168	96	168	168	144	
39	Mrs Gqodi	19405	Town 2 Village 3		180	60	161	92	208	46	161	139	92	138	94	168	96	24	216	24	168	144	72	
40	Mr Menki	19505	Town 2 Village 3		200	200	161	207	230	230	230	276	230	207	232	216	264	216	144	216	192	168	336	
41	Mr Nkala	19706	Town 2 Village 3		240	180	186	139	231	278	230	370	324	230	185	240	168	264	168	96	264	264	384	
54	T.Ntsendwane	19112	Town 2 Village 4a		64	44	119	69	96	96	115	138	150	136	151	52	52	72	156	96	152	137	152	
55	Mrs Mentisi	18927	Town 2 Village 4a		80	60	92	92	46	184	161	69	92	115	93	48	24	421	24	24	48	357	144	
56	P.Mpekula	18979	Town 2 Village 4a		300	320	255	253	392	368	393	465	371	416	303	312	336	192	264	384	384	289	384	
57	Mrs Mpinana	18948	Town 2 Village 4a		161	96	96	279	362	139	417	200	186	139	186	337	96	96	96	362	362	96	96	
58	N. Laleli	19109	Town 2 Village 4a		160	308	346	418	370	347	370	463	508	509	489	240	336	336	384	192	432	336	625	
59	A. Marniwa	18899	Town 2 Village 4a		233	66	373	778	392	144	96													
60	N.Ngodongwana	19119	Town 2 Village 4a		423	242	48	423	181	48	48	226	302	279	0	271	423	242	48	423	181	48	48	
61	Mrs Ndude	18984	Town 2 Village 4a		48	96	144	192	92	23	69	69	69	23	23	72	48	96	144	192	384	264	177	
62	N.Mazwi	18977	Town 2 Village 4a		144	144	168	144	23	23	138	115	207	138	209	120	144	144	168	144	168	168	120	
63	Ntwendana	18929	Town 2 Village 4a		384	493	185	523	537	485	626	532	579	418	162	144	384	240	567	436	1063	432	736	
64	S.Baartman	22731	Town 2 Village 3		40	100	231	161	161	138	161	184	184	230	162	240	192	216	312	192	216	337	407	
65	Mrs Wana	Z46	Town 1		280	299	372	278	348	372	139	116	93	69	71	144	168	120	120	96	144	48	48	
66	R.Khau	Z118	Town 1		320	408	209	649	441	593	465	465	347	394	93	288	398	48	96	461	336	482	332	
67	G.Mtyando	Z52	Town 1		160	120	372	232	185	139	186	186	186	232	186	289	192	168	96	181	96	144	144	
68	N.Vuma	Z97	Town 1		160	120	116	232	184	161	138	184	232	209	282	96	192	144	240	192	120	144	96	
69	Z.Nonde	Z47	Town 1		40	0	0	0	133	116	46	115	189	288	0	48	24	0	0	0	133	0	0	
70	I.Gom	J190	Town 1		40	240	231	208	69	139	162	230	369	349	324	408	336	432	192	288	288	312	249	
71	Mr Qubile	J263	Town 1		308	269	300	269	444	324	485	417	544	239	621	466	345	96	303	302	24	199	458	
72	Mhlaseli	J179	Town 1		282	221	209	255	162	0	232	232	255	348	363	144	386	181	554	168	72	289	289	
73	Mrs Mabele	J229	Town 1		201	200	138	186	186	325	279	510	418	324	279	144	120	240	241	288	240	96	288	
74	N.Mayembani	Z7667	Town 2 Village 1		390	30	24	391	391	365	0	124	204	240	211	390	390	30	24	391	391	365	0	
75	N.Bulawa	29001	Town 2 Village 1		80	40	240	268	93	241	343	310	276	422	282	144	120	144	168	480	346	409	385	
76	L.Sihawu	27394	Town 2 Village 1		482	200	144	519	625	504	168	673	328	393	697	192	482	891	144	519	625	504	168	
77	V.Gee	27371	Town 2 Village 1		241	96	0	96	544	186	186	325	532	120	484	786	241	96	0	96	544	665	96	
78	J.Mbukotho	27339	Town 2 Village 1																					
79	J.Dumse	27305	Town 2 Village 1		280	240	0	46	0	0	0	46	144	301	451	252	270	46	0	0	0	0	0	
80	M.Tabile	27306	Town 2 Village 1		300	241	464	319	372	372	372	417	343	380	421	192	483	300	624	288	336	240	482	
81	M.Sibeko	27395	Town 2 Village 1		20	80	271	121	24	24	93	370	394	468	232	626	360	240	271	121	24	24	192	
82	N.Ntoko	27345	Town 2 Village 1		72	211	180	222	192	192	92	555	369	185	161	120	72	211	180	222	192	192	140	
83	M.Peterson	27319	Town 2 Village 1		60	20	60	48	192	96	144	216	192	108	60	48	60	120	60	48	192	96	144	
84	W.Sibiya	27322	Town 2 Village 1		450	30	48	24	48	24	240	46	207	460	395	72	450	30	48	24	48	24	240	
85	A.Qhagayi	27307	Town 2 Village 1		72	543	151	573	96	46	596	1056	93	93	363	96	72	543	151	573	96	168	596	
86	N.Kwinana	27316	Town 2 Village 1		40	200	165	116	271	24	144	312	132	319	72	38	150	181	60	181	271	24	144	
87	M.Mbanga	43 Lavoyo Dve	Bongweni	18722	362	602	557	371	604	557	604	603	558	422	530	478	723	724	482	1303	625	674	1232	1152
88	B.Blackbeard	2 Tangana Dve	Bongweni	18533																	177	282		1036
89	W.Mpini	3 Ngwenya St	Bongweni	18723	120	240				254	240	185	323	324	346			207			127	125	554	365
90	N.Msi	6 Kwezi Rd	Bongweni	18748																	818	1013	1565	1436
91	D.Zetsu	17 Ipikoko St	Bongweni	18732																	552	662	920	827
92	Miss Toni	12 Ngwenya St	Bongweni	18713	40	40	116	509	625	557	835	905	509	649	513	530	482	529	482	336	673	674	384	899
93	Mr Mwanda	15 Ipikoko Dve	Bongweni	18733	401	463	464	532	950	882	1346	1439	1440	975	750	578	577	794	723	506	1324	384	1108	
94	T.Mtila	12 Kwezi St	Bongweni	18740	336	40	92	470	92	379	175	648	301	416	510	384	336	336	384	470	652	360	528	605
95	Miss Vasi	20 Galaxy Cres	Jonkerdam	24401											344						633	978	1370	1291
96	Mrs Khwinana	5 Starlight Rd	Jonkerdam	24276	30	120	0	60	0	337	343	48	48	46	48	60	30	120	0	60	0	337	343	
97	Mrs Mavumbe	107 Saturn Cres	Jonkerdam	24206																	914	1074	1586	1362
98	K.Welman	53 Saturn Cres	Jonkerdam	24234																	438	542	804	598
99	Nobitha	7 Galaxy Cres	Jonkerdam	24395																	174	240	342	307
100	N.Mbenenge	73 Saturn Cres	Jonkerdam	24224																	373	539	566	683
101	Vuyiswa	59 Galaxy Cres	Jonkerdam	24358	770	96								144	96	384	770	96			487	466		834
102	Lily	11 Galaxy Cres	Jonkerdam	24393																	554	458	906	819
103	M.Somphali	42 Saturn Cres	Jonkerdam	24306																		157	733	785
104	S. Venifolo	J212	Town 1		100	40	92	46	46	192	23		204	93	241	120	120	240	334	264	240	192	240	
105	G.Nosango	3 Ngwakazi St	Town 2 Village 1																					
106	Z. Bevu	7 Tangana Rd	Bongweni	18705																				
107	S. Sibotho	52 Saturn Cres	Jonkerdam	24301																	75	49	280	278
108	A. Mashiya	4 Nienjane St	Town 2 Village 1																					
109	X.Mvango	15 Idaliya St	Bongweni	18542	462	366															108	326	382	329

TABLE 3.1 Electricity consumption by the sample in Khayelitsha, Langa and Guguletu

1992						1991												1990								
JUN	MAY	APR	MAR	FEB	JAN	DEC	NOV	OCT	SEPT	AUG	JULY	JUNE	MAY	APRIL	MARCH	FEB	JAN	DEC	NOV	OCT	SEPT	AUG	JULY	JUNE	MAY	APRIL
315	180	240	150	256	271	120	120	0	199	0	33	0	99	0	66	0	66	0	132	66	199	0	0			
192	30	484	121	0	121	121	30	121	133	66	200	0	0	400	66	0	0	200	200	0	0	0	0			
24	272	151	159	30	121	181	242	242	166	252	265	265	232	199	165	132	0	0	0	0	0	0	0			
144	121	121	60	241	0	121	151	180	33	259	199	499	132	366	66	133	66	0	0	0	0	133	132			
288	727	181	393	303	0	606	242	0	333	333	799	532	266	266	0	133	0	0	0	0	0	0	0			
216	301	223	0	526	0	787	84	90	320	200	832	299	326	266	112	0	266	0	199	333	133	0	0			
482	606	303	606	0	303	787	0	1363	333	666	1194	666	333	0	998	0	666	0	0	1332	0	666	1332			
384	451	516	373	242	60	0	121	0	653	731	796	666	266	599	0	466	333	333	333	332	332	466	599			
337	1635	787	605	1241	545	727	1212	1212	1272	1798	1332	2264	1665	1998	999	0	666	0	0							
96	0	60	60	60	0	60	60	60	66	66	0	390	231	465	266	332	266	0	0	0	0	199	0			
337	302	121	303	0	363	121	0	0	865	265	133	366	499	0	332	0	266	133	333	133	133	200	0			
96	121	121	121	121	0	0	302	151	180	200	133	66	133	0	0	0	266	66	166	0	180	120	0			
144	180	0	181	242	362	302	302	181	266	0	132	132	66	99	33	99	132	33	66	0	0	0	0			
201	120	151	150	204	90	121	120	60	133	199	199	199	99	0	133	0	0	166	0	0	0	0	0			
126	60	181	60	60	30	0	0	0	99	66	400	466	199	266	333	199	0	266	166	133	299	133	265			
240	211	241	362	270	332	242	271	363	266	399	266	266	332	266	266	133	265	332	198	0	332	132	132			
96	421	242	241	181	121	333	271	0	33	33	66	198	0	0	0	0	132	99	132	132	33	0	66			
193	121	0	0	0	0	242	0	0	0	133	122	66	232	0	66	66	66	0	0	0	0	133	133			
527	560	385	222	331	391	349	396	414	517	443	668	478	465	311	0	279	159	199	298	266	378	365	731			
360	391	240	181	126	272	241	211	272	199	266	66	199	266	132	166	0	0	0	0	0	0	0	0			
270	150	355	120	181	150	150	150	150	99	132	132	132	66	132	132	66	0	332	66	66	66	66	0			
0	272	151	181	0	211	181	90	301	133	133	66	133	299	66	66	66	33	66	0	0	0	0	0			
216	270	240	210	150	121	362	211	121	232	196	364	365	332	198	0	298	199	266	266	133	266	133	266			
144	301	271	181	60	0	392	90	181	258	897	199	200	464	0	466	0	0	199	585	0	258	133	233			
573	632	513	464	439	422	523	511	543	432	297	429	363	431	330	530	297	133	266	198	198	264	231	330			
144	160	151	160	121	121	150	121	121	357	462	1027	1174	576	676	278	0	66	371	364	310	318	451	160			
295	302	300	271	240	210	271	270	303	461	332	399	399	266	399	332	266	200	532	266	266	399	333	532			
216	241	240	240	180	180	181	199	240	400	400	200	400	198	165	132	99	133	0	0	0	0	0	0			
540	606	500	483	423	421	514	484	513	355	351	396	378	358	211	271	198	132	410	231	0	463	411	530			
95	120	90	120	84	66	90	60	60	623	669	730	491	548	496	771	233	0	0	0	0	0	0	0			
595	636	574	513	484	453	544	548	601	266	266	266	200	400	0	0	0	0	0	0	0	399	332	266			
312	331	302	282	241	240	301	271	325	96	99	165	237	224	66	0	0	0	0	66	0	199	332	629			
292	301	300	270	240	210	242	264	301	66	99	132	199	231	290	264	430	297	132	331	397	366	100	198			
144	180	156	181	121	121	150	121	126	304	397	783	664	399	398	0	0	66	133	0	199	66	66	0			
									0	0	0	99	165	265	133	199	199	133	0	0	0	0	0			
144	180	60	120	120	60	120	198	240	166	232	199	133	133	166	133	133	133	133	100	0	0	100	66			
268	312	205	242	306	180	217	222	414	205	198	158	198	151	198	165	132	132	132	199	33	0	66	0			
240	121	242	0	302	121	362	181	181	200	199	266	200	200	200	200	0	200	266	133	133	133	133	133			
264	242	242	241	121	180	271	174	241	198	166	66	196	199	132	213	166	199	132	66	266	199	0	0			
96	0	0	121	0	0	0	0	0	0	0	133	0	133	0	0	0	0	0	0	133	0	0	0			
264	309	270	210	160	271	332	241	181	266	324	264	258	0	133	351	332	332	332	399	332	266	399	266			
0	363	393	315	454	410	303	302	332	199	232	285	365	298	198	232	199	266	266	266	199	232	132	185			
216	199	363	0	363	181	302	150	181	198	259	66	199	265	266	66	266	133	266	0	266	266	0	0			
48	483	120	241	120	240	120	240	120	264	132	264	132	265	198	198	132	132	133	132	198	132	133	133			
48	60	60	0	160	180	242	121	60	265	0	132	66	0	132	66	100	133	66	33	99	66	0	132			
466	0	393	400	242	0	466	0	393	400	558	719	355	399	0	0	0	0	333	0	0	333	333	333			
452	60	512	265	120	332	452	60	512	365	199	265	265	285	265	332	331	0	0	0	0	0	0	0			
484	483	451	666	423	545	484	483	451	665	466	333	532	266	465	497	399	133	0	0	0	0	0	0			
375	276	162	106	72	120	211	180	120	165	343	284	166	192	299	365	365	0	0	0	0	0	0	99			
48	0	60	60	42	60	0	151	0	0	0	33	33	66	332	331	264	0	0	0	0	0	0	0			
369	423	242	303	484	300	362	421	393	530	466	431	432	465	464	332	331	332	399	399	0	0	0	266			
225	210	156	144	108	162	222	138	253	258	297	398	332	264	198	198	264	132	0	0	66	331	265	66			
408	487	301	360	0	0	121	121	0	198	264	363	200	0	0	0	0	0	0	0	0	0	0	99			
192	106	60	181	60	120	60	121	121	120	199	199	135	133	266	266	133	133	266	133	233	266	199	279			
636	651	360	543	361	120	666	240	0	132	561	330	265	330	330	363	450	0	0	0	0	0	198	165			
596	635	363	665	362	543	151	573	610	550	596	563	464	490	366	297	198	397	66	465	0	0	0	0			
0	319	72	181	150	181	60	181	271	100	252	198	132	165	132	165	53	225	132	126	92	66	145	33			
722	606	968	605	0	0	0	0	0	981	1232	1152	1364														
625	343	135	224	145	180				282	291	256	375														
276	416	156	264	208	224				411	681	596	445														
1265	1605	865	1161	592	1060				1037	1801	1433	1696														
606	905	552	792	499	493				743	1002	1527	1094														
604	242	665	785	579	0	0	0	0	862	956	899	850														
242	1106	634	767	121	242	302	452	423	451	589																
384	511	543	481	331	60	0	0	0	985	832	605	726														
		586	896	449	597																					
		662	831	453	566				910	1102	1021	1062														
1017				563	676	0	0	0	1074	1586	1362	1017														
		428	596	278	383				529	783	687	554														
		191	289	212	182				407	429	502	395														
		468	480	416	413				434	584	640	513														
		149	482	225	450				466	795	700	517														
		459	795	543	708				732	924	908	866														
		456	749	469	489				186	480	1130	770														
204	181	241	181	161	121	242	121	242	133	266	166	200	266	198	133	166	200	133	198	99	0	0	0			
393	484	423	532	363	302	393	484	423	532	798	862	664	798	498	531	528	133	0	0	0	0	0	264			
									331	922	788	1100														
		218	258	160	196				357	550	659	669														
286	301	121	362	121	121	242	0	0	66	46	112	132	198	264	198	133	0	0	100	0	0	0	0			
313	477	300	401	293	404				448	566	412	477														

The total number of electrified consumers (universe) in Khayelitsha has increased in size from 1 865 in November 1990 to 9 511 by March 1994. Much of the increase has occurred over last 12 months. This partially accounts for the tailing off in the average level of consumption of the universe of all consumers in the area.

Meanwhile the survey sample in Khayelitsha has remained relatively constant. This sample, with only a few exceptions, of movement or refusal to participate any further, is the same "panel" selected in phase 1. The criteria for selection were then that the sample included small, medium and large consumers of electricity and that they were distributed across Khayelitsha. The former stratification has been left behind as consumers undoubtedly have moved from one electricity consumption stratification to another over the past 40 months. However, the average of the sample has mirrored the average of all consumers in the area, with exceptions notably during the winter of 1991 and 1992. What can also be noted is that the sample and the universe averages appear to be diverging. This would be expected if the consumption of the newly electrified was lower initially but is growing with time. Chapter 5 explores this issue further. The average which grew from 200 to 244 between phase 1 and 2, declined to 209 units in phase 3.

In figure 3.8, the average consumption trends of the sample (illustrated by the shaded rectangles) and the universe (histogram collumns for three phases) are shown.

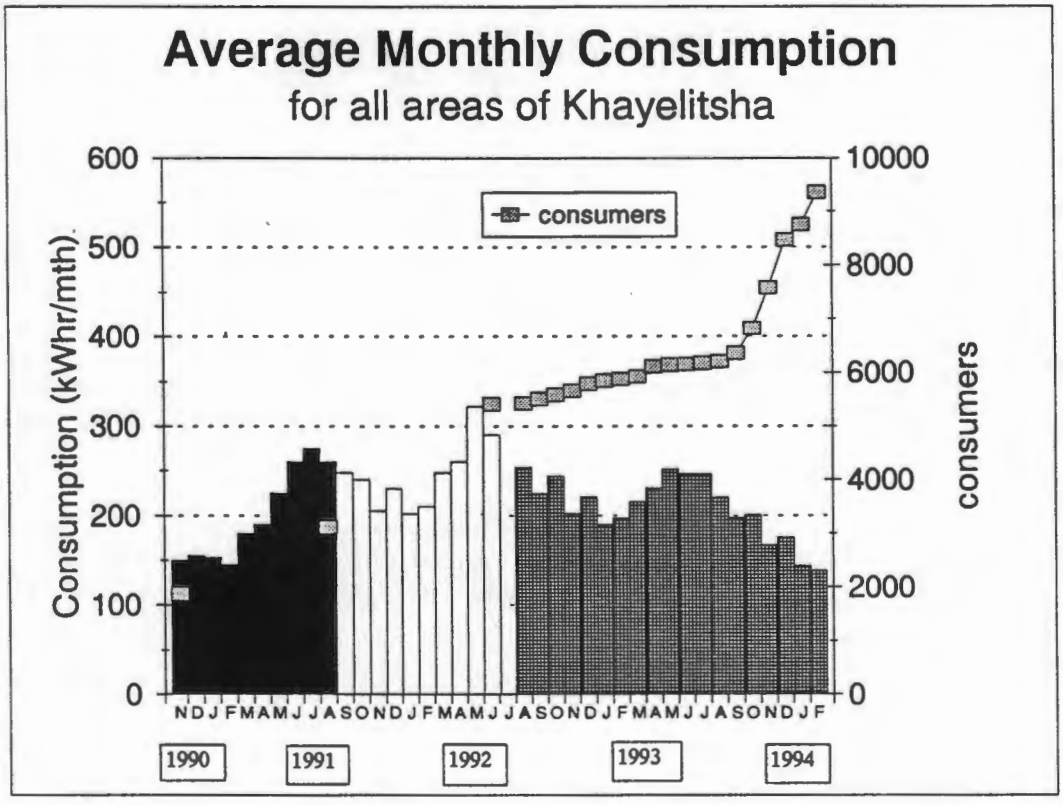


FIGURE 3.8 The average consumption of the sample and universe in Khayelitsha

Figure 3.9 records the growth in the number of end-users of electricity and the average consumption for all areas in Khayelitsha. The rapid increase in the pace of electrification in the second half of 1993 co-incides with the decrease in average electricity consumption. This trend that increased electrification would lead to a reduction in average consumption was expected for two main reasons; firstly that newly electrified customers take a while (15 months is suggested in chapter 6) to reach a stable consumption level, and, secondly that the newly electrified are likely to be poorer than have previously gained access to electricity. This latter statement can be illustrated by the fact that prior to Phambili Nombane's involvement in Khayelitsha the electrification was limited to formal housing areas. Another complication is that the trends are based on the sales and not the real consumption, which on average could be far higher.

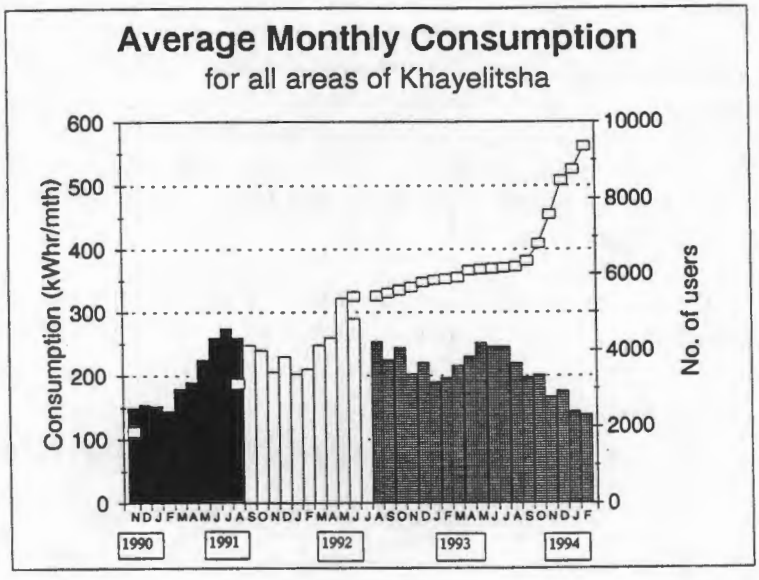


FIGURE 3.9 Electricity consumption and end-user increases in all Khayelitsha

Figure 3.10 gives an indication of the spread in electricity consumption in Khayelitsha during February 1994. The 15% of the sample who did not purchase electricity could indicate the extent of electricity theft ("meter bridging"), those who have not used much electricity (still using the R5 free electricity they received at the time of connection) and/ or those disconnected for one reason or another.

The frequency distribution is uneven. Reasons for this could be the number of newly connected consumers. 50% of consumers are using below 100 units per month. This once again underscores the effect of new connections on average electricity consumption.

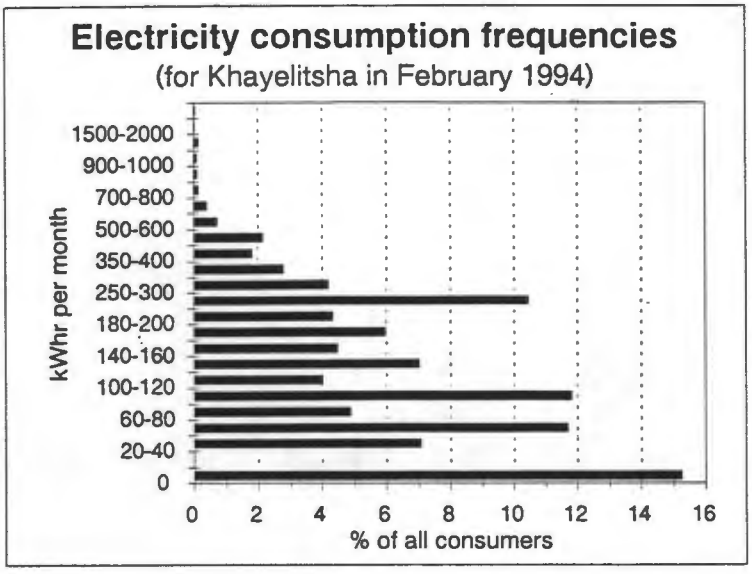
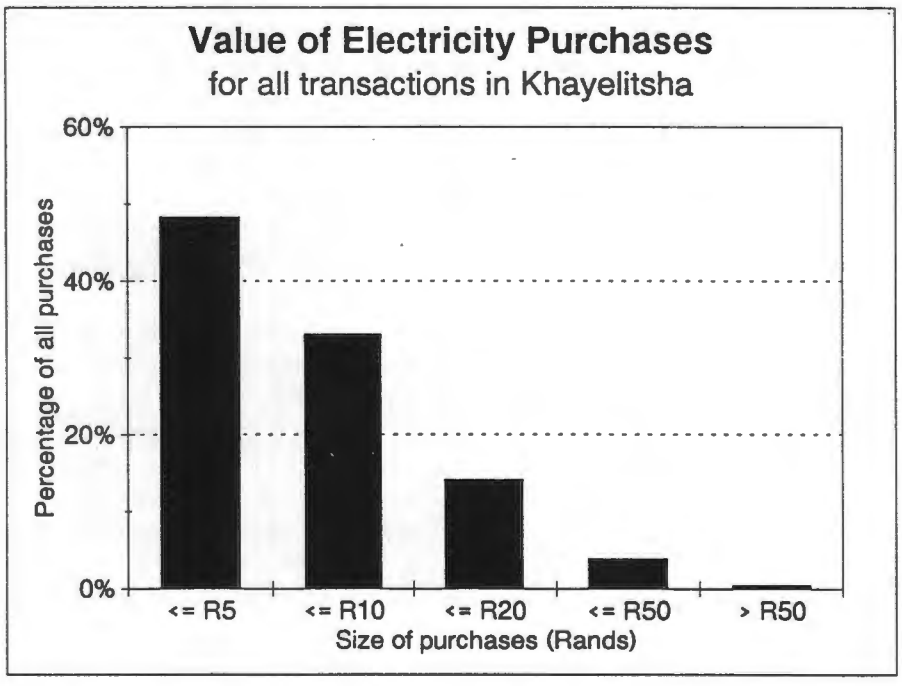


FIGURE 3.10 Electricity consumption frequencies for Khayelitsha in February 1994

3.2.9 Size and frequency of pre-payment sales in Khayelitsha

Figures 3.11a and 3.11b show the size and frequencies of electricity pre-payment sales in the third phase of the study. The reason this analysis was undertaken was to get a feel for how pre-payment electricity metering was meeting the size and frequency of incomes - in other words; whether electricity dispensed in this way is affordable for the poor.



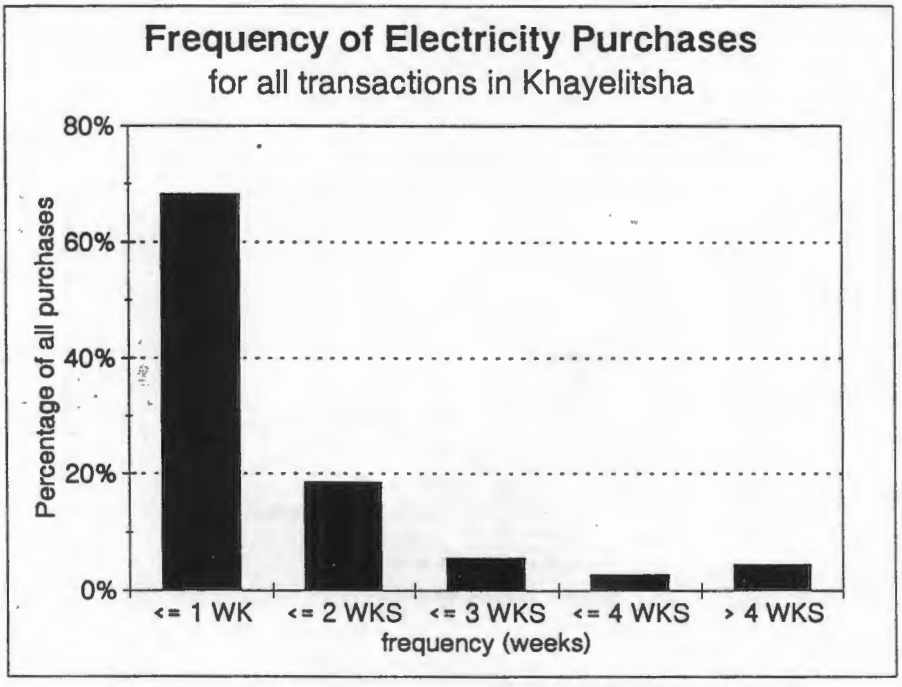


FIGURE 3.11 a and b The size and frequency of electricity sales in Khayelitsha

Paraffin and coal, in many areas, are directly in competition with electricity to fulfil household energy services. These fuels have been considered as affordable energy options because of the low cost of access and the affordable quantities of the fuels which can be purchased (Williams 1994). Pre-payment metering has clearly made a difference to the affordability of electricity. But according to Eskom, the frequency of purchases, and the added sales costs, has resulted in an increase in the cost break-even level of electricity consumption, from 350 to 537 kWh/month for the Eskom S1 tariff (Ligoff 1994).

3.3 Langa and Guguletu

As mentioned above, Langa and Guguletu are older townships in Cape Town. They were originally selected to represent low-income areas in the Western Cape which have had access to electricity for a long time. It was hoped that by studying the use of electricity in these areas that an indication of what could be expected in Khayelitsha would be revealed. However, the use of electricity in these two areas is dynamic, and not stable as originally expected. Much has to do, firstly with the quality-of-supply (see chapter 7), and secondly the Cape Town City Council's policies to address the issue of arrears. Section 3.3 of this chapter considers the consumption of the universe and the samples in these two areas. It considers the level of arrears and how this has changed over time.

In phase 2 consumers in Langa and Guguletu were divided into three categories. These categories were established for the consumption data for a 12 month period from December 1991 to November 1992, and included:

- category 1: those who are making *no* payments (arrears still increasing);
- category 2: those have made *some* payments but their arrears are still increasing; and
- category 3: those who are making payments which are *reducing arrears*;

In phase 3 a similar exercise was conducted. The results are included below.

3.3.1 The sample and universe in Langa

The universe of electricity users in Langa comprises 2 527 or 72% of all houses in Langa. This is a small reduction from 2 570 electrified households recorded in phase 2. The sample in Langa comprises only 18 households. Figure 3.12 shows the average monthly electricity consumption of the two groups of consumers, which appear to track one another closely. It can be seen from the figure that the average monthly consumption of electricity for all consumers has decreased from 497 in phase 2 to 459 units per month in phase 3. The sample provided averages of 505 and 473 units per month, for phases 2 and 3.[1] Figure 3.12 presents the averages for both the sample and the universe in Langa.

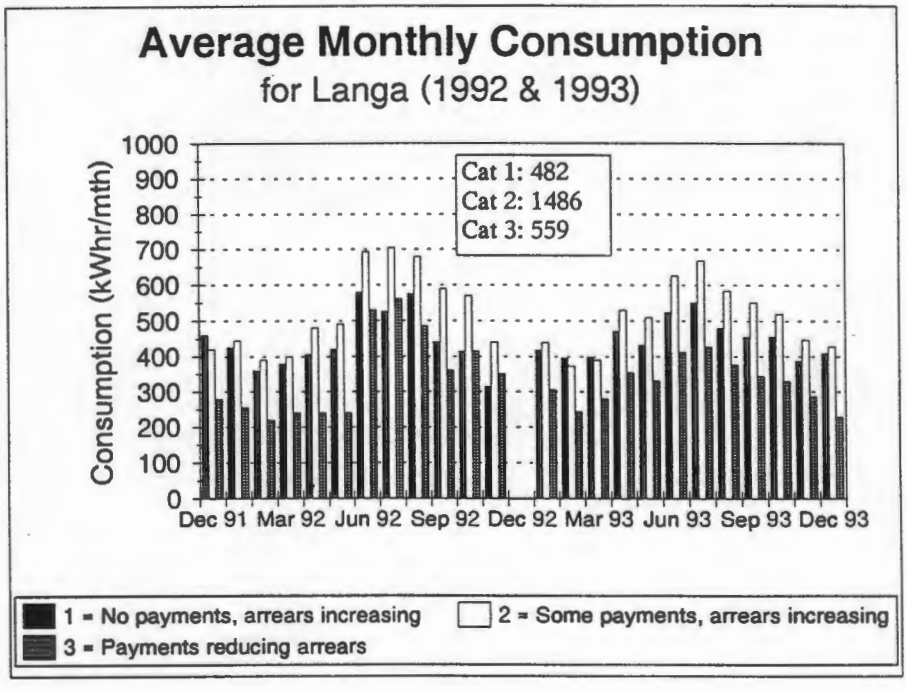


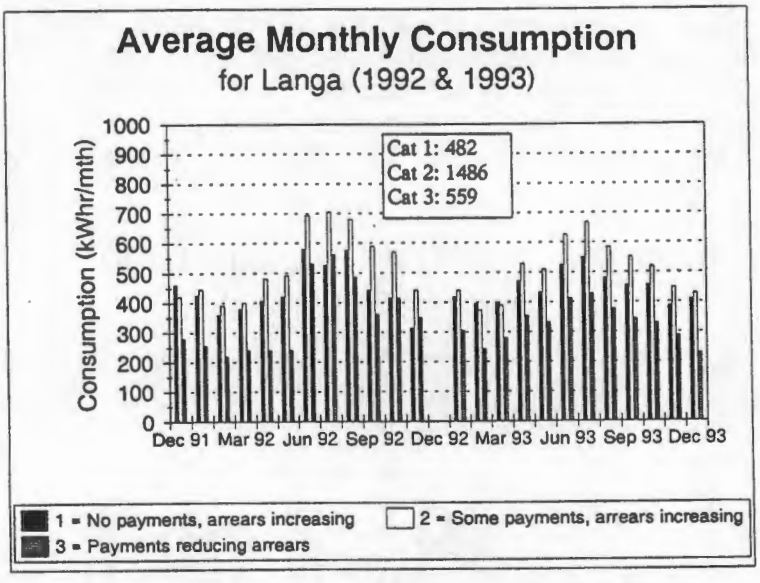
FIGURE 3.12 The average consumption of the sample and universe in Langa

The reason for the decrease in electricity consumption, may be because the electricity debt of many of the electricity consumers is being more effectively collected.

[1] The combined average for the sample in Langa and Guguletu in phase 1 was 632 kilowatthours.

3.3.2 The arrears situation in Langa

Figure 3.13a shows the different categories of debtors. Figure 3.13b describes the average monthly electricity consumption for each of the categories of electricity consumers in Langa.



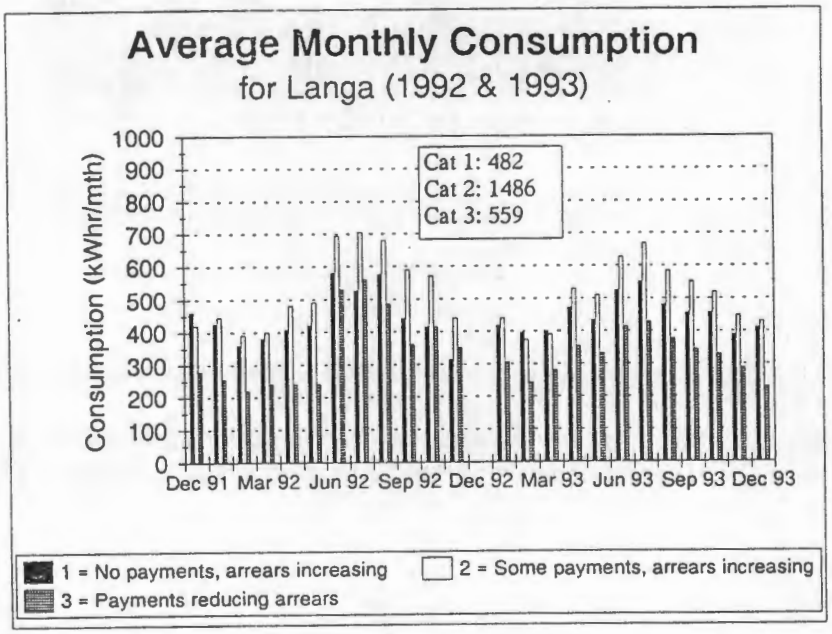


FIGURE 3.13a and b Consumer categories in Langa and their consumption of electricity

Between phases 2 and 3 there has been an increase in the size of category 1, (those who have made no payments) from 13.3 to 19.1% of the consumer base. Category two (those making some payments) has decreased from 70.7% to 58.8%, and category 3 (those reducing arrears) has increased from 15.9% to 22.1%.

The enumerators in these areas sensed a prevailing negative attitude or mistrust towards the arrears collection agency (AZA). The respondents perceived it to be operating independently from the the Cape Town Electricity Department. It appeared that it was not known how money paid to AZA would reach the City's Electricity Department. Respondents speculated that AZA was exploiting their inability to pay electricity debts and making gains from the desperate situation. Some of the respondents were not able to pay for their electricity because of their immediate socio-economic situation - they are just too poor. Some of these people mistook the enumerators for social workers who would be offering some sort of energy welfare.

The figure 3.13b provides an indication of the monthly average consumption of electricity for each consumer category. This suggests, as in phase 2, that category 2 of consumers who are making some payments, yet are not reducing their arrears are consuming the most electricity, while category 1 of consumers, those who are making no payments, are consuming the least.

3.3.3 The sample and universe in Guguletu

The universe of electricity users in Guguletu comprises 7 459 or 90% of all houses in the area. This is a small increase from the 7 408 electrified households recorded in phase 2. The sample in Guguletu comprises only 20 households. Figure 3.14 describes the average monthly electricity consumption of the two groups of consumers (the sample and the universe), which appear to track one another closely. The sample has a higher monthly average than the universe this was 533 in phase 2 and 708 kilowatthours per month in phase 3. It can be seen from the figure that the average monthly consumption of all electricity consumers has decreased from 523 in phase 2 to 485 units per month in phase 3. The phase 1 monthly average of Langa and Guguletu samples was 632 units.

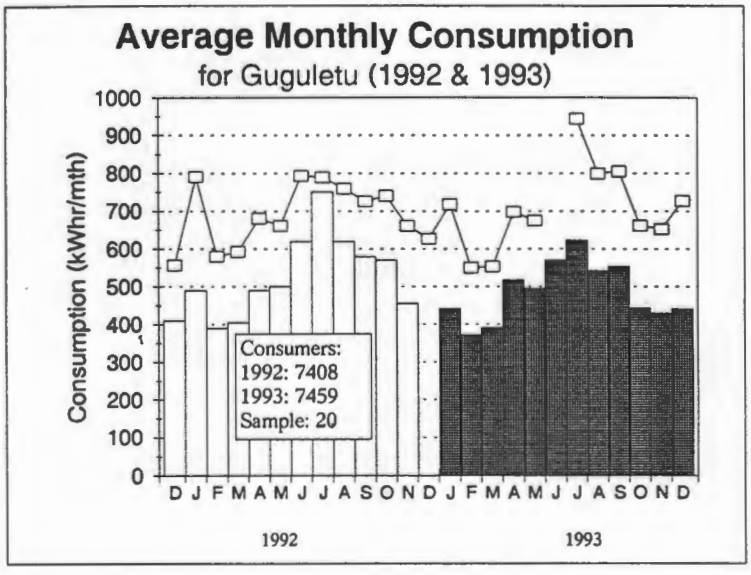


FIGURE 3.14 The average consumption of the sample and universe in Guguletu

As with the case of Langa, the reason for the decrease in electricity consumption, may be because the electricity debt of many of the electricity consumers is being more effectively collected.

3.3.4 The arrears situation in Guguletu

Figure 3.15a reveals the different categories of debtors in Guguletu, while figure 3.15b describes their average monthly electricity consumption.

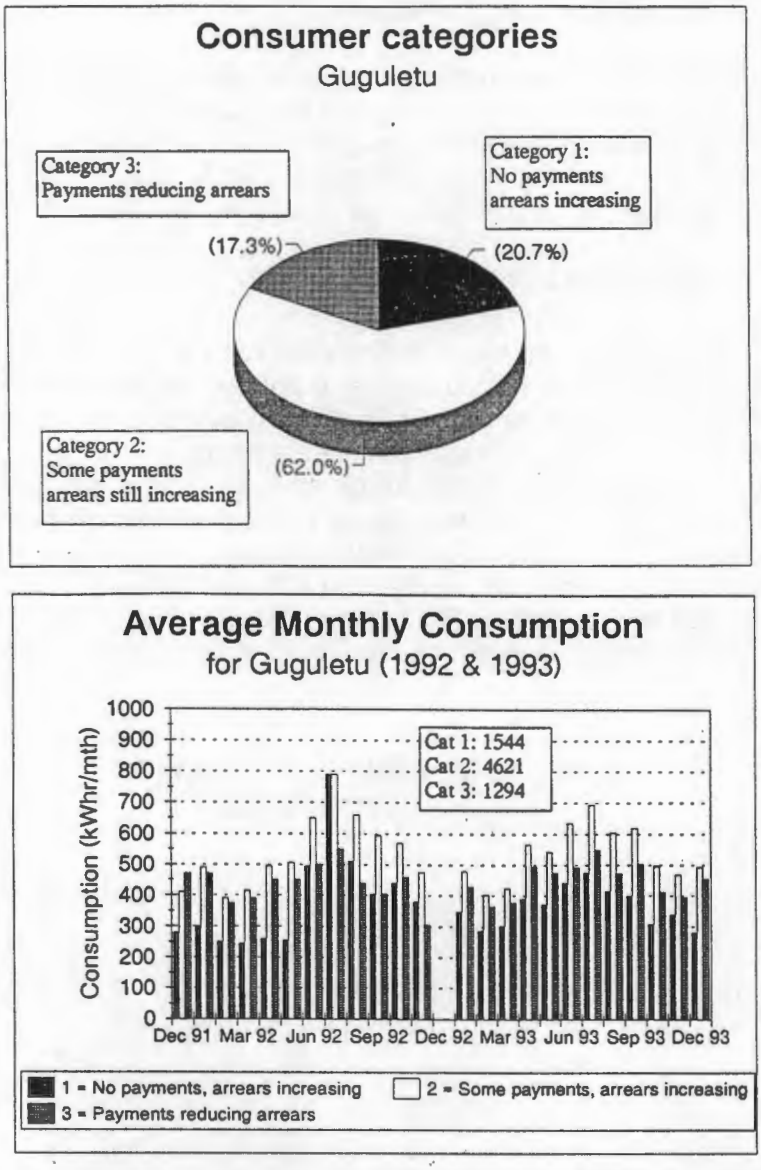


FIGURE 3.15a and b Consumer categories in Guguletu and their consumption of electricity

It is noticeable that between phases 2 and 3 there has been an increase in the size of category 1, (those who have made no payments) from 15.4 to 20.7% of the consumer base. Category two (those making some payments) has decreased from 69.7 to 62%, and that category 3 (those reducing arrears) has increased less than in Langa from 14.9 to only 17.3%. This implies that the Cape Town City

Council's policy of debt collection via their agent is working less well than in Langa. However, as was the case with Langa, they would be undoubtedly concerned to note that there has been an increase in consumers who have made no payments over the 12 month period.

The figure 3.14b provides an indication of the average monthly consumption of electricity for each consumer category. This suggests that in phase 3, that category 2 of consumers who are making some payments, yet are not reducing the arrears, are consuming the most electricity. Category 1 of consumers, that is those who are making no payments, are consuming the least. This is the same pattern as was observed in the case of Langa.

3.4 Conclusions

The main points emerging from the chapter are summarised as follows:

- average monthly electricity consumption in town 1 in 1993 was the lowest for all three phases at 168 kilowatts per month, down from 194 and 229 in phases 1 and 2;
- average electricity consumption has decreased in town 2 village 1, town 2 village 4a, Jonkersdam and Bongweni all of which recorded lower averages for phase 3 than in either of the previous two phases;
- the average monthly electricity consumption in Khayelitsha has decreased from 244 to 209 kilowatthours in phase 3;
- during phase 3, the number of electricity consumers in Khayelitsha has nearly doubled from 5 414 to 9 511;
- in areas in which there have been large increases in newly electrified households, average monthly household consumption of electricity has decreased, signifying that newly electrified consumers use less electricity;
- pre-payment metering systems allow for frequent and small purchases of electricity;
- In both Langa and Guguletu there are increases in the categories of electricity users who have not paid anything for electricity, and those who have reduced their arrears in 1993;
- there are decreases in average consumption of electricity in both Langa and Guguletu; and

- table 3.2 provides a summary table of consumption figures for all areas.

TABLE 3.2 Summary table of electricity consumptions in all areas studied

All Electricity Consumers

areas	phase 1 kWh/month			phase 2 kWh/month			phase 3 kWh/month		
	summer	winter	year	summer	winter	year	summer	winter	year
T1	147	222	194	212	260	229	120	198	168
T2V1	246	351	248	197	271	252	175	223	208
T2V3	124	194	157	162	212	185	186	239	211
T2V4A	261	399	280	315	387	304	225	319	286
Jonkersdam	196	279	216	205	276	247	164	213	201
Bongweni	291	424	342	305	463	396	251	344	311
other pre-payment	*	*	*	350	467	403	282	350	322
credit meters	*	*	*	490	596	599	$	$	$
All Khayelitsha	154	248	200	210	290	244	172	237	209
Langa	*	*	*	411	508	497	395	560	459
Guguletu	*	*	*	453	538	523	435	578	484

Sample

areas	phase 1 kWh/month			phase 2 kWh/month			phase 3 kWh/month		
	summer	winter	year	summer	winter	year	summer	winter	year
T1	217	209	171	212	260	198	210	257	231
T2V1	233	299	198	197	271	277	178	279	227
T2V3	188	217	155	185	212	185	171	270	215
T2V4A	275	329	261	315	387	318	229	256	226
Jonkersdam	335	386	374	205	276	434	124	204	184
Bongweni	358	535	735	217	462	527	375	578	497
All Khayelitsha	175	441	344	258	315	313	215	311	266
Langa	585	644	632	381	427	520	382	573	473
Guguletu	#	#	#	615	635	#	641	843	707

* indicates no data available

# indicates that the figure for Langa is the average for both Langa and Guguletu combined

$ these figures were not calculatd in phase 3

Chapter Four

WHO IS THE SAMPLE?

4.1 Introduction

The aim of this chapter in the report is to provide the reader with a feel for households which were studied as part of the micro-analysis sector of the study. Where possible the information on the socio-economic nature of the households is compared with previous phases.

Information on the respondents includes: the length of occupancy and the type of tenure; the size of the households; the heads of households; levels of education; and the number of adults doing waged work. Information on the gender dynamics of households, and energy decision makers within the household, and household income and expenditure is provided.

The information contained in this chapter does not attempt to give a full profile of the sample, but some socio-economic indicators which are of use when considering the determinants which affect, energy service and consumption related behaviour. Chapter six explores some of these socio-economic indicators and attempts to get an idea of factors that may influence electricity consumption.

4.2 Households

The longitudinal nature of the project is such that all of the original 118 respondents of the previous phases be revisited in the subsequent phases. Therefore the third phase of the project set out to interview the same households which were interviewed in phase 2. With the exception of 3 households this was achieved. The few respondent households that were not included in the third phase, were either not available or not prepared to continue to participate in the project. One resident of Langa had lost her house as a result of fire.

The questionnaire number, date of interview, interviewer's name, the name of respondent and area in which the household is situated, are listed in table 4.1 below.

TABLE 4.1 The sample

RESPONDENT	AREA	INTERVIEWER
S JACK	Guguletu	N.NONQGOTO
L SONQELA	Guguletu	N.NONQGOTO
M QOBO	Guguletu	N.NONQGOTO
***		
J KGATI	Guguletu	A N JONAS
N NTLOKO	Guguletu	N NONQGOTO
M SONJINCA	Guguletu	N NONQGOTO
M MAKULUMA	Guguletu	A JONAS
N HLWAYA	Guguletu	N NONQGOTO
GLADYS LETLABI	Guguletu	C.VUYO
B. MHLAWULI	Langa	C.VUYO
***		
P MATOLE	Langa	C VUSO
B GOBO	Langa	C VUSO
N KULA	Langa	C VUSO
J SITSILA	Langa	C VUYO
Mr NDOBINI	Langa	C.VUSO
C MAPETE	Jonkersdam	L.NTLOKO
MDZULA M. E. Mr.	Jonkersdam	S.MEMANI
P GCWELE	Jonkersdam	L.NTLOKO
MATSHAYA F Mrs.	Jonkersdam	S.MEMENI
DUBISIKO L. A. Mrs.	Jonkersdam	S.MEMANI
MR WONDO	Bongweni	V.THAMAGE
D FINK	Bongweni	L.NTLOKO
N MONI	Bongweni	L.NTLOKO
***		
LETIA	Bongweni	L.NTLOKO
MR NOYI	Town 2 Village 3	L.NTLOKO
KHOLISWA	Town 2 Village 3	L.NTLOKO
MISS N ZENZILE	Town 2 Village 3	L.NTLOKO
Z MAKHALIMA	Town 2 Village 3	S.MEMANI
Mrs NTLOKO	Town 2 Village 3	L.NTLOKO
T MAGXOLA	Town 2 Village 3	S.MEMANI
N MHLANA	Town 2 Village 3	S.MEMANI
MS NJELU	Town 2 Village 3	L.NTLOKO
R N MATETU	Town 2 Village 3	S.MEMANI
MRS SIYOBA	Town 2 Village 3	L.NTLOKO
S F MBOLEKWA	Town 2 Village 3	S.MEMANI
M QODI	Town 2 Village 3	S.MEMANI
B MANKABANE	Town 2 Village 3	S.MEMANI
T KONDILE	Town 2 Village 3	S.MEMANI
L MAGODLA	Langa	C.VUSO
G MYENI	Langa	N NTLOKO
C. TETYANA	Langa	C.VUSO
R. NTENETYA	Langa	C.VUSO
M MBIZELA	Langa	C.VUSO
B JONAS	Guguletu	N JONAS
C NOBATHANA	Guguletu	I NTLOKO
T NDIMANGE	Guguletu	N NONQGOTO
E MAGUMA	Guguletu	A JONAS
B BAM	Guguletu	N NONGQOTO
Mrs EDWIN MACALA	Langa	C.VUSO
S MAYA	Langa	C VUSO
Mrs MBULA	Town 2 Village 4a	L.NTLOKO
FILTANA	Town 2 Village 4a	L.NTLOKO

TABLE 4.1 The sample

NUMBER	RESPONDENT	AREA	INTERVIEWER
56	MRS MPEKULA	Town 2 Village 4a	L.NTLOKO
57	MRS MAKINANA	Town 2 Village 4a	L.NTLOKO
58	F LALELA	Town 2 Village 4a	S MEMANI
59	MRS MANAIWA	Town 2 Village 4a	L.NTLOKO
60	MR B JONGILE	Town 2 Village 4a	L.NTLOKO
61	MRS NDUDE	Town 2 Village 4a	L.NTLOKO
62	K NJIKA	Town 2 Village 4a	L.NTLOKO
63	MRS M BOOI	Town 2 Village 4a	L.NTLOKO
64	MS SITYASHWANA	Town 2 Village 3	L.NTLOKO
65	MR WANA	Town 1	L.NTLOKO
66	Mrs KHAU	Town 1	L.NTLOKO
67	G MTYANDO	Town 1	L.NTLOKO
68	N VUMA	Town 1	S.MEMANI
69	C SEFAL	Town 1	S.MEMANI
70	M GOM	Town 1	S.MEMANI
71	N GQUBILE	Town 1	P M SIBACA
72	E MAHLASELA	Town 1	S.MEMANI
73	MS MABELE	Town 1	L.NTLOKO
74	N MDEKAZI	Town 2 Village 1	S.MEMANI
75	MRS XAKUMA	Town 2 Village 1	L.NTLOKO
76	N. SIHAWU	Town 2 Village 1	L.NTLOKO
77	V GAE	Town 2 Village 1	L.NTLOKO
78	J MBOKOTHO	Town 2 Village 1	L NTLOKO
79	M DUMSE	Town 2 Village 1	S.MEMANI
80	T TABILE	Town 2 Village 1	L.NTLOKO
81	S M SIBEKO	Town 2 Village 1	S.MEMANI
82	N NTLOKO	Town 2 Village 1	L.NTLOKO
83	M PETERSON	Town 2 Village 1	L.NTLOKO
84	N VENA	Town 2 Village 1	L.NTLOKO
85	QAGANA E. N. Mr.	Town 2 Village 1	S.MEMANI
86	M.C.L. KWINANA Mrs.	Town 2 Village 1	S.MEMANI
87	N I MBANGA	Bongweni	S.MEMANI
88	MRS M BLACKBEARD	Bongweni	L.NTLOKO
89	S J MAQETHUKA	Bongweni	S.MEMANI
90	N MTSI	Bongweni	L.NTLOKO
91	MS D ZETHU	Bongweni	L.NTLOKO
92	N TONI	Bongweni	P M SIBACA
93	S J MWANDA	Bongweni	S.MEMANI
94	[BONGI] NONTSHANA	Bongweni	P SIBACA
95	VASI	Jonkersdam	L.NTLOKO
96	XXX	Jonkersdam	P M SIBACA
97	N SOMPALI	Jonkersdam	L NTLOKO
98	G WELDMAN	Jonkersdam	S MEMANI
99	N SIYO	Jonkersdam	P M SIBACA
100	M MBENENGE	Jonkersdam	S MEMANI
101	M SIDYINO	Jonkersdam	S.MEMANI
102	LILY SO[HOTHELA	Jonkersdam	S.MEMANI
103	M SOMPALI	Jonkersdam	L NTLOKO
104	N VENIFOLO	Town 1	L.NTLOKO
105	C DUMA	Town 2 Village 1	S.MEMANI
106	F N LALELA	Bongweni	S.MEMANI
107	S SIBOTHO	Jonkersdam	P M SIBACA
108	M MDUTYANA	Town 2 Village 1	L NTLOKO
109	G MVANGO	Bongweni	S.MEMANI

TABLE 4.1 The sample

NUMBER	RESPONDENT	AREA	INTERVIEWER
110	L NOFEMELA	Bongweni	S.MEMANI
111	G MJOLI	Guguletu	N JONAS
112	G NTWANA	Guguletu	L NTLOKO
113	T MACWILI	Guguletu	L NTLOKO
114	LINDELWA LUGALO	Guguletu	C.VUSO
115	L NGOMA	Langa	C.VUSO
116	GABUZA	Langa	C.VUSO

4.2.1 Tenure

The legal constraints that previously limited the access of urban poor to land has recently been alleviated. At present both men and women have the right to land and household tenure. 84% of the women headed households were owned, whereas of the households of headed by men (and those who would not reveal who was the head), 70% were owned.

In Langa and Guguletu 51% of the respondents stated that they owned the dwelling. This response compares with the 90% in Khayelitsha who answered the question in the affirmative. Rental housing stock is being gradually transferred to residents of the two older townships, while Khayelitsha was built by developers with the intention of selling the housing units to potential purchasers.

In phase 2 the potential for different investment behaviours in the dwellings in terms of thermal performance and fixed appliances was considered without knowledge of the ownership patterns. This question was included in the study for the first time in this phase.

4.2.2 Occupancy

In the previous phases of this study the respondents answered that they had lived on average, 2.2 and 4.1 years in Khayelitsha, and 20.1 and 23.6 years in Langa and Guguletu. In the third phase the average reported duration of tenures were 3.8 and 25.1 years for the newer and older townships respectively. While the latter figure is in keeping with the time lapse between the phases, the decrease in average reported tenure in Khayelitsha cannot be explained from the data collected.

4.2.3 Size of household

The sizes of households have varied over the phases. This is to be expected within the dynamics of the movements of extended families (with more than two generations present), and urban households with the possibility of a rural home. In Khayelitsha the average sizes of households for the three phases were 4.3, 3.8 and 4.3. In phase 3 the ranges were from 2 to 8 persons per household. The sizes recorded for households in Langa and Guguletu were 7.7, 5.8 and 6.5 for the phases 1 to 3 respectively. Household sizes ranged from 4 to 10 persons.

4.2.4 Age

The average age of adults in Khayelitsha was 35.8 years. In Langa and Guguletu the average is similar at 36 years.

4.2.5 Education levels

The average number of years of formal education completed in Khayelitsha was 9 years amongst adults and in Langa and Guguletu this is 9.3 years.

4.2.6 Waged work

The percentage of adults doing waged work in Khayelitsha has decreased steadily over the study period, from 66 to 61 and finally 51% from phase 1 to phase 3. In Langa and Guguletu the level of employment improved between phases 1 and 2, from 42 to 46%. In phase 3 the level of employment of adults had reached a low of 35.4%.

4.3 Who was interviewed?

The list of those interviewed is included above in table 4.1. However, table 4.1 does not provide a detailed the role of gender in decision-making. All of the houses in the previous sample were revisited, however, in Langa and Guguletu only 65% and in Khayelitsha 56% of the respondents were interviewed in previous phases. In most cases this could be put down to who was at home when the interviewer visited.

Figure 4.1 describes some categories of respondents: energy decision makers; heads of households; women; and combinations of these categories.

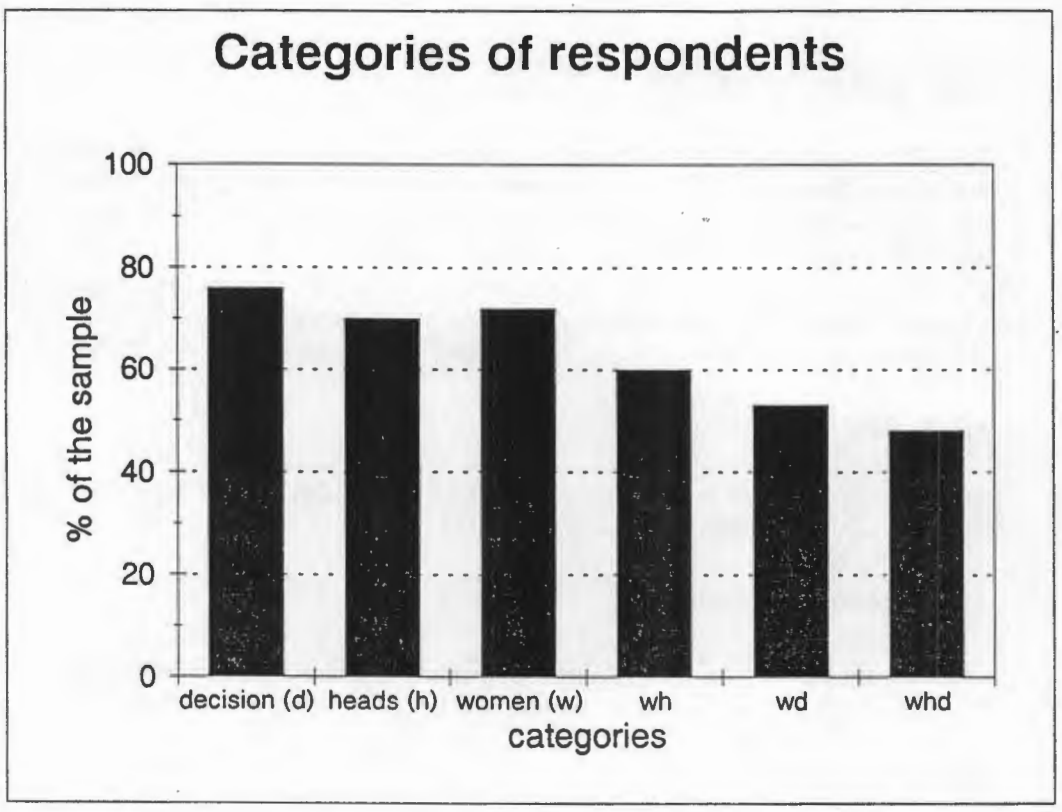


FIGURE 4.1 Categories of respondents

4.3.1 Decision makers

Of the 115 interviews conducted, 77% were reportedly with the person who makes decisions about energy within the household.

4.3.2 Heads of household

Of the 115 households, 70% of interviews took place with a respondent reporting to be the head of the household. Some people would neither say whether they were the head of the household nor who was the head.

4.3.3 Women

In the previous two phases the percentage of women headed households in Khayelitsha were 66 and 61% of all households visited. In Langa and Guguletu these figures were 76 and 62% respectively. In phase 3 nearly 73% of the interviews were conducted with women. Amongst those interviewed, 60% were female heads of households, 53% were females who make the energy decisions within the household, and 48% were women who are the heads of households and the energy decision makers. It has been suggested if women are in such high numbers in the formal houses in Khayeltsha, (it is quite possible) that this figure could be higher in the informal site-and-service areas. Such observations underscore the urgency of bringing women into the household energy policy formulation.

4.4 Income and expenditure

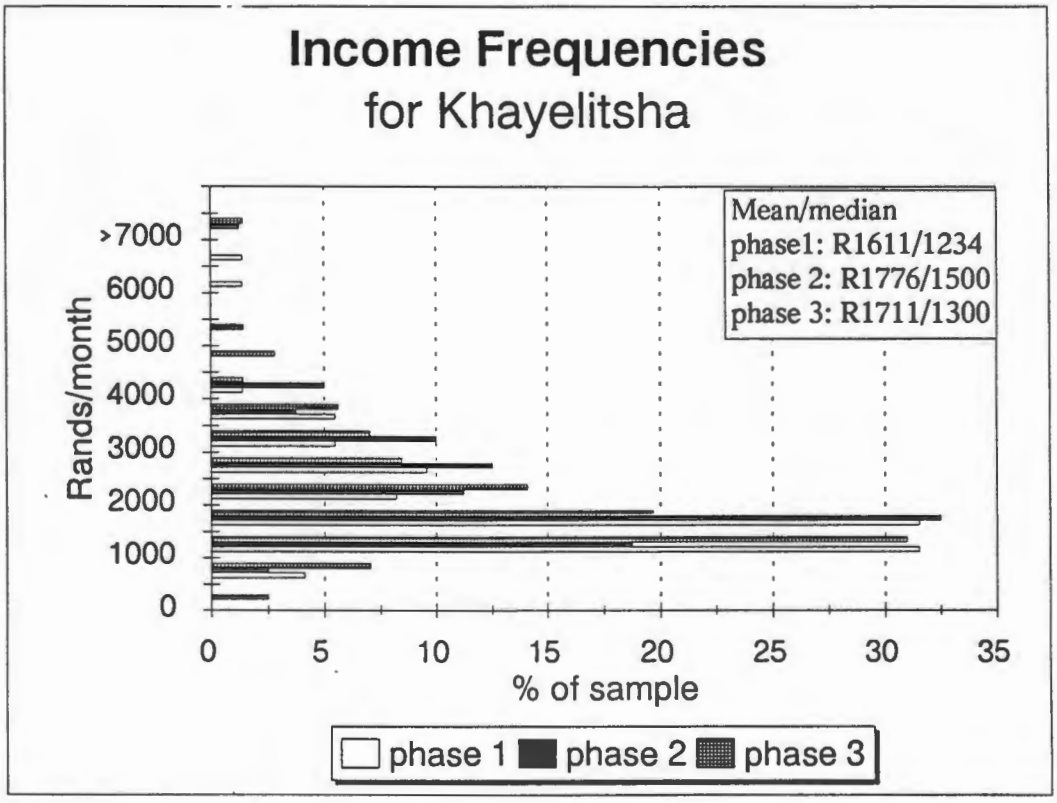
The interviews of the sample households requested information from respondents on the nature of their household incomes and expenditures. These are provided below in some detail, while chapter 5 disaggregates the energy service expenditures in still more detail.

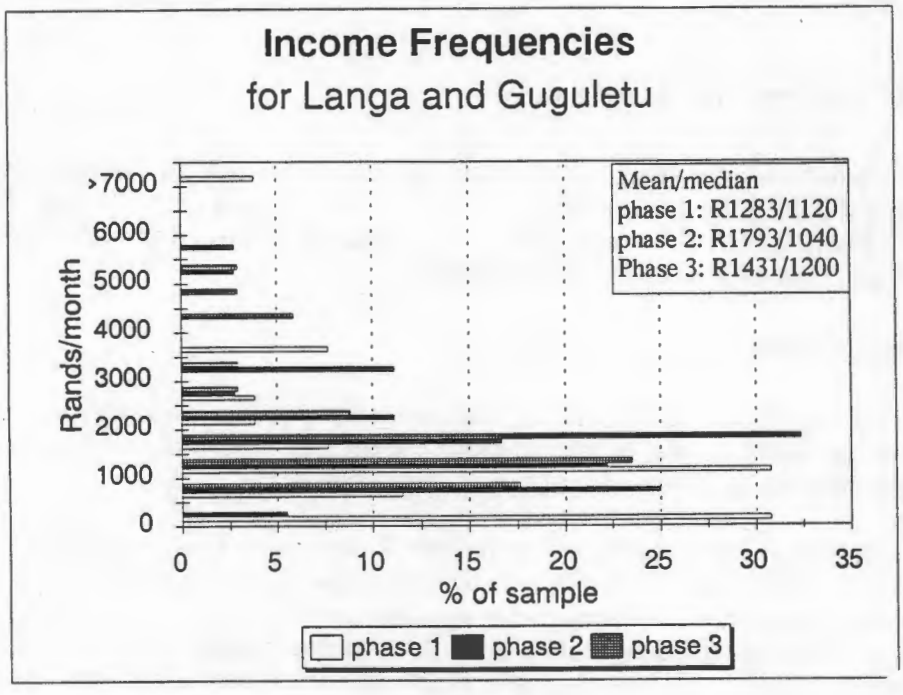
4.4.1 Income

Income was broken down into the following components: income from wages work, pensions, money sent from family or friends, rent from tenants, income from stokvels, and any others.

Employment amongst adults is at the lowest level it has been during the entire study period. And as expected, from the data collected, the average level household incomes have dropped in nominal terms since phase 2 in both areas. What is surprising from the data is that despite the decrease in the number of working adults, and the decrease in average incomes, the lowest income category (below R500) has disappeared from both areas. In Langa and Guguletu the median increased in nominal terms reflecting this, yet in Khayelitsha this trend is not apparent.

Figures 4.2 a and b show the income distribution frequencies in Khayelitsha and Langa and Guguletu.





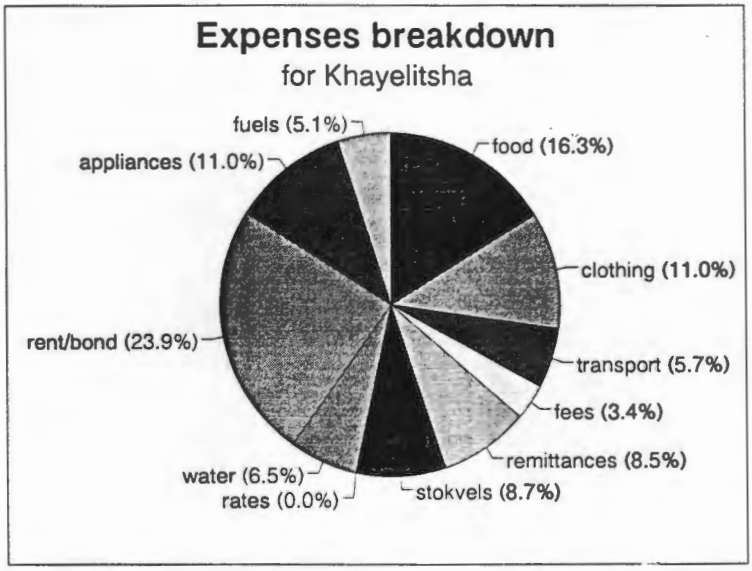
FIGURES 4.2 a and b Income frequencies in Khayelitsha and Langa and Guguletu

4.4.2 Expenditure

The respondents were asked for detail on the amount of money they were spending on a range of households needs. In Khayelitsha the average expenditure was calculated to be R1 172 per month, while in Langa and Guguletu R1 191 per month. Figures 4.3 a and b disaggregate the destinations of household spending.

In some cases the detailed information on expenditures on fuels was different from those provided by the more detailed revelations on a fuel-by-fuel basis which was conducted at the beginning of the interview. It is interesting to note that respondents in Khayelitsha over-estimated their fuel expenditure second time around, while respondents in Langa and Guguletu under-estimated theirs. The second estimation was used in the figures 4.3 a and b below. Fuels and appliances averaged 16.1 and 12.3% for Khayelitsha and Langa and Guguletu respectively.

Figures 4.3 a and b provides a breakdown of household spending in Khayelitsha, Langa and Guguletu.



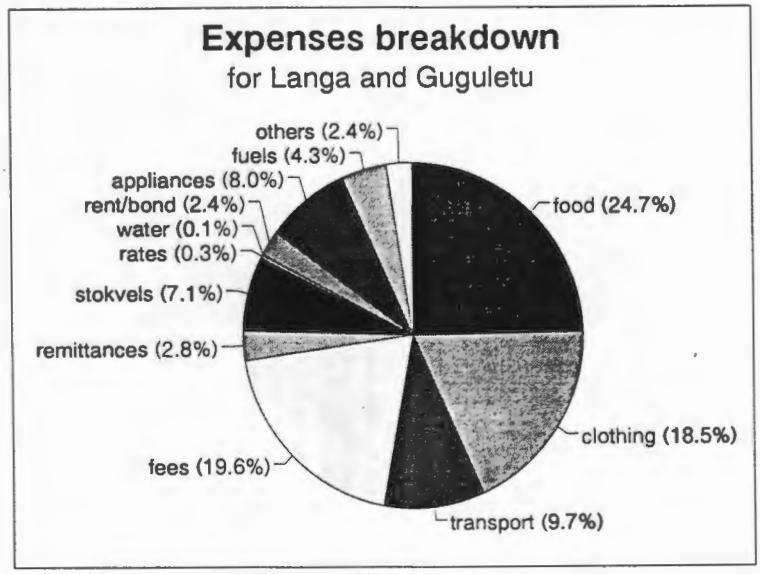
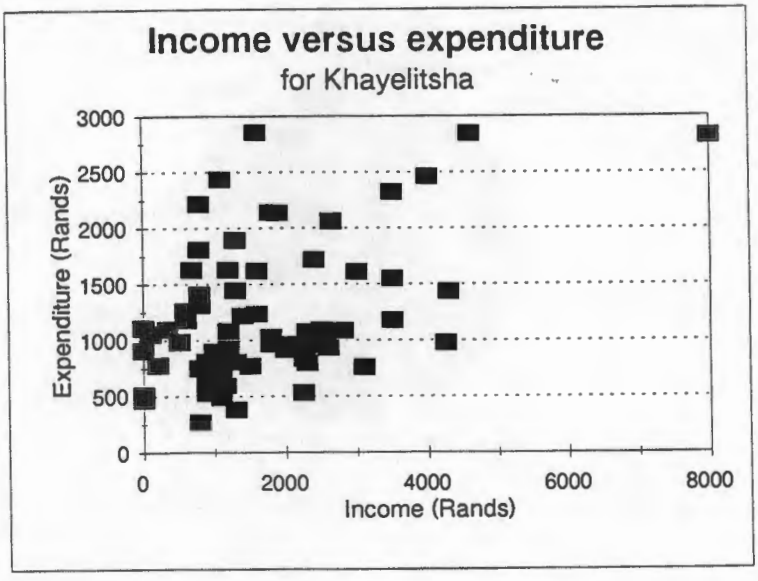


FIGURE 4.3 a and b Disaggregated household expenditures in Khayelitsha and Langa and Guguletu

Figures 4.4 a and b describe the relationships between income and expenditure for the two areas.



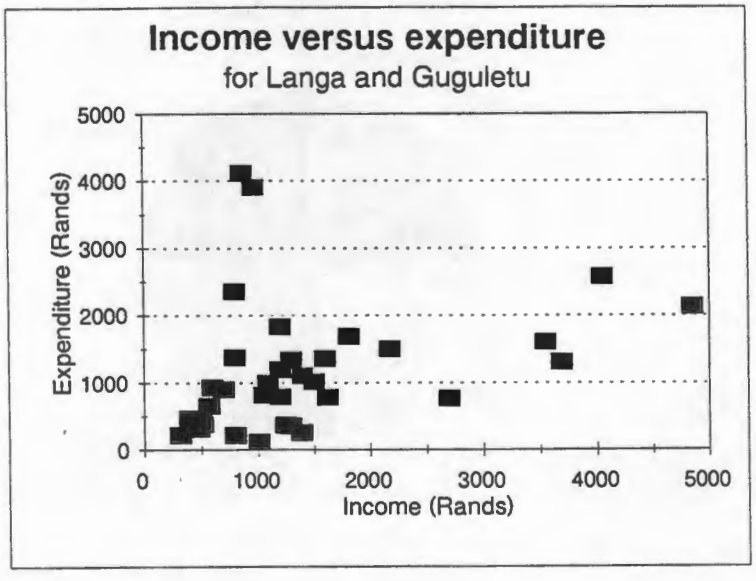


FIGURE 4.4a and b Income and expenditure scatter plots for Khayelitsha, and Langa and Guguletu

67% of households in Langa and Guguletu and 71% in Khayelitsha, are spending less money that they record as their income. The difference between these figures could be due to some income sources not being disclosed, or expenditure being over-estimated.

In Khayelitsha the R-squared regression between income (the independent variable) and expenditure (the dependent variable) was 0.23, and in Langa and Guguletu the same indicator was 0.1. This implies Pearson Product-Moment Correlations (*r*) of 48 and 32% for the two areas respectively.

4.5 Conclusions

The following are details of the sample. The figures are firstly for Langa and Guguletu and secondly for Khayelitsha:

- 51% and 90% of the houses were owned by the residents;
- the time of occupancy is 25.1 and 3.8 years;
- the size of households are 6.5 and 4.3 persons;
- the average ages are 36 and 35.8 for adults;
- the number of years of formal training completed for adults are 9.3 and 9 years;
- the number of adults doing waged work decreased in both areas. 35 and 51% of adults were employed;
- 65 and 56% of the respondents were the same as interviewed in phase 2;
- in both areas 77% were energy decision makers, 73% were women and 70% of respondents reported being the head of the household;
- income had decreased in both areas to R 1 191 and R 1 172;
- those that have retained waged work are have increased their incomes;
- 67 and 71% of households claimed to be spending less than they earned for the Langa and Guguletu and Khayelitsha respectively; and
- the correlation between income and expenditure are both below 50%.

Chapter Five

HOUSEHOLD ENERGY SERVICES

5.1 Introduction

There are many energy services which are common to most households, these include cooking, space and water heating, lighting, refrigeration, ironing, entertainment (TV, video, hi-fi and radio), clothes washing and other productive uses (such as power tools). The interviews in this phase of the project probed which energy services were employed in the household. This method was considered essential to revealing an understanding as to the how decisions are made in providing each energy service from the end-users' perspective. The questionnaire proceeded to ask questions relating to each of the energy services; what are the fuel and appliance combinations in daily use? and then what are the fall-back or special occasion combinations utilised to fulfil the household energy services?

This chapter is the core of this phase of the project, taking the reader through the household from energy service to energy service. This method contrasts strikingly with the previous two phases where the questions were posed: "which of the following fuels are used in the household?" and; "appliance type?". The phase 3 methodology resulted in similar data being gathered, but from the end-users' perspective. Furthermore, in providing answers from this perspective, vital clues as to the decision-making processes within the household are revealed.

This chapter presents information which:

- describes the energy services in the households visited;
- describes the number of households which utilise these energy services;
- lists the fuels and appliances used within the household (and where appropriate, the frequency of their use);
- indicates why certain fuel and appliance combinations are chosen to fulfil the various energy services;
- lists of out-of-use yet still maintained appliances;
- quantifies net (delivered) and useful energy use per household and per capita; and
- quantifies the cost to the household of the energy services.

The quantitative data is given texture through anecdotes and some experiences which the interviewer underwent and which the questionnaire did not necessarily capture. When presenting quantitative data on use of appliance and fuel combinations, information from previous phases is placed alongside phase 3 data. In presenting the methods of acquisition of appliances, and the evaluation of why these are used, the percentage of the sample quoted is only for those that use these appliances. In some instances the percentages add up to more than 100%, this is because there is a high frequency of multiple cooking appliance ownership.

The cost calculations are in 1991 rands.

5.2 Energy Services

Households were asked which of a list of household energy services they employed. These are described in figure 5.1, which presents the percentage of the entire sample using the various energy services.

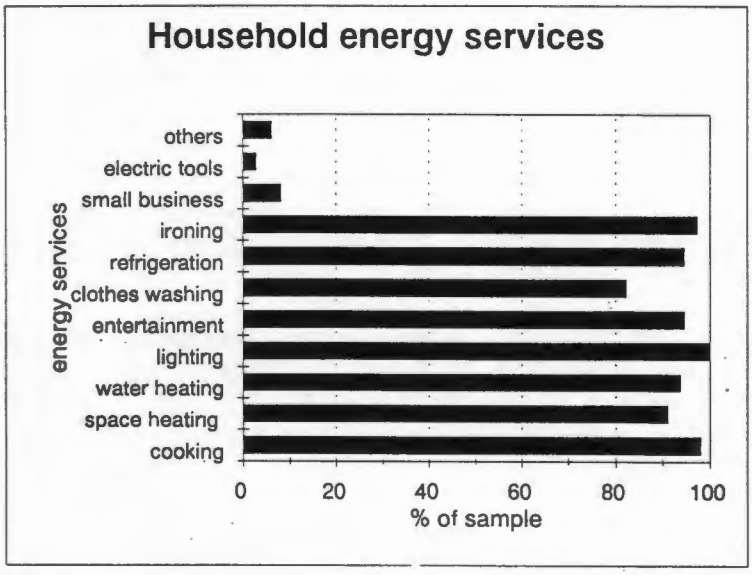


FIGURE 5.1 Energy services used within the household

How these energy services are met, and the preferences involved, are discussed below.

5.2.1 Cooking and reheating food

The respondents were requested to give details on how they fulfilled cooking services within the household. They were then asked to provide information on the method by which they acquired the cooking appliances and to indicate how they rated the fuel and appliance combinations which they currently use in fulfilling the cooking service.

Cooking appliances in daily use

Cooking services in Khayelitsha are almost entirely fulfilled using electricity. Nearly 20% of the households, however, cooked with gas on a daily basis. The proportion of those cooking with gas has remained similar between the first and third phases.

Amongst those households using electricity for cooking, there has been a sharp move away from electric hot plates to electric stoves. Such a move has resulted in phase 3 suggesting that only 22% of the households, as opposed to 40% in phase 1, are using hotplates on a daily basis. Over the same period the number of electric stoves has increased from 46 to 68% in the households in the Khayelitsha sample. This implies that the indications of intended purchases in

phase 2 (see figure 5.4) was more than fulfilled.[1] Enumerators suggest that many respondents considered a hot-plate a cooking appliance only until a 4-plate stove could be afforded. This was particularly true for Khayelitsha where a number of newly electrified households received hot-plates as gifts at the time of receiving electricity.

In Langa and Guguletu the picture is not so clear. This may be as a result of fluctuations in the quality of the electrical service and the policies with respect to the arrears problem, discussed in chapter three. However, as in the case of Khayelitsha, there is a reduction in the use of electric hot-plates from 38% to 13% between phases 2 and 3. Electric stove use has remained around 80% in phases 1 and 3.

Electric frying pans are used increasingly on a daily basis, with nearly 10% of the households frying food in this way. Paraffin appears to be becoming an increasingly popular fuel for daily cooking, whereas gas is barely used on a daily basis, but is often kept as a backup fuel.

In the Langa and Guguletu sample the perceptions of cooking are different from those in Khayelitsha. The interviewers have recorded the following notes:

- four households expressed having hot-plates but also use a primus to save electricity;
- "paraffin is used to cook umqusho" this is a dish of samp and mealies which must be cooked at low heat for many hours; and
- a person with gas suggested that it is cheap for cooking "whether we have electricity or not, I am certain my family is guaranteed a meal."

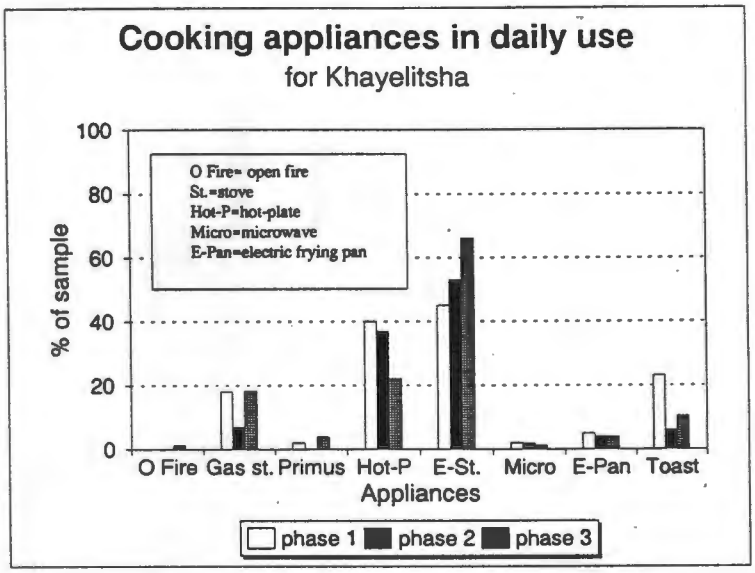
while others preferred electricity:

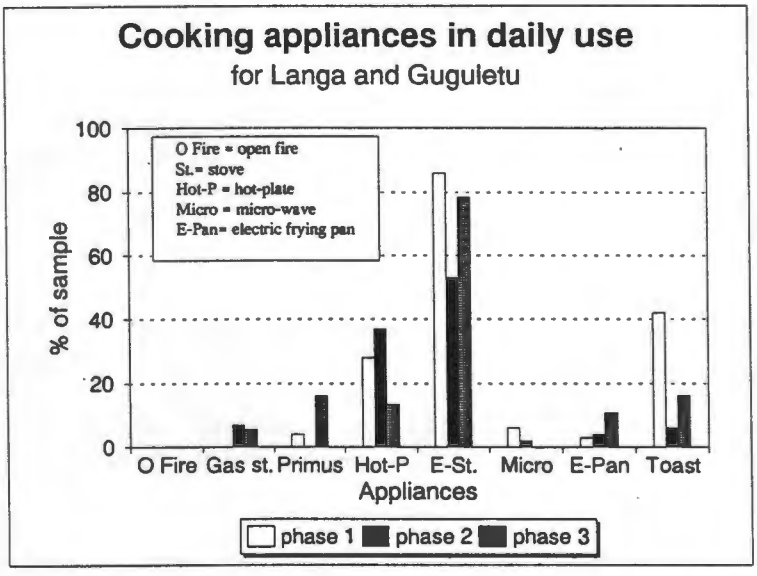
- found daily cooking with electricity cheaper; and
- one person owned an electric stove but only cooks on electricity in the weekend to save electricity (her household was in arrears on electricity payments.

Five respondents acknowledged that their socio-economic conditions were not such that they could afford the switch to electric cooking.

[1] In phase 2, only 3 respondents suggested that they intended to purchase electric stoves (Thorne and Theron 1993).

Figures 5.2a and b indicate fuels and appliances used daily for cooking in Khayelitsha and Langa and Guguletu respectively. Where similar data was available from previous phases, this is included to provide an idea of use trends.





FIGURES 5.2a and b Cooking appliances in daily use in Khayelitsha and Langa and Guguletu

Cooking appliance acquisitions

In both areas the most popular method of acquiring cooking appliances is by paying hire-purchase instalments on new appliances. In Langa and Guguletu nearly 70%, and in Khayelitsha near 50% of the cooking appliances were obtained in this way. In these areas 18 and 32% of the appliances were bought new for cash and 20 and 21% were bought second-hand for cash in the two areas respectively.

Figure 5.3 describes the method of appliance acquisition.

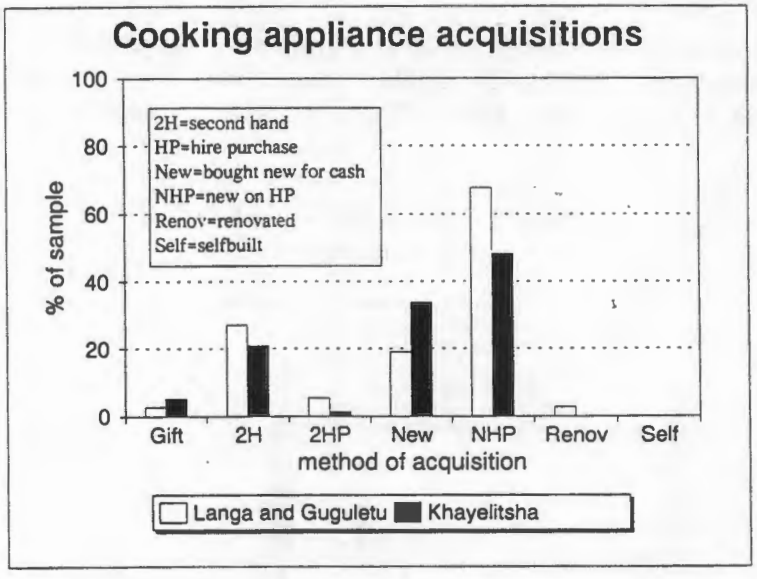


FIGURE 5.3 Cooking appliance acquisition methods in Khayelitsha and Langa and Guguletu

Reasons for cooking with different fuels

The third aspect of cooking which is considered here is why households chose to cook with gas, paraffin and/or electricity.

The case for electricity is clear. Of those cooking with electricity, more than 80% agree that cooking with this fuel is clean, reliable and safe. Fewer credit gas cooking with the same degree of cleanliness or reliability, and only 48% believe it to be safe. Those using paraffin show a the same trend, but with only 53% considering paraffin to be clean.

However, 100% of those cooking with paraffin, and over 80% of those cooking with gas believe it to be a cheap fuel - the figure for electricity is 27%. Likewise, 27% of those cooking on electricity, 55% of gas users, and 73% of those using paraffin give their reason for using the fuel/appliance combination as cheap appliances. 32% of those using electricity for cooking credit the multiple utility of electrical cooking as important, for gas only 13% credit this reason, and 67% of paraffin users.

Figure 5.4 summarises reasons for cooking using electricity, gas and paraffin.

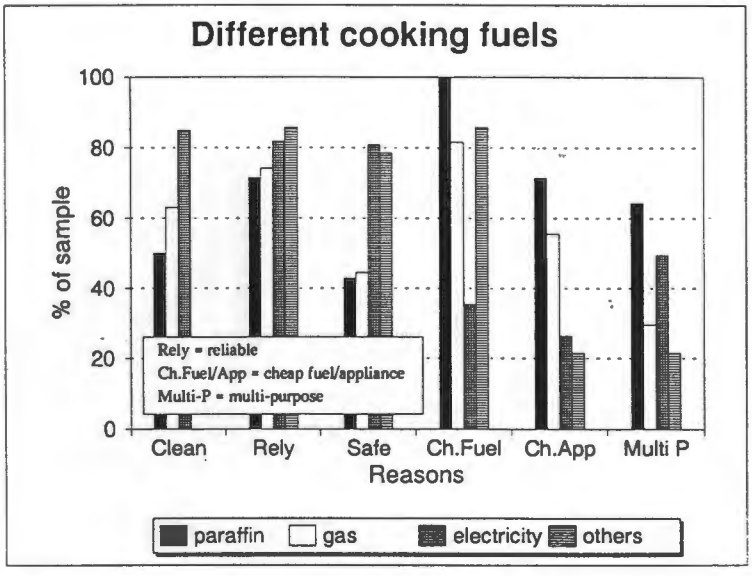


FIGURE 5.4 Reasons for cooking using electricity, gas (LPG) and paraffin

5.2.2 Space heating

As was the case with cooking, the respondents were requested to give details on how they fulfilled the space heating service within the household. They were then asked to provide information on the method by which they acquired heating appliances, the frequency of using this fuel and appliance combination and an indication of how they rated these fuel and appliance combinations.

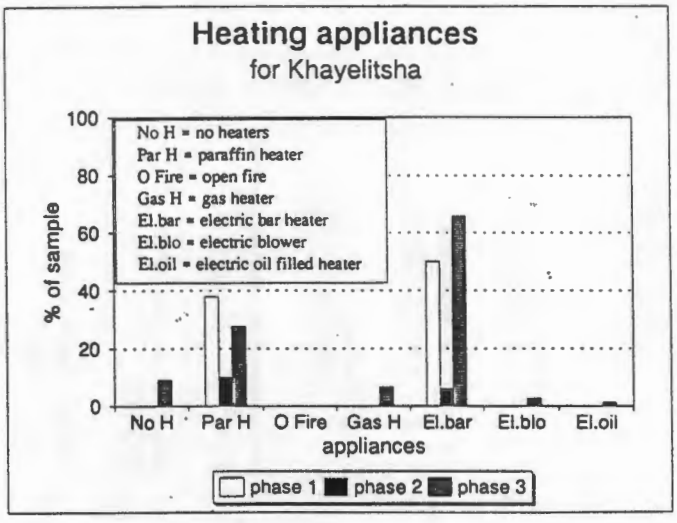
Space heating appliances in daily use

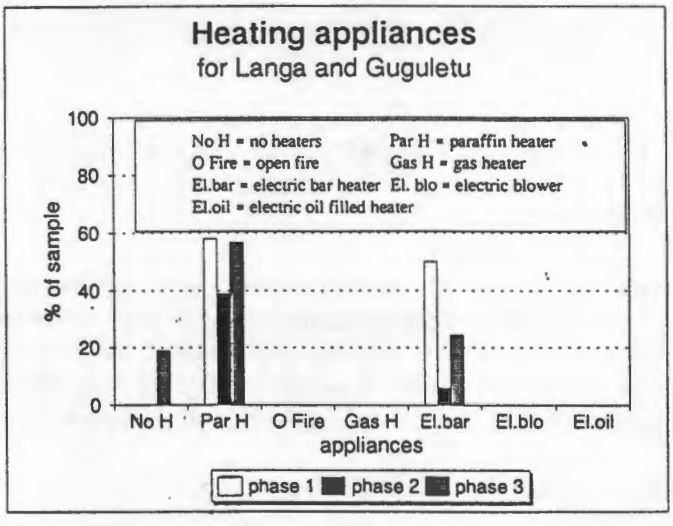
Most respondents suggested that they heat their homes in winter, while others heat the house when it is cold.

Electrical space heating appliances are becoming increasingly dominant in Khayelitsha. In phase 1, 50% and in phase 3 more than 70% of the sample there use this method of space heating. 96%, or nearly all, of these heaters are electric (radiant) bar heaters. Paraffin heaters have decreased in prominence from 38 to 28% of the sample. Gas heaters are used in about 8% of homes and about 10% use no space heating at all. Those who do not use space heating suggest that they cannot afford to, or their house is sufficiently heated by cooking activities.

In Langa and Guguletu the trends are opposite to those observed in Khayelitsha. Paraffin heating frequencies have remained fairly stable near 57% when phases 1 and 3 are compared, however the reduction in the number of electric heaters from 50 to 26% is noted. Nearly 20% of the sample do not use space heating.

The figures obtained in phase 3 have removed the picture of mass space heating "applicide" detected in the mostly summertime interviews of phase 2. Figures 5.5 a and b show the trends in heating appliance use for the three phases in Khayelitsha and Langa and Guguletu.





FIGURES 5.5a and b Space heating appliances in daily use in Khayelitsha and Langa and Guguletu

Space heating appliance acquisition

The most popular method of acquiring space heating appliances is by paying cash for these. In Khayelitsha nearly 55% of the households have acquired their heaters in this way, while in Langa and Guguletu 50% have done likewise. Heating appliances, as they are more moderately priced that stoves, are more likely to be affordable in first cost terms. However, 22 and 29% of the sample in Khayelitsha and Langa and Guguletu respectively new heaters for which instalments were arranged.

There appears to be a level of trade in second hand space heating appliances. Around 18% of the respondents in Khayelitsha and 10% of those in Langa and Guguletu, reported buying their appliances second hand. A few respondents received their heating appliances as gifts.

Figure 5.6 describes the methods by which households acquired space heaters in both areas.

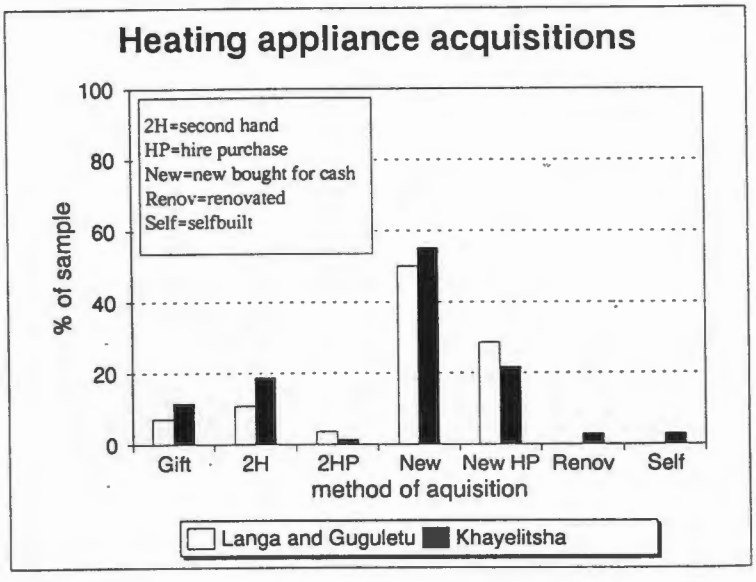


FIGURE 5.6 Space heating appliance acquisition methods in Khayelitsha and Langa and Guguletu

Reasons for heating space using different fuels

Space heating appliances in the areas under consideration were mainly fuelled with gas, paraffin and/or electricity. These are the same fuels as were used for cooking. However, an unexpectedly high number of households in both areas reported "no heaters". Unfortunately this response was not pursued to find out how members of these households handle the cold, this question should be followed in future phases.

As with cooking, the case for electrical space heating is clear. 80% and above suggest that electrical space heating is clean, reliable and safe. However, only 23% believe the fuel to be cheap. 50% agree that the electrical space heating appliances are cheap. Less than 10% think electrical space heating has multiple uses.

Paraffin fuel space heating has low ratings with respect to being clean and safe. Only 32% suggest that it is clean and 28%, safe. In terms of reliability, 57% agree that it is reliable. Paraffin is acknowledged by 94% to be a cheap fuel, 86% agree that the space heating appliance is cheap, and paraffin space heating is considered by 75% to provide multiple services if a primus stove is used.

Gas (LPG) provides space heating for only a few households in the sample. However, of those households which use it for space heating, 80% suggest it is clean and that the fuel is cheap. 60% say it is reliable and safe, while only 40% believe that the appliances are cheap.

Figure 5.7 summarise reasons for providing space heating using electricity, gas and paraffin.

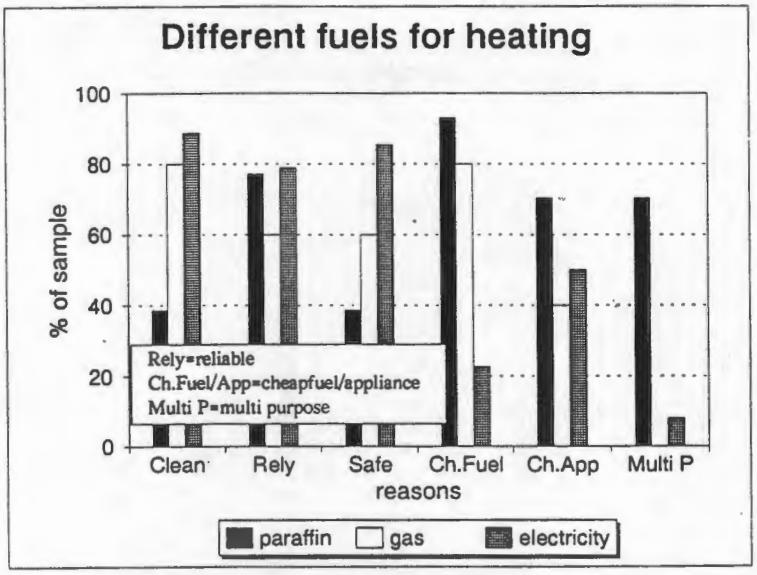


FIGURE 5.7 Reasons for space heating using electricity, gas (LPG) and paraffin

At present, Eskom is conducting an experiment with ten of the houses in the Khayelitsha sample to assess the (electrical) space heating response to having insulation installed above the ceiling. It this experiment, the electricity load, the indoor temperature and humidity are being monitored. The ambient temperature will be obtained from the local meteorological station. The study may also attempt to understand the socio-economic benefits of thermal efficiency to these households.

5.2.3 Water heating

Respondents were requested to give details on how they fulfilled the water heating service within the household. This included water heating for washing clothes, making beverages and for personal hygiene. They were then asked to provide information on the method by which they acquired the appliances used to warm/boil water, the frequency of the use of these fuels and appliances and to indicate how rated these were rated.

Water heating appliances in daily use

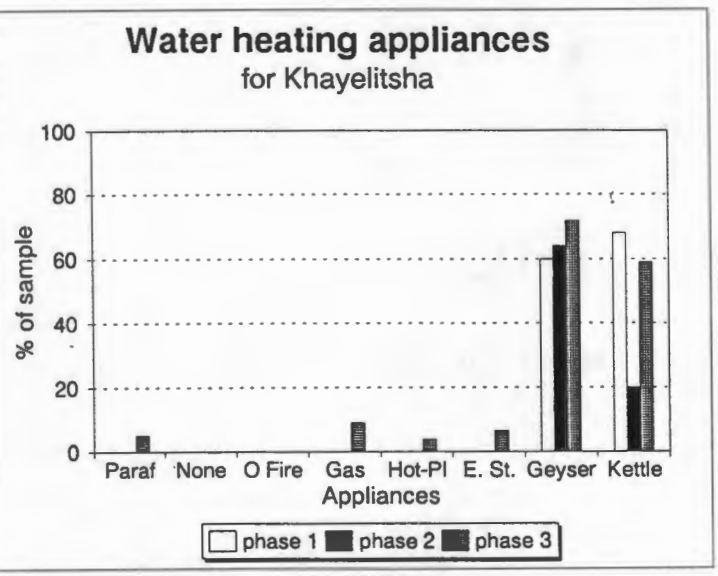
The recently built formal houses in Khayelitsha, with the exceptions of those houses built in Town 1 (the original "core" houses) and some instances in Town 2 villages 1 and 3, were constructed with built-in electric hot water storage geysers. In the first phase, 60% of the households had such installations, however since then a further 11% have achieved access to geysers; by phase 3, 71% of the respondents had geysers installed.

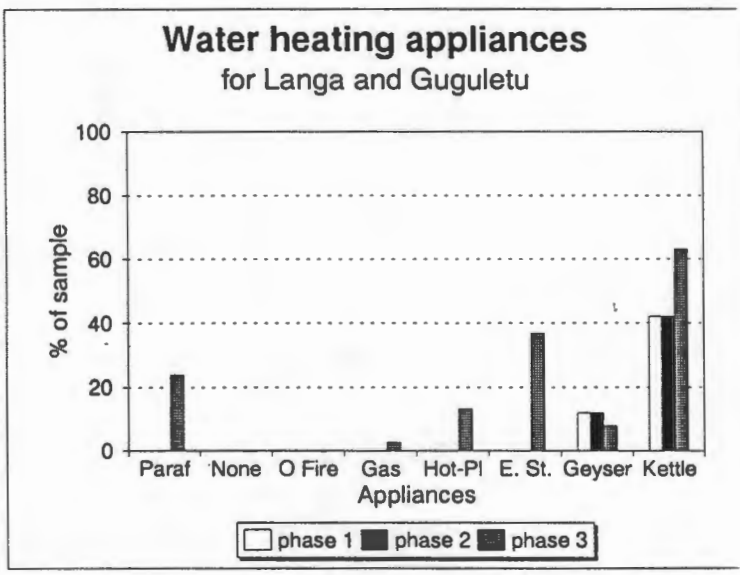
In phase 3, electric kettles were used by 60% of the households, down from the 69% who used them in phase 1. The remaining water heating is achieved through the use of water heating in pots on paraffin (6%), gas (9%), hot-plates (5%) and electric stoves (7%). In Khayelitsha, most of the people with geysers keep them on all the time, a few, however, only turn them on only in winter.

In Langa and Guguletu geysers were not installed at the time of construction, and few have been installed since then. Phase 3 reported 9% of respondents owning geysers, compared to 11% reported in phases 1 and 2. The bulk of the rest of the water heating is on paraffin stoves (25%) electric stoves (36%) and in kettles (64%). Kettle usage appears to be more popular in phase 3, as in phases 1 and 2 kettles were used by 43% of the households. The kettles, which some households refer to being turned on for much of the time, may be of an urn type equipped with a thermostat, but this was not confirmed through the questionnaire. The low occurrence of geysers in Langa and Guguletu, may account for the high interest in these appliances.

In Langa and Guguletu, the frequency of using hot water heaters is just over twice per day (once in the morning and once in the evening). The preference amongst those who use hot water once per day is in the mornings.

Figures 5.8a and b describe the ownership of water heating appliances in Khayelitsha and Langa and Guguletu.





FIGURES 5.8a and b Water heating appliances in daily use in Khayelitsha and Langa and Guguletu

Water heating appliance acquisitions

The most popular method of acquiring water heating appliances is by paying cash for these. In Khayelitsha 47% of the households have acquired their water heaters in this way, while in Langa and Guguletu 52% have done likewise. Hire purchase features as the second most popular manner for acquiring water heating appliances in both areas, and in Langa and Guguletu second-hand appliances were obtained by 26% of households.

The figures for Khayelitsha do not add up to 100% as some respondents had difficulty explaining how the geyser came with the house when they bought it. Others explained this method of acquisition as "new with instalments" or "new for cash". Figure 5.9 describes the methods by which households acquired water heaters in both areas.

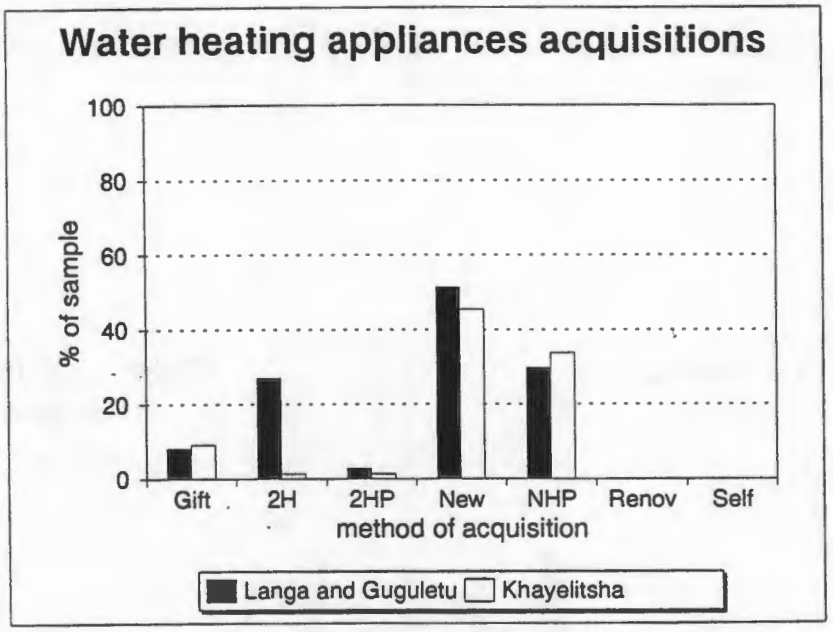


FIGURE 5.9 Water heating appliance acquisition methods in Khayelitsha and Langa and Guguletu

Reasons for heating water using different fuels

The fuels used to heat water in the areas under consideration were reported as being with gas, paraffin and/or electricity. These are the same fuels as were used for cooking and space heating. Those households using electricity are disaggregated into those using kettles and those using geysers.

As with cooking and space heating the patterns of rating preferences are similar. More than 80% of the respondents believe that paraffin and paraffin burning appliances are cheap, but while reliable (75%), and multi-purpose (57%) they are not favoured in terms of their safety (50%). Of the respondents using paraffin, 58% considered paraffin clean for heating water but less than 15% suggest that using paraffin is expensive in first-(appliance) and running (fuel) costs.

At the other extreme is heating water with an electric hot water storage geyser. This are considered to be clean (82%), reliable (98%), and safe (92%).

Kettles and gas stoves are rated similarly for water heating, being seen as clean reliable and safe. The difference is in the those who consider gas as cheap, whereas electricity is considered expensive.

Figure 5.10 summarises reasons for providing water heating using electric kettles and geysers, gas and paraffin.

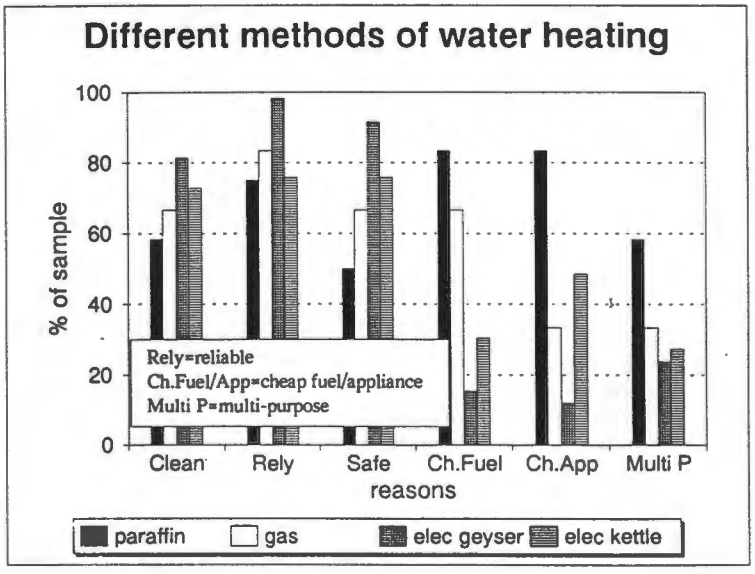


FIGURE 5.10 Reasons for water heating using electricity (geysers and kettles), gas (LPG) and paraffin

5.2.4 Lighting

Respondents were requested to give details on how they fulfilled the lighting requirements within the household. They were then asked to provide information on the method by which they acquired the appliances used to light their homes under normal and emergency conditions, the amount of time lighting was required and how they rated the lighting options which they used. In discussing the reasons for using electric lighting options, fluorescent lighting (where it was specifically referred to by the respondent) is discussed separately from other electric lighting options.

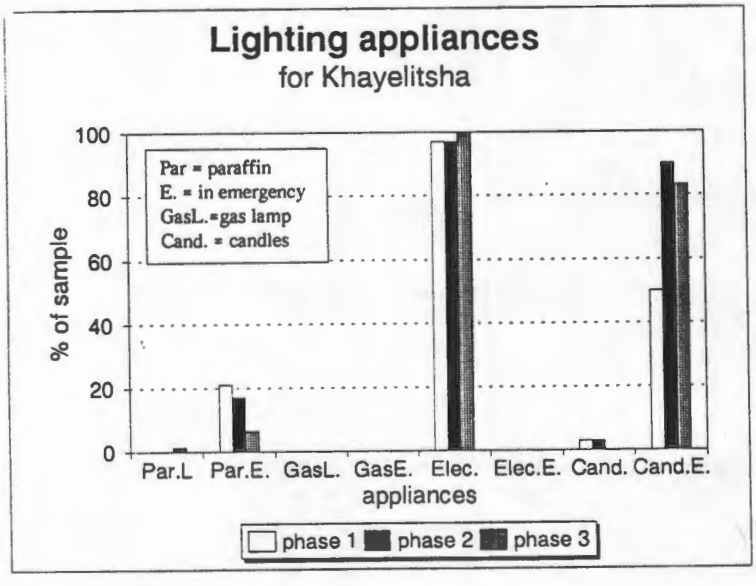
Lighting options in use

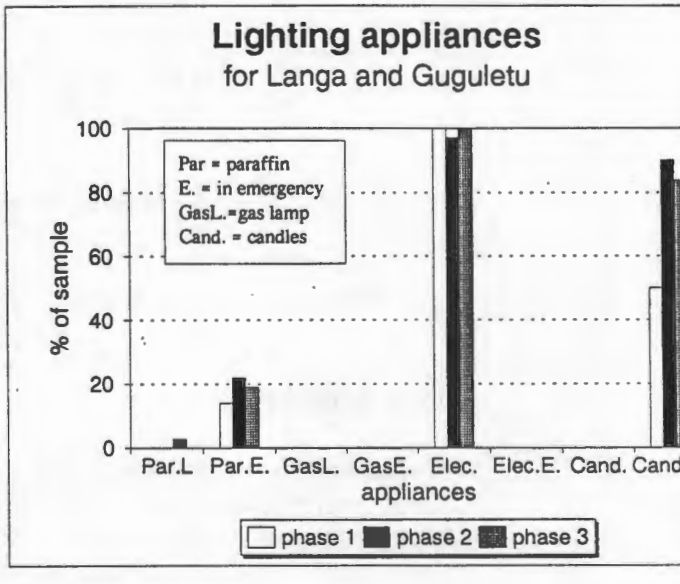
In Khayelitsha, all of the sample use electric lighting on a daily basis. Less than 3% use candles on a daily basis, and one household uses a paraffin lamp daily. Candles are the primary standby, with 83% of the households using them in cases of emergency. In phase 1, 50% of the sample, and in phase 2, 90% of the

sample used candles for emergencies.[2] The use of paraffin lamps in emergency situations has been reduced from 22% in phase 1 to 7% in phase 3. In Khayelitsha households use lighting for an average of 4.1 hours per night.

In Langa and Guguletu, all of the households use electricity for daily lighting requirements. One household uses a paraffin lamp on a daily basis for lighting, and 19% use it as an emergency lighting option. The proportion of households using candles for emergency lighting is identical to Khayelitsha, that is 83%. In Langa and Guguletu, respondents reported using electric lighting for 4.9 hours per night.

Figures 5.11 a and b describe the methods of lighting in Khayelitsha and Langa and Guguletu





FIGURES 5.11a and b Lighting in Khayelitsha and Langa and Guguletu

[2]The figures for lighting using candles and paraffin were not disaggregated between the two areas in phases 1 and 2.

Lighting appliance acquisitions

In Khayelitsha, nearly 90% of the sample bought their appliances new.

In Langa and Guguletu, 55% of households bought their appliances new, 28% suggest that they were gifts, and nearly 40% suggested that their lighting appliances were self-built. The gifts that was given may refer to the compact fluorescent light bulb that were given to respondents in the second phase. But the self-built answer is confusing. It could refer to the lamp stands and shades. Figure 5.12 describes the methods by which households acquired lighting appliances in both areas.

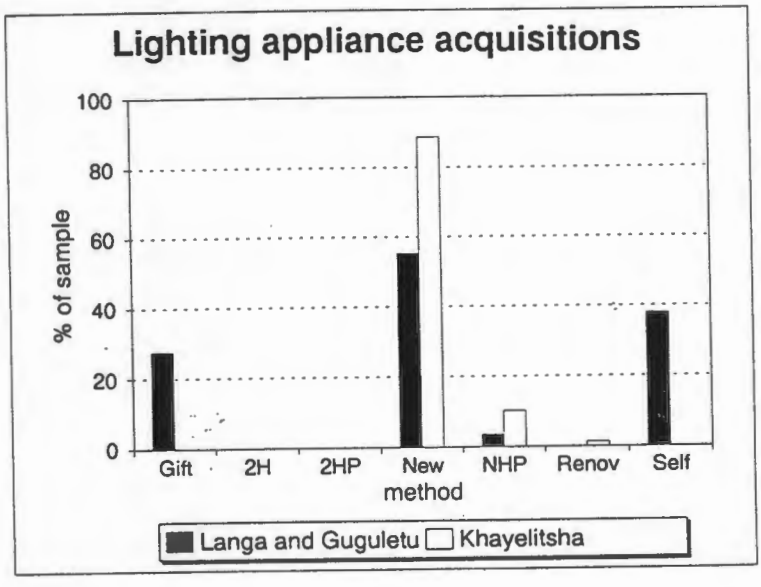


FIGURE 5.12 Lighting appliance acquisition methods in Khayelitsha and Langa and Guguletu

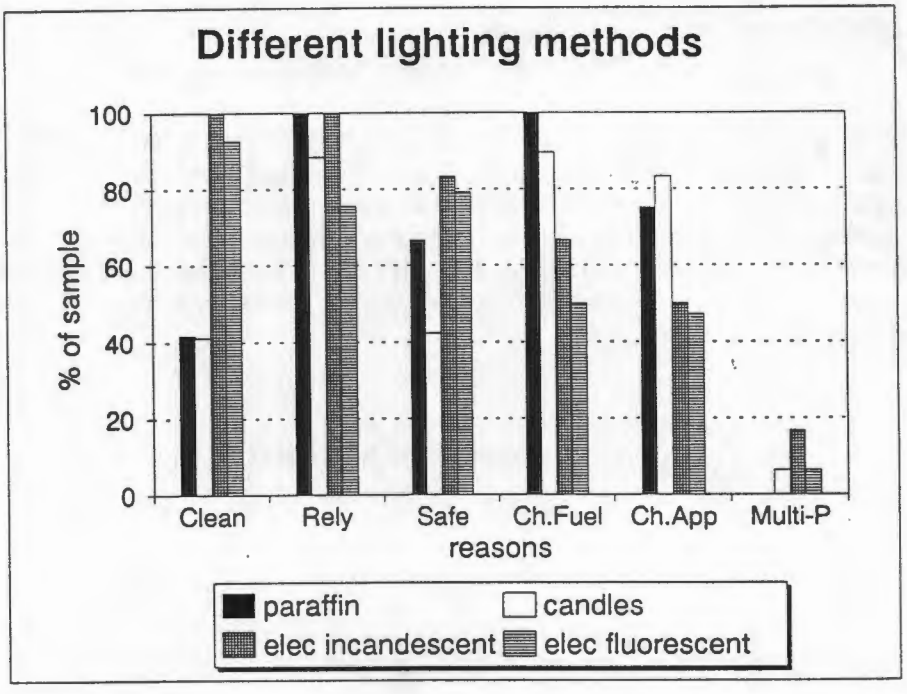
Reasons for using different lighting options

The reasons for choosing candles, electrical and paraffin lighting are discussed here. A few of the respondents specified fluorescent lighting and the reasons for using this type of electrical lighting is analysed separately from unspecified electrical lighting options. This latter category is referred to as incandescent lighting in what follows.

Electrical lighting is considered as clean by more than 90% of the sample. Fluorescent lighting is more reliable than incandescent. Both lighting options are considered to be safe (80%). Fewer respondents consider the fuel or the appliances to be cheap.

In contrast with electric lighting neither candles nor paraffin lamps are considered to be clean (40%), and candles (42%) less safe than paraffin (66%). The most popular reasons for using these appliances/fuels are that they are reliable, and the fuels and appliances are cheap.

Figure 5.13 summarise reasons for using the different lighting options.



FIGURES 5.13 Reasons for using the different lighting options

5.2.5 Entertainment

Respondents were requested to give details on what energy sources powered entertainment appliances. These were predominantly, radio, television (TV), hi-fis, and videos (VCRs). They were then asked to provide information on the method by which they acquired these "appliances", the daily duration these "appliances" were in use and how they rated the options which they used.

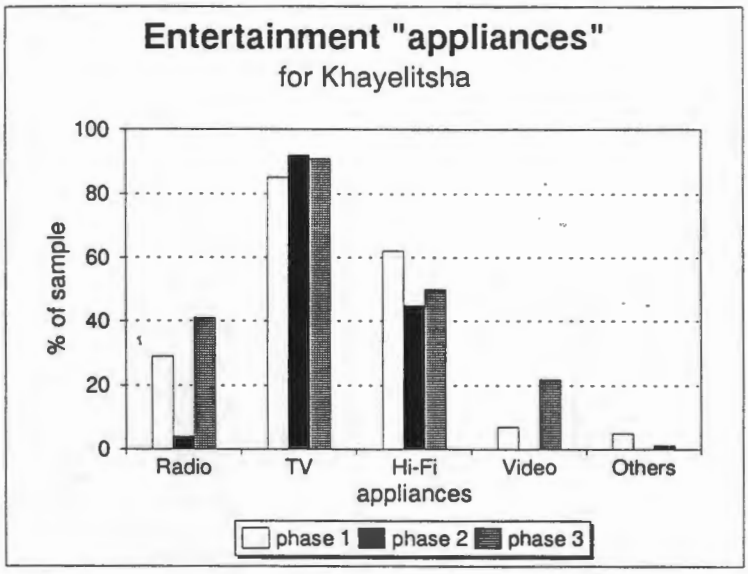
Entertainment "appliances" in use

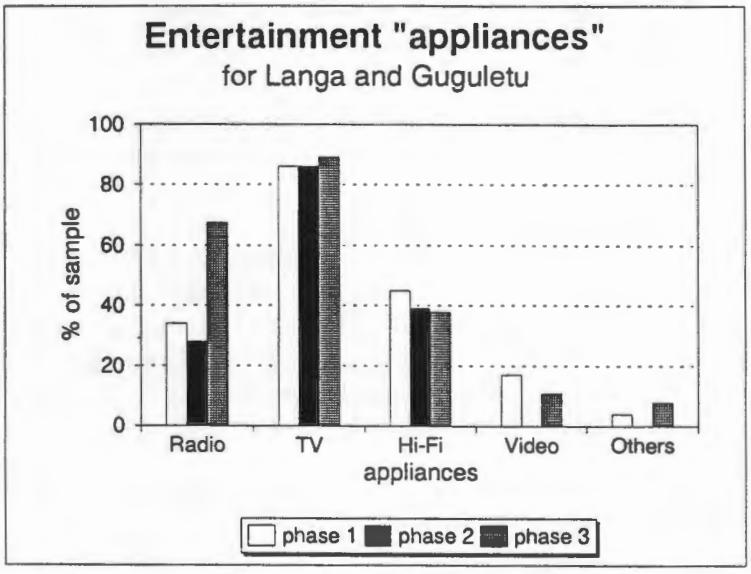
In Khayelitsha, radio ownership has grown from 29 to 42% between phases 1 and 3. TV ownership appears to be levelling off at 90% in phase 3 having been at 86 and 92% in phases 1 and 2. Hi-fi ownership has dropped from a high of 63% in phase 1 to 50% in phase 3. VCRs have increased in ownership from 7 to 23% between phase 1 and 3. Others which include TV games and M-Net decoders seem to enjoy a low level of ownership.

In Langa and Guguletu, radio ownership has increased from 33 to 68%, between phases 1 and 3. TV and hi-fi ownership appears to have levelled off at 90 and 37% respectively.

All of the modes of entertainment options described by respondents were electrically fuelled, and predominantly by grid electricity.

Figures 5.14 a and b describe the electrically fuelled entertainment modes in Khayelitsha and Langa and Guguletu.





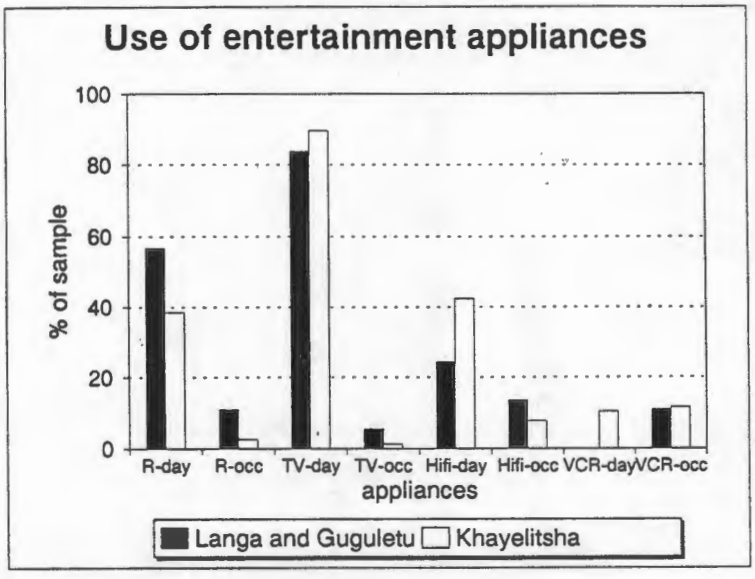
FIGURES 5.14a and b Entertainment in Khayelitsha and Langa and Guguletu

In Khayelitsha, respondents suggested that at least one of the entertainment appliances listed above was in use 6.5 hours of the day![3] Further they provided breakdowns of the use patterns of each of the appliances. All of the appliances (with the exception of VCRs) were used predominantly on a daily basis.

In Langa and Guguletu, households use at least one of these appliances on average for 5.7 hours of the day. The pattern described for Khayeltsha is replicated for the older areas, with the exception being that significantly more households owning radio, hi-fi and TVs use these appliances less frequently than daily.

Figure 5.15 describes the frequency of use of entertainment appliances.

[3] Some of the households reported using these appliances "all of the time" or "all day". In the average calculations these households were credited with 16 hours per day appliance use.



FIGURES 5.15 Use of entertainment appliances in Khayelitsha and Langa and Guguletu (R=radio, day=daily, and occ=occasional use)

Entertainment "appliance" acquisitions

The method by which the entertainment appliances were reportedly acquired was overwhelmingly through instalments paid for appliances bought new. In Khayelitsha this accounted for 77% of the acquisitions and in Langa and Guguletu 85%. For these same areas 23 and 14% of the appliances were bought new for cash respectively. Gifts and appliances bought second hand account for a further 15 to 20% of all households' reported transactions.

Figure 5.16 describes the methods by which households acquired entertainment appliances in both areas.

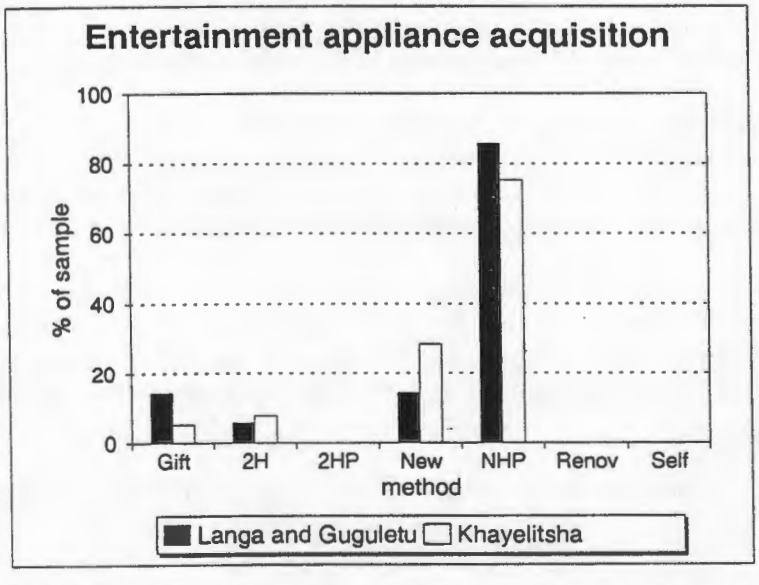


FIGURE 5.16 Entertainment appliance acquisition methods in Khayelitsha and Langa and Guguletu

Reasons for using entertainment appliance options

In all areas the electrically-fuelled appliances score well in terms of the cleanliness, reliability, safety and cheapness of appliances, all between 68 and 84%. The cheapness of the fuel is the reason given by only 28% of the households.

Of all the households visited two respondents reported using batteries for the appliances. One household was using the battery for a radio, and another reported using batteries for both their radio and TV.

Figure 5.17 summarise reasons for using the different entertainment options.

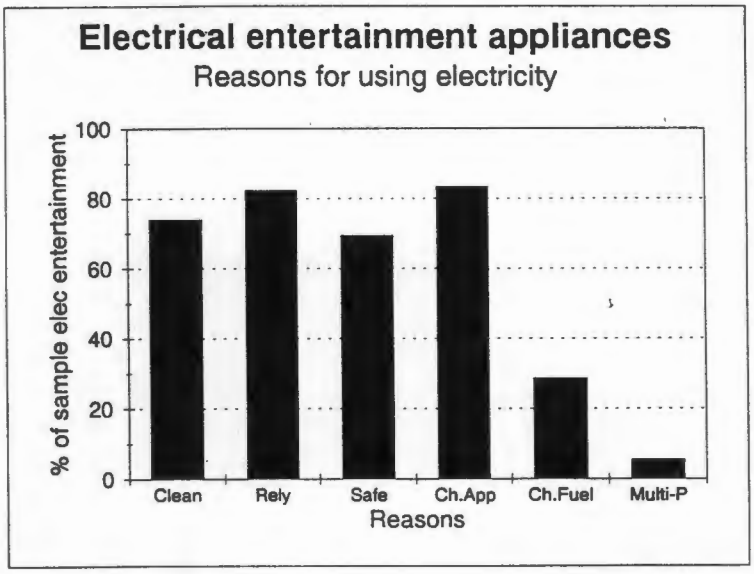


FIGURE 5.17 Reasons for using different entertainment options

5.2.6 Clothes washing

Respondents were requested to give details on how they fulfilled their clothes washing requirements within the household. The responses were predominantly that clothes washing was done by hand. How to handle this answer with respect to clothes washing - the energy service, was debated, however it was assumed that the households could have used warm water for this service and as such it could still be categorised as a household energy service. Few households owned washing machines, and those that did were then asked to provide information on the method by which they acquired these appliances. Households were asked about the frequency of clothes washing and how they rated the clothes washing options which they used.

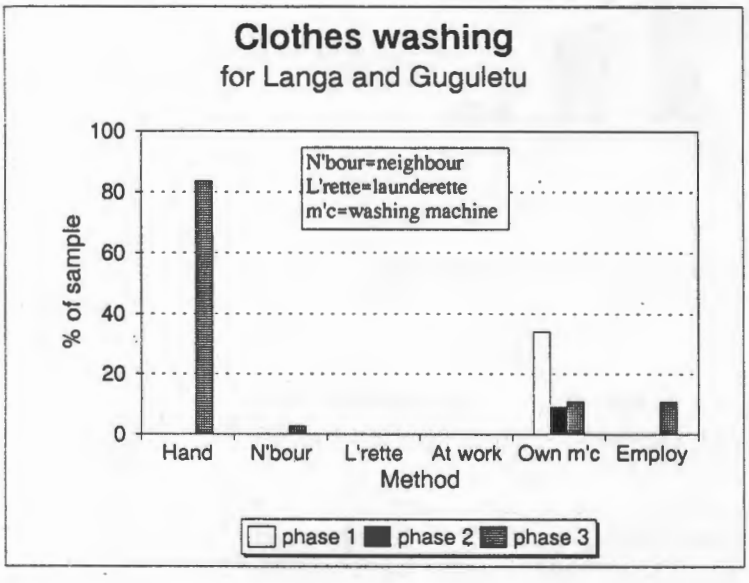
Clothes washing methods in use

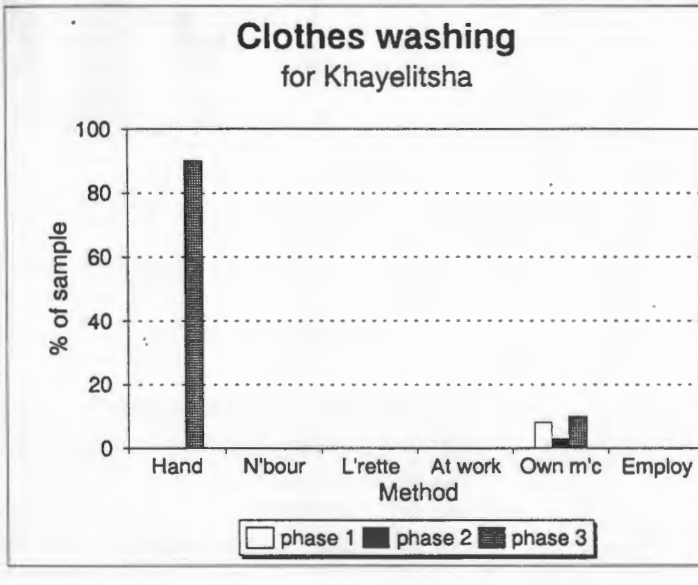
In Khayelitsha, nearly 90% of the households wash their clothes by hand. The remaining 10% use their own washing machines. Phase 1 of this study also reported 10% ownership of washing machines, revealing that there has been no increase in the ownership of these appliances. None of the households reported using their neighbour's washing machine, launderettes, doing their washing while at work, nor employing anyone else to wash the clothes for them.

In Langa and Guguletu a similar pattern was revealed to that in Khayelitsha. There, 84% of households in the sample suggested that they wash clothes by hand and 10% suggested that they used their own washing machine. This figure confirms the large decrease from phase 1 where a figure of 33% of households owning these appliances was recorded. 10% of the households employed people to wash their clothes and 1 household reported using their neighbour's washing machine. The reason for the rapid decrease between phase 1 and phases 2 and 3 in the number of washing machines in Langa and Guguletu, is not explainable from the data collected. It is for this reason that washing machine ownership data (as with electric heaters) should be treated with caution

In Khayelitsha for those that reported frequencies of clothes washing, the average was 2.1 times per week. This figure compares with the reported average frequency of 2.6 for Langa and Guguletu.

Figures 5.18 a and b describe the methods of washing clothes in Khayelitsha and Langa and Guguletu.





FIGURES 5.18a and b Clothes washing methods employed in Khayelitsha and Langa and Guguletu

Washing machine acquisitions

In Khayelitsha, 57% of the respondents reported that the method by which the washing machines were acquired was through paying instalments on a new machine. The remaining 43% acquired their's new for cash.

In Langa and Guguletu, of the four machines reportedly in use, one was bought new on an instalment agreement, one respondent did not reveal the method of acquisition, while the remaining two bought their's second hand for cash.

Figure 5.19 describes the methods by which households acquired washing machines in both areas.

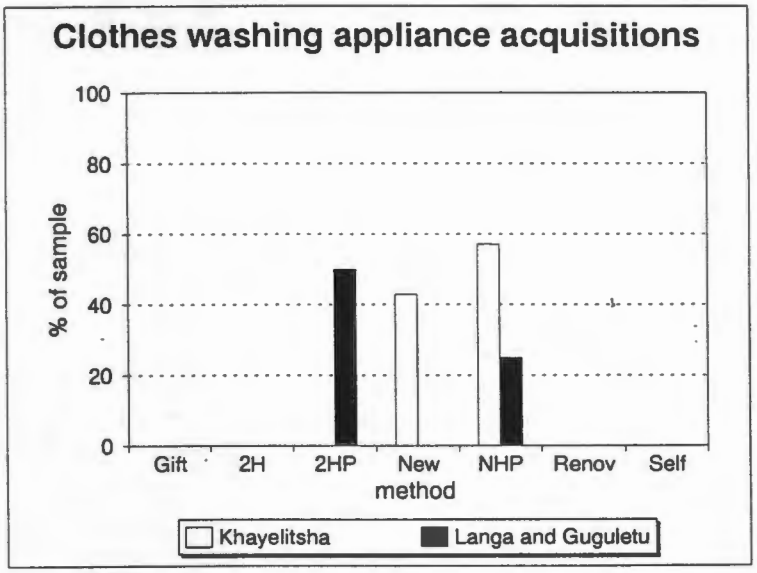


FIGURE 5.19 Washing machine acquisition methods in Khayelitsha and Langa and Guguletu

Reasons for using clothes washing techniques

The two methods of clothes washing which are compared here by hand, and using a washing machine. For both machines and hand, 86%, 100% and 88% of the households report cleanliness, reliability and safety as their reasons respectively. However, many more rate hand washing in terms of the cheap fuel, cheap appliances and the multi-utility of the washing as higher. Once again, if the appliance in question when hand washing is considered cannot surely be the person doing the washing, the bowl/tub in which the washing takes place can only be the appliance referred to by the respondents.

Figure 5.20 summarises reasons for using the two methods of hand washing.

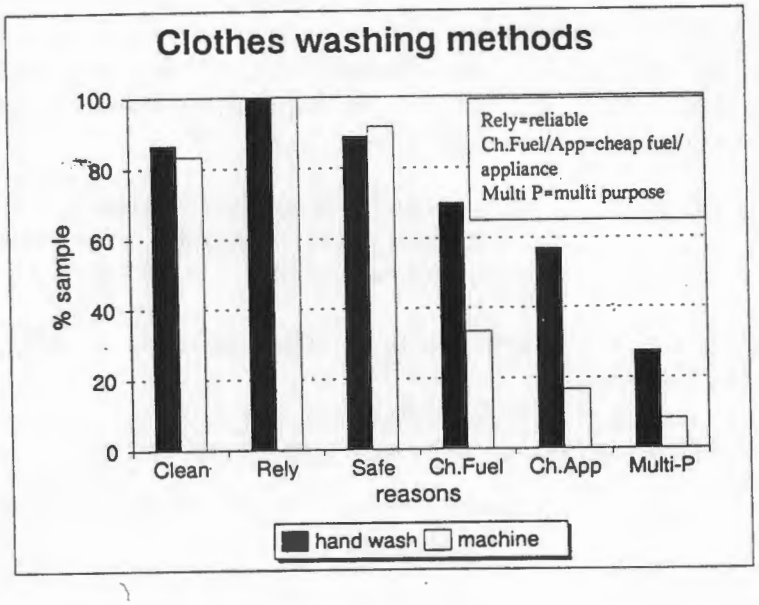


FIGURE 5.20 Reasons for using the different clothes washing options

5.2.7 Ironing

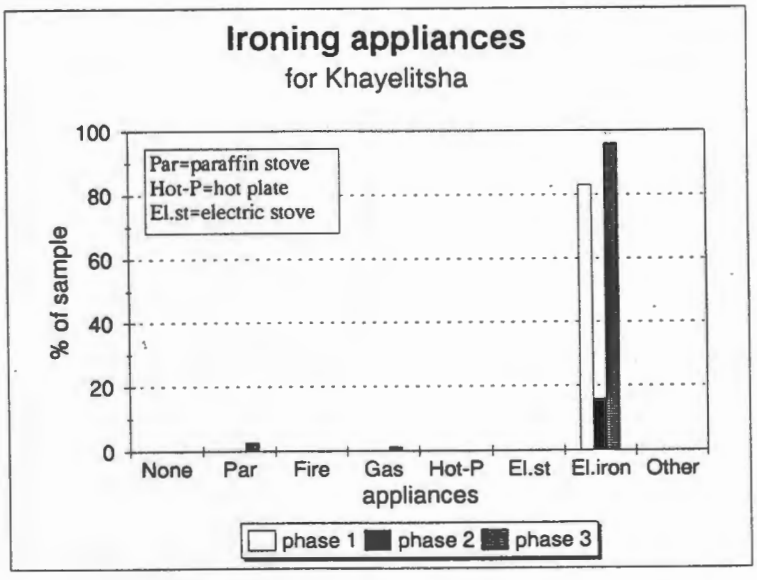
Respondents were requested to give details on how they ironed clothes within their household. The responses were predominantly that ironing is done using electricity, however other sources of heat, such as gas, paraffin and electric stoves were mentioned as the power sources. Households were asked to provide information on the method by which they acquired these appliances. Households were asked about the frequency of ironing and how they rated the options which they used.

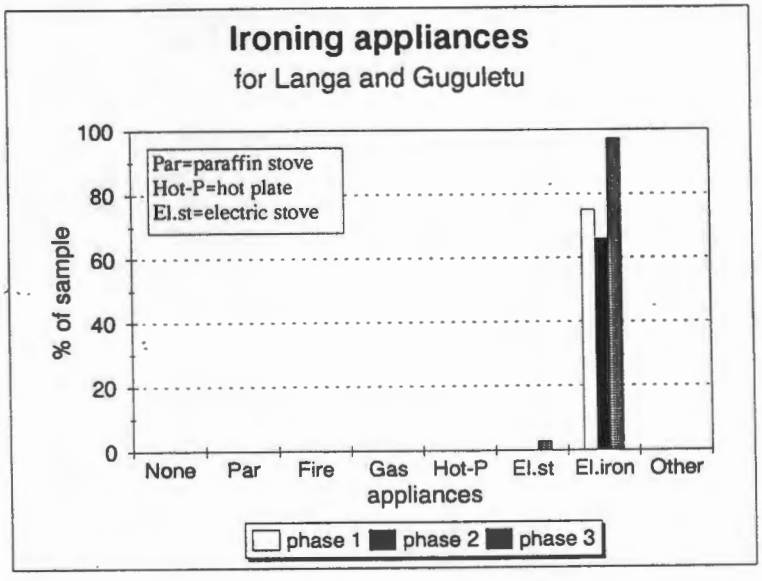
Ironing methods in use

Ironing, like the entertainment appliances is almost entirely fulfilled using grid electricity. In Khayelitsha, and likewise in Langa and Guguletu, 96% of the households use electricity for ironing, and in both cases this is up from the figures recorded in either of the previous two phases.

In Khayelitsha the frequency for ironing was 3.5 times per week, while in Langa and Guguletu, the average ironing frequency was 2.4 times per week.

Figures 5.21 a and b describes the appliances and methods used for ironing in the two areas.





FIGURES 5.21a and b Appliances and methods of ironing in Khayelitsha and Langa and Guguletu

Ironing appliance acquisitions

In Khayelitsha 76% of the irons were obtained new and bought for cash. 12% paid for their irons in installations while less than 8% acquired theirs second hand or as a gift.

In Langa and Guguletu the pattern is similar, with more households (87%) having bought their iron for cash. 9% obtained their by paying instalments, while less than 6% bought their's second hand or received theirs as a gift.

Figure 5.22 describes the methods by which ironing appliances were acquired.

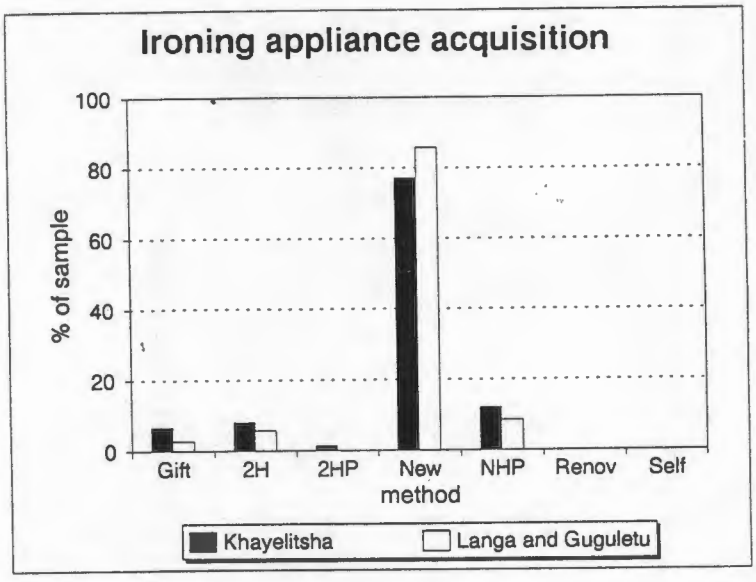


FIGURE 5.22 Methods of acquiring irons in Khayelitsha and Langa and Guguletu

Reasons for using different ironing options

Respondents who use electric irons cite cleanliness, reliability and safety (all above 80%) as the reasons for their choice of irons. There is little support for the cheapness of the fuel as a reason, while 50% agreed that the cheapness of the appliance was one of their reasons for using an electric iron.

In contrast the minority using paraffin and gas to heat solid metal irons gave their reasons for using these fuels to heat their irons as the cheapness of the fuel and appliances. Safety aspects are acknowledged by 66%, while 27% recognise the combinations' reliability, but none of the respondents could credit these methods with being clean. Figure 5.23 describes the reasons recorded above graphically.

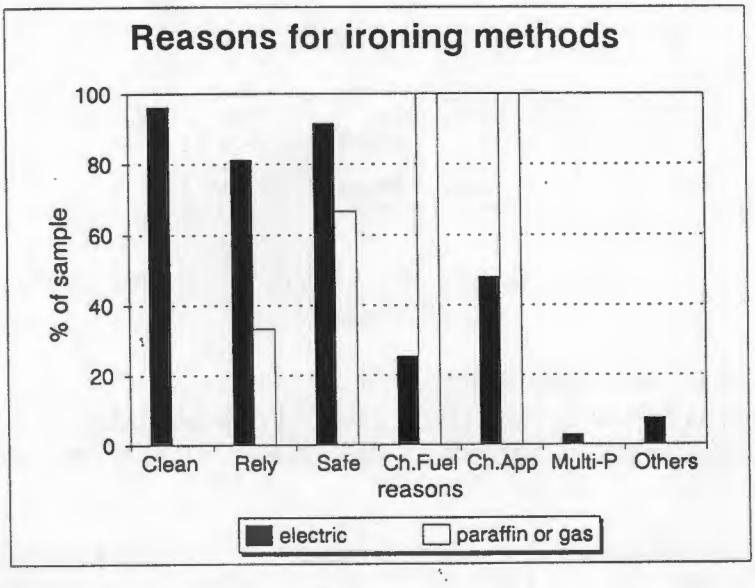


FIGURE 5.23 Reasons for using different ironing fuel and appliance combinations in all areas

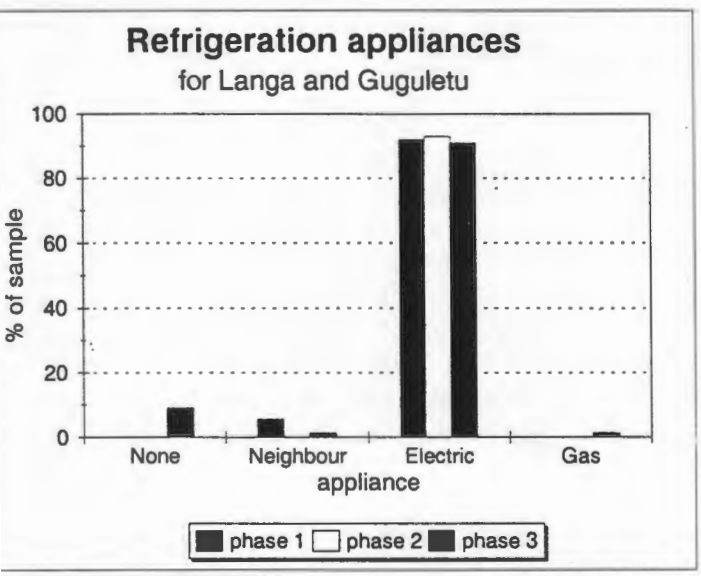
5.2.8 Refrigerating food

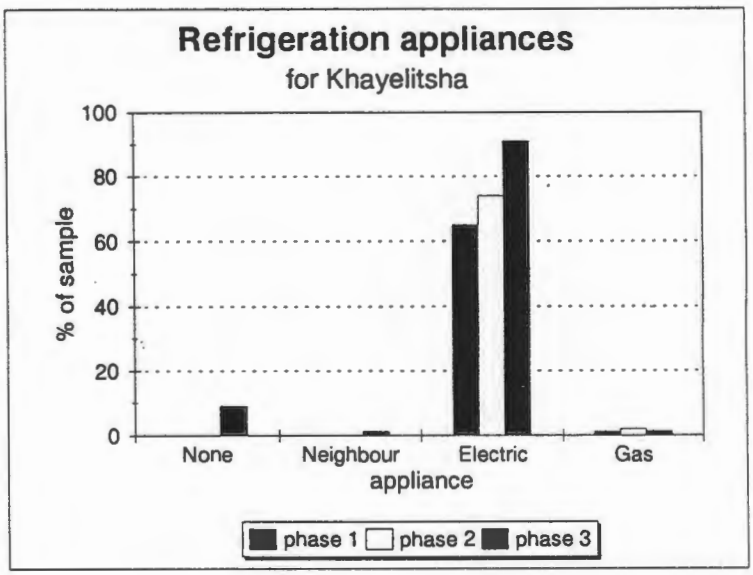
Respondents were requested to give details on how they fulfilled their refrigeration needs within their household. The responses were predominantly that refrigeration is accomplished using electricity. Households were asked to provide information on the method by which they acquired these appliances, and how they rated their refrigeration fuel and appliance combination which they used.

Refrigeration methods in use

In Khayelitsha there has been an increase in the number of refrigerators. In phase 1, the figure stood at 67%, by phase 2 ownership of electrical refrigerators had reached 72%. By phase 3, 89% owned electrical fridges, 2% gas, 2% used their neighbour's fridge and the remaining 8% owned no fridge, neither did they have access to one. In Langa and Guguletu the level of electric fridge ownership has remained constant over the three phases, between 88 and 90%. There is 1 household using a gas fridge and another using their neighbour's fridge. About 8% have no access to a refrigerator.

Figures 5.24 a and b describe the method and appliances used for refrigerating food in Khayelitsha and Langa and Guguletu.





FIGURES 5.24a and b Methods and appliances used to refrigerate food in Khayelitsha and Langa and Guguletu

Refrigeration appliance acquisitions

In Khayelitsha, 74% of the refrigerators were obtained new and paid for (or are being paid for) in instalments. About 13% were bought for cash. 10% bought their refrigerators second hand and 3% received theirs' as a gift.

In Langa and Guguletu the pattern is similar, with 74% of households having bought their fridge new on a hire-purchase agreement. None of the households bought theirs for cash, but nearly 27% bought fridges second hand, 20% for cash and 7% by paying instalments.

Figure 5.25 describes the methods by which refrigerators were acquired in both areas.

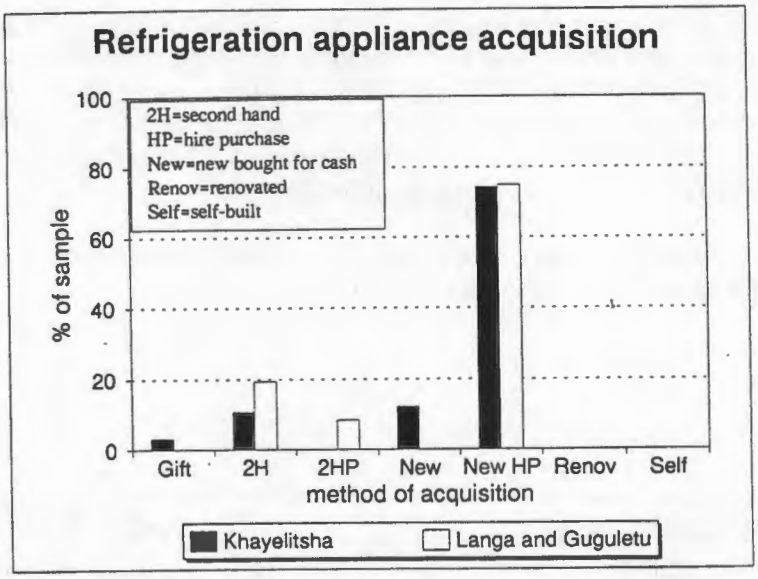


FIGURE 5.25 Methods of acquiring fridges in Khayelitsha and Langa and Guguletu

Reasons for using different refrigeration options

Only electrical fridges were considered in this section as the alternative appliances using different fuels were generally not in evidence in any of the areas being studied. Of all the electrical appliances, electrical refrigeration achieved the most acclaim in terms of saftey, cleanliness and reliability. More than 90% considered the combination to be safe, clean and reliable. While all of the sample using this combination agreed that it was clean, only 40% and 30% gave as their reason for using the fuel and apppliance combination that the fuel and appliances, respectively, were cheap.

Figure 5.26 describes the reasons for using electrical refrigeration.

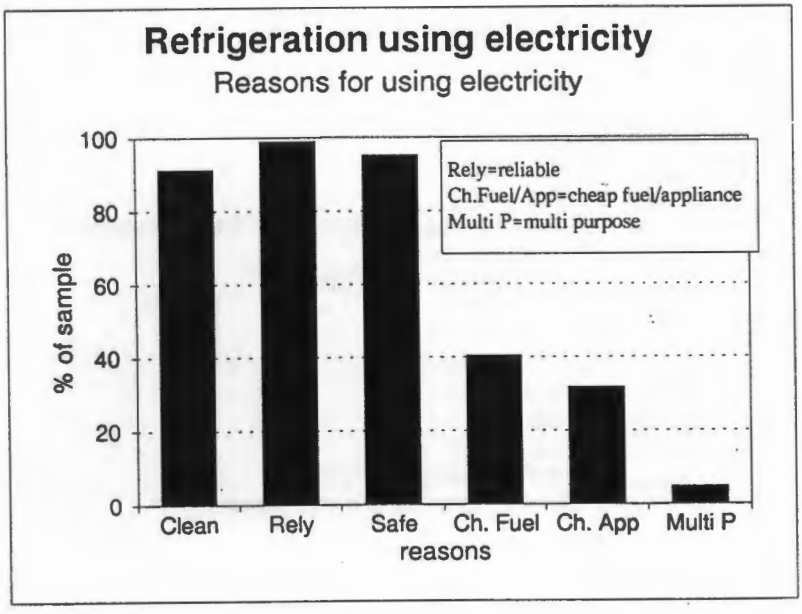


FIGURE 5.26 Reasons for using electrical refrigeration in Khayelitsha and Langa and Guguletu

5.3 Out-of-use appliances

In all areas covered in the study, households were questioned about the appliances they used on a daily basis, those that were used occasionally and those which were considered out-of-order, but which were still kept.

42 appliances were reported as being out-of-order, yet still kept by the household. Of these appliances, all but two of them were non-electrical appliances; a gas lamp and paraffin heater. The rest were all electrical, and included notably 7 TVs, 5 irons, 4 kettles and 4 stoves. The respondents were not asked what they planned to do with these appliances, but it could be speculated that electrical appliances, which are not readily fixed without expertise, are kept in order to be fixed at some time in the future when the household can afford it. Likewise, the other non-electrical appliances, which are more easily understood are either more easily fixed by households, or are adjudged to have no salvage value, and are thrown out.

Figure 5.27 presents the full list and number of appliances reported to be out-of -order in the households visited in Khayelitsha and Langa and Guguletu.

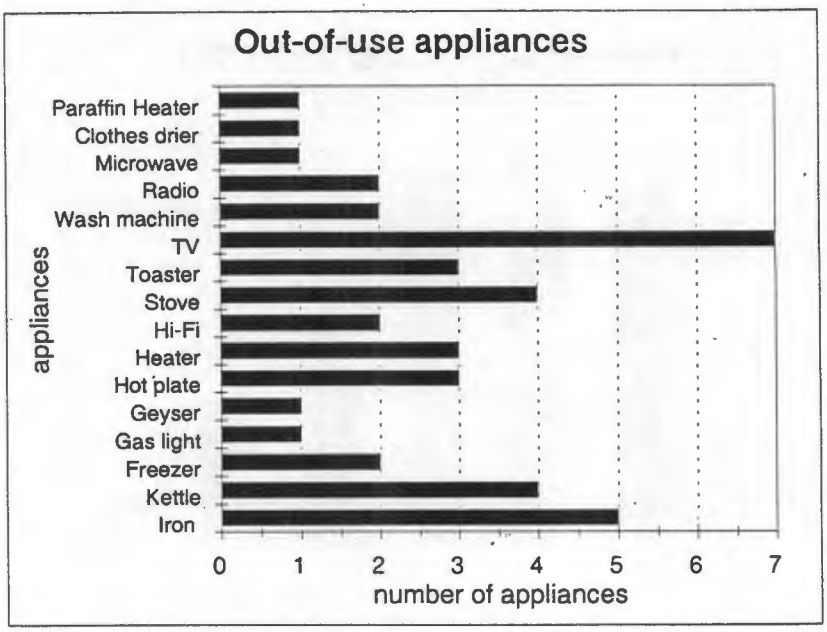


FIGURE 5.27 Out-of-use appliances in Khayelitsha and Langa and Guguletu

5.4 Fuels used

The selection criteria for selection of the survey sample was that homes were electrified. The conditions of access to electricity may have changed during the project, either permanently; as is the case with Mabe (questionnaire number 12), whose house has burned down, or in other instances where other reasons such as excessive arrears have resulted in disconnections (see table 3.1). However, despite the households all enjoying access to electricity, only 3.5% of the sample use electricity exclusively. The remaining households also use candles, paraffin, gas (LPG) and, in one case, wood. Figure 5.28 gives a breakdown of the portion of the sample which use different fuels in their household.

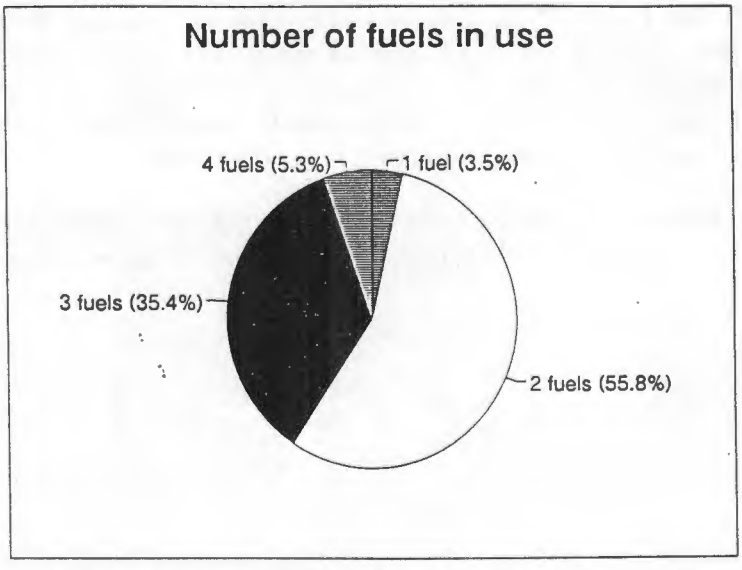


FIGURE 5.28 The number of fuels used by the sample

Amongst the sample all had access to electricity but three had been disconnected, 89 used candles, 42 paraffin and 35 LPG.

The average number of fuels in use was similar for the older and newer townships, with 2.4 fuels being used per household in both areas. This result is surprising from the "energy ladder" perspective, but entirely logical when the quality-of-service and affordable access appliances are considered. However, it confirms the need for multiple fuel information when consideration is given to energy information dissemination. It also contains some clues as to the preferences and perceptions of the reliability of the different fuels used within the household.

The reliability of the different fuels was tested in the questionnaire and the results, with particular reference to electricity, appear to mirror those of phase 2. In the older areas of Langa and Guguletu 69%, and in Khayelitsha 94% of the respondents considered electricity to be reliable. In contrast 71 and 33% of the respondents in the two areas respectively considered paraffin to be reliable. Amongst those using gas, it was surprisingly highly recommended in terms of its reliability, considering the concerns around safety which are often expressed. In the two areas 73 and 60% of the respondents considered it reliable. In both areas just over 60% considered candles reliable. Figure 5.29 describes the perceptions of reliability of fuels in the two areas.

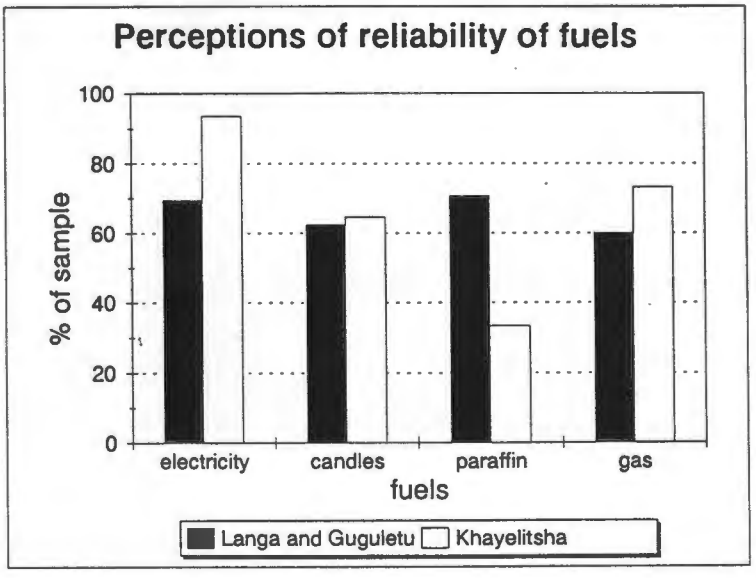
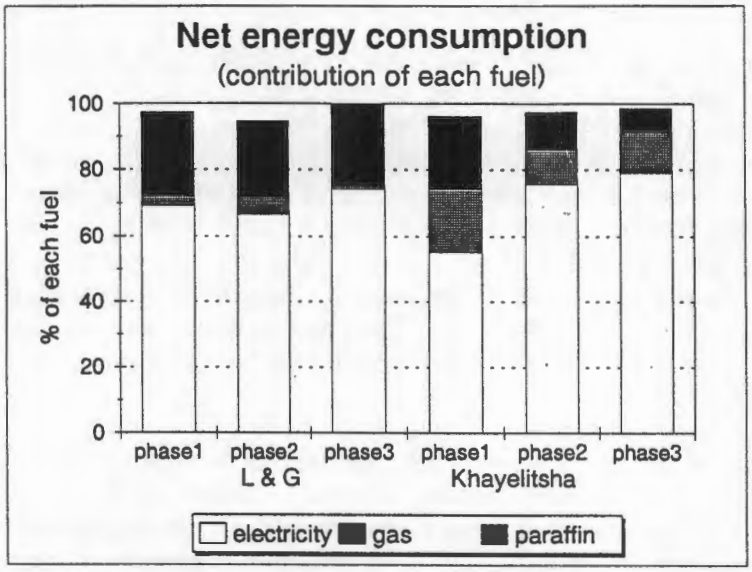


FIGURE 5.29 Perceptions of the reliability of fuels used in Khayelitsha and Langa and Guguletu

Despite 31% of the respondents considering electricity not to be reliable in Langa and Guguletu, and the positive perceptions of the respondents for paraffin and gas, only 5 of the sample of 115 considered electricity not to be their fuel preference. Households in Langa and Guguletu use on average nearly twice as much electricity as those in Khayelitsha (see chapter 3).

Figures 5.30 provides an illustration of what proportion of energy used in the household is sourced from each fuel in the two areas.



FIGURES 5.30 Proportion of net energy contributed by each fuel

From the figure it is apparent that the proportion of household energy sourced from electricity is growing in both areas, having reached 75% in phase 3 from 70% in phase 1 for Langa and Guguletu. In these older areas the contribution attributed to paraffin has remained constant at around 20%. In Khayelitsha the contribution of electricity has grown more noticeably from 55 to 78% between phases 1 and 3. Paraffin contributes about 5% and gas 12%. The remaining proportion of net energy comprises candles, batteries, and wood, which appear to be providing a decreasing proportion of the net energy in both areas.

5.5 Energy consumption

5.5.1 Net and useful energy consumption

Table 5.1 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.[4] The amount of other fuels consumed was recorded in the survey.

Average monthly electricity consumption in Langa and Guguletu is significantly higher than in Khayelitsha.

[4] It is necessary to point out that the amount consumed does not necessarily equal the amount paid for. Chapter 3 contains more information on the arrears situation.

TABLE 5.1 Monthly consumption of fuels

Fuel	Units	Whole sample			Langa and Guguletu			Khayelitsha		
Phases		1	2	3	1	2	3	1	2	3
Elec	kWh/month	421	377	370	632	520	577	344	313	271
Gas	kg/month	6.9	3.08	2.3	2.1	2.92	0.76	8.8	3.15	3.09
Paraffin	l/month	16.1	8.6	7.6	22.4	17.4	18.3	13.2	4.6	2.46
Wood	kg/month	3.0	3.4	0	3.5	7.9	0	2.5	1.3	0
Coal	kg/month	0.7	0	0	0.3	0	0	1.1	0	0
Car batt.	charges/month	0.5	0.02	0	0.7	0	0	0.4	0.03	0
Candles	packets/month	0.6	0.75	0.72	0.7	0.81	0.49	0.6	0.73	0.82

Table 5.2 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.

TABLE 5.2 Energy content of various 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

(Sources: Borchers et al (1991); Viljoen(1989))

Figure 5.31 shows the average monthly net energy consumption in the areas sampled.

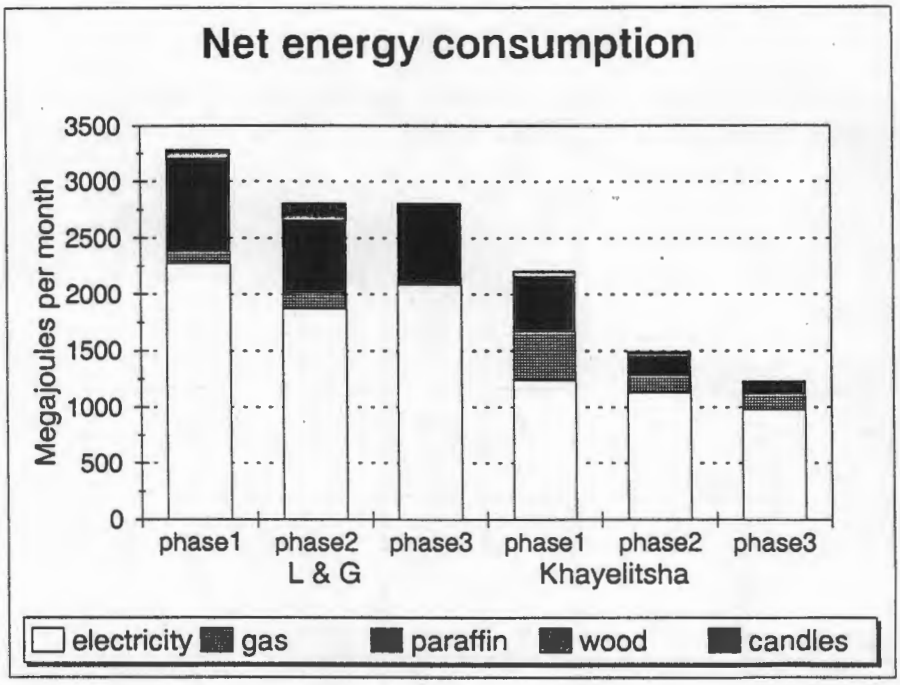


FIGURE 5.31 Average monthly net energy consumption

This figure also includes the net energy used in phases 1 and 2. In all areas between phases 1 and 2, there was a significant decrease in the net amount of energy consumed. In phase 3, while there was a continuation of this trend in the Khayelitsha sample (1 250 MJs), the net energy in Langa and Guguletu appeared to stabilise around 2 750 Megajoules per month per household (MJ/month). This data should be treated with caution as accurate non-electric fuel data is difficult to obtain. Methods which attempted to gain a longitudinal consumption data for non-electric fuels (see appendix A pages 23 to 24) used were not successful in this phase.

The major contribution to net energy consumption in both areas is the amount of electricity used. As seen in chapter 3, electricity consumption for the sample households has decreased in phases 2 and 3 from that recorded in phase 1. The possibilities of the extent of arrears affecting the consumption of electricity was examined in chapter 3; other possible determinants are explored in chapter 6.

What is obvious from the figure above is that the quantity of net energy in the form of paraffin and gas is decreasing.

Table 5.3 shows the conversion efficiencies assumed for cooking appliances using each of the fuels. These values were used to translate net energy used into the useful energy used.[5]

[5] The conversion factors are the same as have been used in the previous two phases and for consistency these were re-used in phase 3. For better representation of the possible efficiencies it is advised that minimum and maximum ranges are used (see Thorne 1994a).

TABLE 5.3 Conversion efficiencies for various appliances

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

(Source: Bennett (1977))

Figure 5.32 describes the trends in useful energy consumption per household per month. These figures were obtained using the efficiency of conversion between net (or delivered) energy and the cooking service (see table 5.3 above), and are therefore only approximations, as other services would have other energy conversion efficiencies.

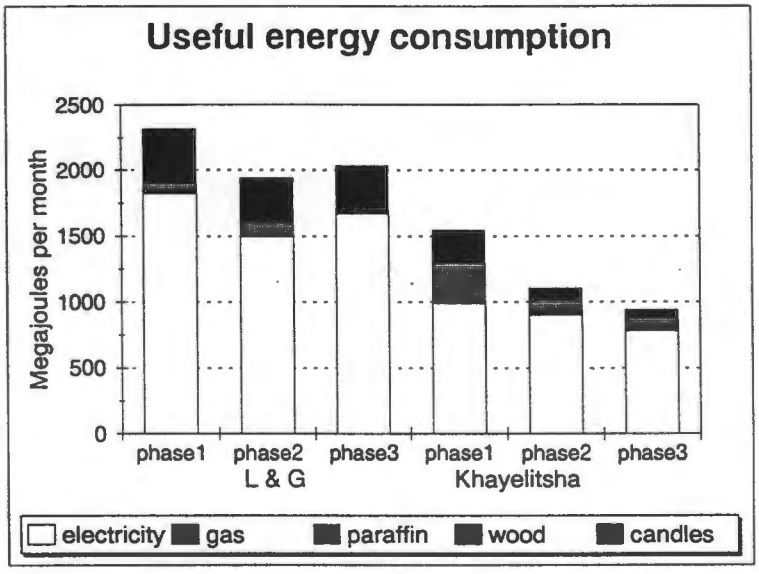


FIGURE 5.32 Average monthly useful energy consumption

Figure 5.32 shows the average monthly useful energy consumption in the areas sampled.

Useful consumption in Langa and Guguletu in phase 3 is once again higher (2100 MJ/month) than in Khayelitsha (950 MJ/month). There is a reduction in the useful household energy consumption in phases 1 and 2 for Khayelitsha from 1 553 to 1 105 MJ/month. For Langa and Guguletu the useful energy

consumption has increased over that measured in phase 2 (1 809 MJ/month), but still less than that recorded phase 1 (2 323 MJ/month). This implies reductions of 16 and 29% in useful energy consumption for the households in the two areas from phase 1 to 2, and an increase of 16 and decrease of 14% between phases 2 and 3 for the two areas respectively.

5.5.2 Per capita net and useful energy consumption

Figure 5.33 shows the average monthly useful per capita energy consumption in the areas surveyed from phase 1 to 3.

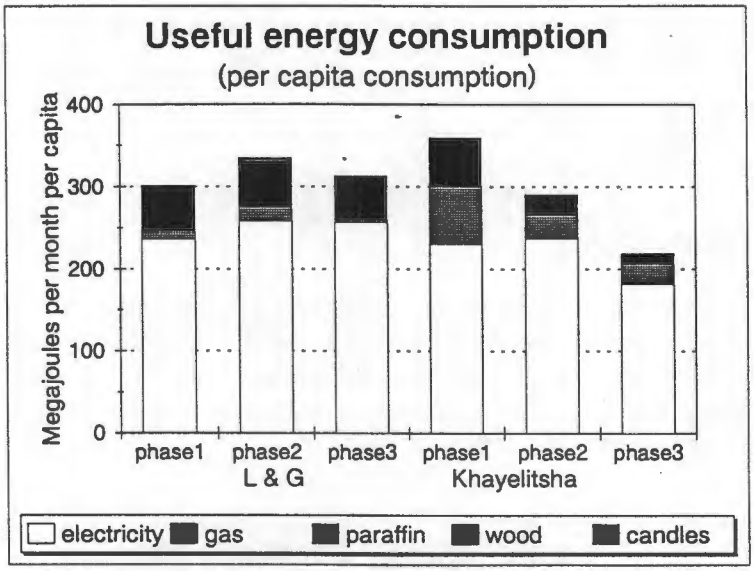


FIGURE 5.33 Average monthly per capita useful energy consumption

In phase 1, energy consumption per household in Langa and Guguletu was higher than in Khayelitsha, but energy consumption per capita was lower. In phase 2, the per capita net and useful energy consumption was lower than in phase 1. By phase 3, Langa and Guguletu had 315, as opposed to the 220 MJ/month per capita in Khayelitsha.

5.6 The costs of the fuels used

This section examines the contribution of different fuels to household energy expenditure. Included are the following:

- fuel prices in Langa and Guguletu and Khayelitsha;
- average monthly energy service costs in the areas surveyed;
- the relationship between energy service costs and income levels; and
- the contributions of fuels to the household energy budget.

5.6.1 Fuel prices in the areas surveyed

Table 5.4 indicates the actual costs per unit of useful energy obtained from different fuel/appliance combinations. The useful energy for cooking using the different fuels are presented graphically in figures 5.33a and b. These figures were calculated using;

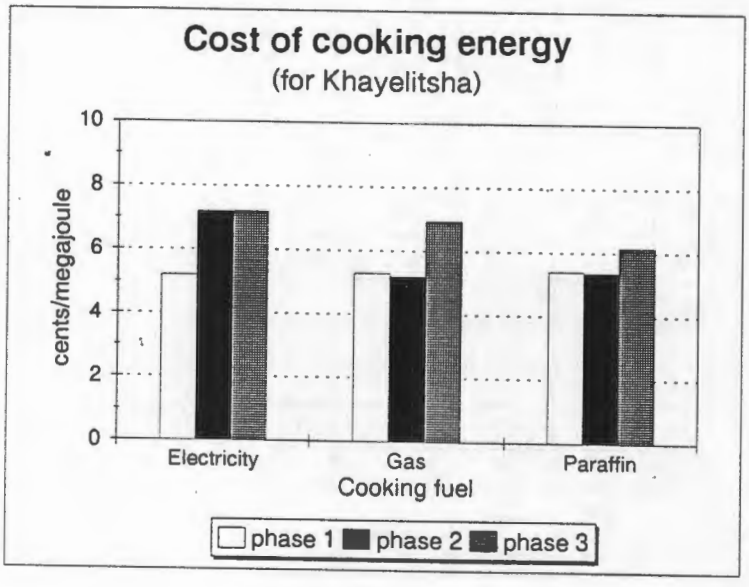
- the actual amount that households paid (or were charged) per litre, kg or kWh of paraffin, gas or electricity, (reported in the interviews[6]);
- average appliance efficiencies were used, as specified in table 5.3; and
- the calorific values of gas (per kg) and paraffin (per litre) included in table 5.2.

TABLE 5.4 Energy costs

Fuel	Unit	Khayelitsha			Langa and Guguletu		
PHYSICAL QUANTITIES							
phases		1	2	3	1	2	3
Elec. unit charge	c/kWh	15.00	20.7	19.88	10.53	16.7	16.72
Monthly fixed charge in bill	R	0.00	-	-	3.00	-	-
Ave. elec. cost	c/kWh	15.00	20.7	19.88	11.2	16.72	16.72
Gas	R/kg	1.8	1.77	2.38	2.4	1.59	2.97
Paraffin	R/l	1.00	.99	1.14	1.1	1.02	1.06
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	47	37	40	50
NET ENERGY COST							
Electricity	c/MJ	4.2	5.8	5.8	3.1	4.6	4.6
Gas	c/MJ	3.8	3.6	4.9	6.9	3.2	6.1
Paraffin	c/MJ	2.7	2.7	3.1	3.0	2.8	2.9
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	13.6	10.3	11.6	14.5
USEFUL ENERGY COST IN COOKING APPLIANCES							
Electricity	c/MJ	5.2	7.2	7.2	3.9	5.8	5.8
Gas	c/MJ	5.3	5.2	6.9	9.9	4.6	8.7
Paraffin	c/MJ	5.4	5.4	6.2	6.0	5.5	5.7
Wood	c/MJ	53	52	-	58	58	-
Coal	c/MJ	33	-	-	16	-	-
Car batteries	c/MJ	289	385	-	-	-	-
Candles	c/MJ	17	22	27.2	21	23	29

[6] The exception is in the price of electricity which was obtained from the distribution authorities in the areas sampled.

Please note that cooking using candles or car batteries as fuel sources is obviously spurious, but the in getting a sense of the cost per useful megajoule (as in table 5.4), cooking efficiencies were used. Figures 5.34 a and b describe the trends in the cost of the different fuels for cooking.



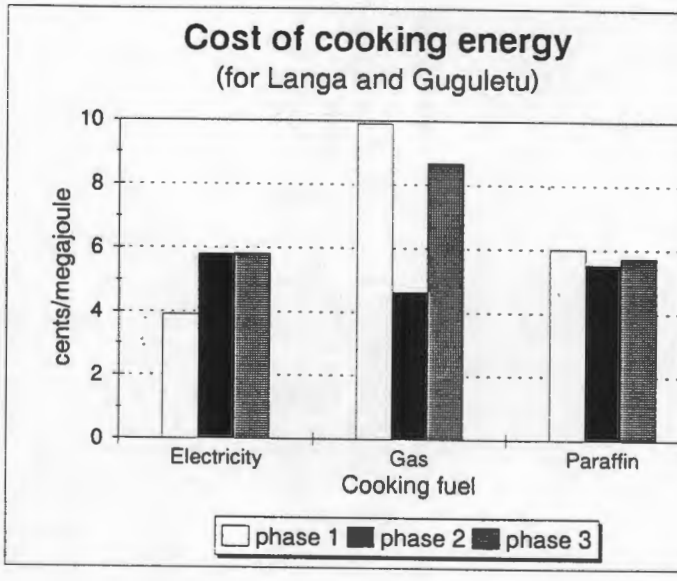


FIGURE 5.34a and b The cost of useful energy for cooking in Khayelitsha and Langa and Guguletu

In phase 1, electricity was shown to be the cheapest fuel for cooking (either on a full stove or a hot plate) both in Langa and Guguletu and in Khayelitsha. Phase 2 showed that while the nominal retail price of electricity has increased, it had decreased in the cases of paraffin and gas, making them both cheaper fuels for cooking than electricity in all the areas surveyed. Phase 3 provides evidence that in Langa and Guguletu, the cost of cooking using electricity is competitive with paraffin at 5.7 and 5.8 cents per useful megajoule respectively, while it is cheaper than gas, which is 8.7 cents per unit. In Khayelitsha the costs of gas and paraffin have increased, at the same time the price of electricity has remained stable. Cooking can be achieved at an estimated 7.2, 6.9, and 6.2 cents per useful megajoule, for electricity, gas and paraffin.

It is clear that in useful energy terms, electricity is more expensive than gas and paraffin in Khayelitsha. In Langa and Guguletu, with respect to cost alone, gas should be avoided, but electricity and paraffin are competitive. In phase 1, electricity was the cheapest fuel in both areas. The reversal was attributed to the increased price of electricity and the nominal decrease in the price of gas and paraffin in both areas. The large decrease in the gas price from R 2.4 to R 1.59, and the subsequent increase to R 2.97 per kilogram in Langa and Guguletu appears to be due to the limited number and decreasing use of gas amongst the sample. If the low use of gas in the sample reflects the tendency amongst the universe in these areas, the cost of supplying a minority fuel such as gas (which is not price regulated) could arguably affect the price per unit.

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

5.6.2 Real Average monthly energy costs

Figure 5.35 shows the real average monthly energy service costs for households from phase 1 through to phase 3. The figures include the costs related to the hire-purchase (HP) payments, but not cash costs for appliances. All figures are real, and have been reduced to 1991 Rands using the indices of 15% for 1992, and 10% for 1993.

Within the Khayelitsha sample, there was a decrease in nominal expenditure on energy services, between phase 1 and 2. The decrease was from R 151/month to R 84/month. In phase 3 the figure was up again to R 112/month. While the contribution of fuels has been decreasing in real terms since phase 1, the major variable in the data has been the cost of appliance hire-purchases to households. These have varied from R 71 to R 17 to R 63 per month from phase 1 to 3.

In Langa and Guguletu a similar trend was apparent between phases 1 and 2 with the reduction from R 122/month to R 108/month. However, in phase 3 the highest figure to date of R 143/month was recorded. In the case of Langa and Guguletu, the variations can be mostly attributed to the variation in monthly hire purchase instalments. The figures have been from R 20 to R 19 to R 60 per month from phase 1 to 3.

In phase 1, appliance purchases were clearly a priority for newly electrified residents in Khayelitsha. The somewhat unexpected decrease in these expenditures in phase 2, could have been attributed to the appliances having been paid off or repossessed. However, no information gathered in this survey can verify either of these assumptions.

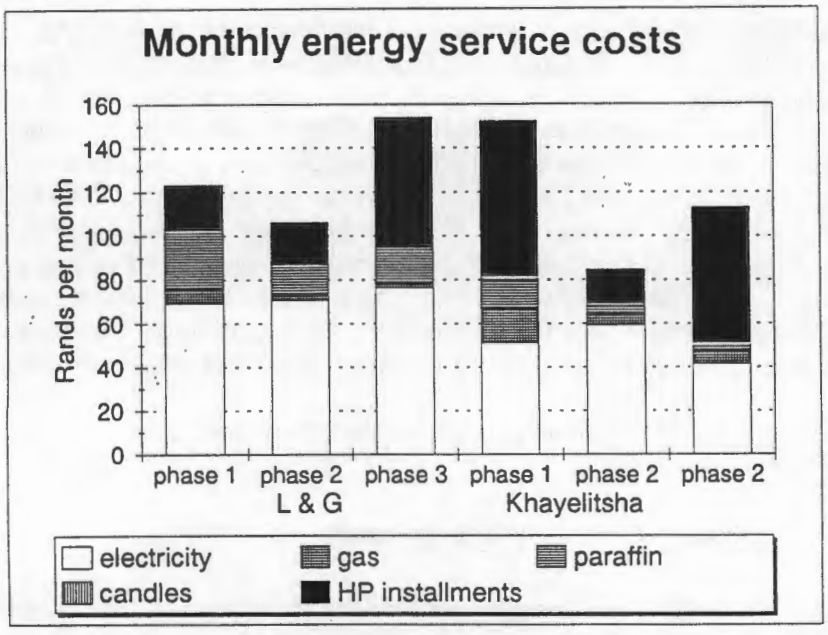
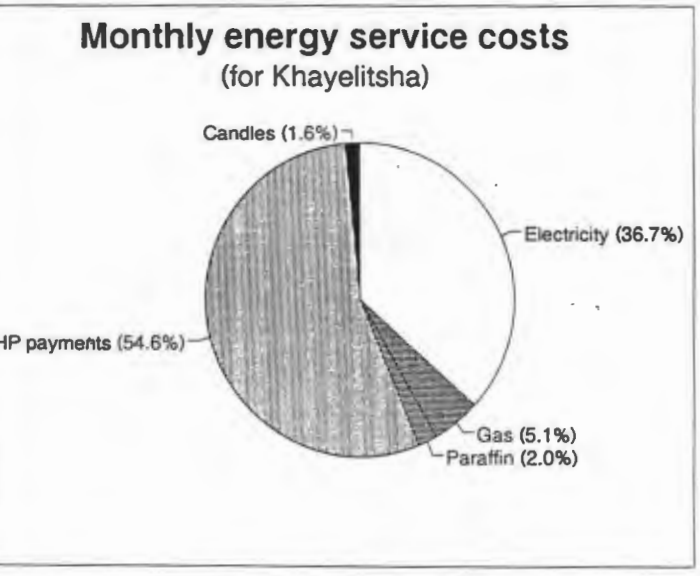
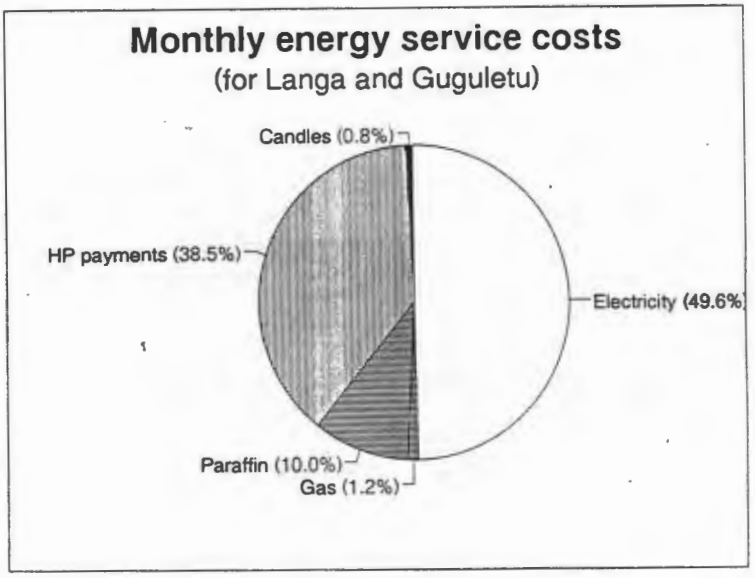


FIGURE 5.35 Average monthly energy costs

5.6.3 The relationship between household income and energy expenditure

Figures 5.36a and b show the percentage of income attributed to the different fuels and the hire-purchase instalments for Khayelitsha and Langa and Guguletu in phase 3. It is notable that with the exception of paraffin in Langa and Guguletu, which accounts for 10% of the energy service costs, hire-purchase instalments and electricity dominate energy service costs. In Khayelitsha these account for 55 and 37% of the costs, and Langa and Guguletu, 39 and 50% of the costs respectively.





FIGURES 5.36a and b Monthly energy service cost breakdowns for Khayelitsha and Langa and Guguletu

Figure 5.37 describes the relationship between expenditures and household incomes.

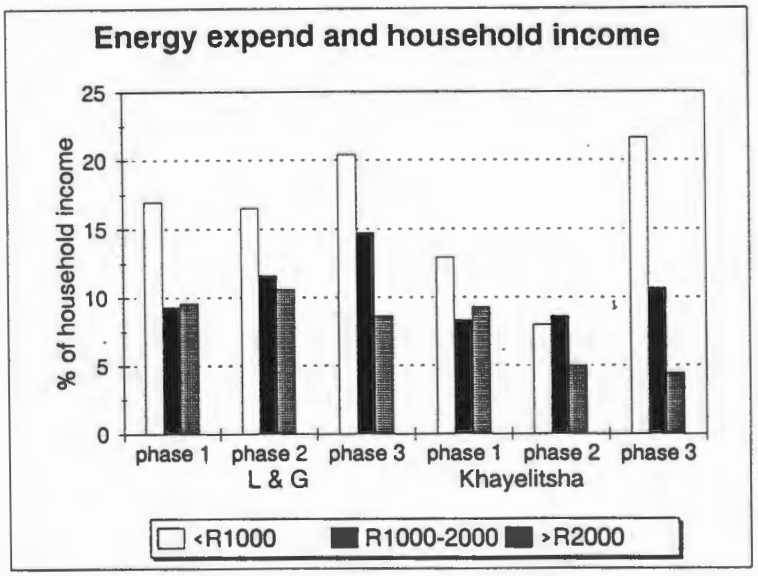


FIGURE 5.37 Energy expenditure by income group

In Khayelitsha, the phase 3 results suggest that 22% of the income of the poorest (below R 1 000 per month) is being used to satisfy household energy service needs. This is nearly double the figures in phases 1 and 2. In the highest income category, only 4% of the income is spent on fulfilling energy services.

In Langa and Guguletu, the percentage of energy related expenditure has grown in the two lower income categories, that is the category below R 1 000

per month and that between R 1 000 and R 2 000. In phase 3, 21 and 14.5% of household income in the lowest two categories was being spent on energy services there. In the highest income category, (above R 2 000), the energy expenditure reached 8% in phase 3, which is the lowest level of all three phases.

These results show that despite the decrease in the number of members of the household employed doing waged work and the decreasing frequency of incomes in the lowest income category (see chapter 4), the percentage of income allocated to energy service is increasing, indicating that the demand for energy services is inelastic with respect to income[7].

Income as a determinant of electricity consumption is further explored in chapter 6.

5.7 Conclusions

The chapter is divided into a number of sections which analyse different aspects of household energy services. The fuels and appliances used to fulfil the different household energy services, the out-of-use appliances, the fuels, net (delivered) and useful energy consumption, and the costs of the energy services. The proportions provided in the conclusions refer to the proportion of the sample utilising the energy service/fuel and appliance combination being described.

Energy services conclusions are:

- between 80 and 100% undertook: lighting, cooking, ironing, refrigeration, entertainment, water heating, and clothes washing;

cooking, space and water heating

- in Khayelitsha, there is a movement from cooking on hot-plates (22%) to cooking on stoves (66%), while in Langa and Guguletu, there appears to be an increase in daily cooking using paraffin (16%) but electric stove use is still high (77%);

- most cooking appliances are bought new on hire-purchase schemes (50 to 70%) while less (20 to 35%) are acquired new and second-hand (20 to 30%) for cash respectively;

- for the heavier thermal energy services (cooking, water and space heating), using electricity is preferable to LPG and paraffin in terms of cleanness and safety, but the latter are preferred to electricity when the cheapness of the fuels and appliances are considered. All fuels are considered as similarly reliable, gas is favoured above paraffin in terms of cleanness, and paraffin is the favourite multi-purpose fuel for these services;

[7] Elasticity refers to the degree to which money spent on one good or service can be transferred to others. In this case, energy services are a basic necessity, and money spent on these is not easily spent on other goods or services across the spectrum of incmes of the sample. Therefore energy services are considered inelastic with respect to income.

- in Khayelitsha there is increasing use of electric bar heaters (66%), and reduction in paraffin heating. In Langa and Guguletu space heating with paraffin (57%) is higher than heating with electricity (24%);

- most space heaters are bought new for cash (50 to 55%), fewer (less than 30%) bought heaters on hire purchase terms and (less than 20%) second hand;

- geysers are used for water heating by most Khayelitsha households (70%), while only a few have electric geysers in Langa and Guguletu (less than 10%). Water heating is achieved using stoves and kettles. Kettles are owned by (55 to 65%) of households;

- water heaters were acquired new (45 to 55%) and new on hire-purchase (30 to 35%), in Langa and Guguletu many (30%) bought their appliance second-hand;

lighting and entertainment

- all households in the sample use electricity for lighting, and most (more than 80%) use candles, and some paraffin (8 to 20%) as a back-up;

- lighting using paraffin and candles is not considered clean (40%), and candles are not considered safe (40%). Electric lighting is considered clean (90 to 100%) and electric fluorescent lighting (100%), reliable. Electric lighting is not considered cheap in terms of the fuel (50 to 70%) nor appliance (50%).

- all entertainment "appliances" are electrically powered. In Khayelitsha, these include TVs (90%), hi-fis (50%) and radio (40%), while in Langa and Guguletu these include TVs (90%), radio (70%) and hi-fis (40%);

- almost all entertainment appliances are acquired new on hire purchase terms (75 to 85%);

clothes washing, ironing and refrigeration

- almost all household wash clothes by hand (85 to 90%), with only a few owning washing machines (10%);

- almost all households use electric irons (more than 95%), most of which were purchased new for cash (75 to 90%);

- ownership of refrigerators is increasing in Khayelitsha (90%); the same number as are owned by those in Langa and Guguletu. In both areas there are households without their own fridge, or having access to their neighbours' fridge (10%);

- nearly all fridges are bought new on hire purchase terms (70 to 75%), while some are acquired second hand for cash (10 to 20%);

out-of-use appliances, number of fuels in use and their reliability

- 42 appliances (7 of which were TVs) amongst 115 households were found to be out-of-use, yet kept;

- only 3.5% of the sample use only electricity, most use 2 fuels (56%), others (35 and 5%) use 3 and 4 fuels concurrently;

- in Langa and Guguletu, respondents considered electricity to be as reliable as paraffin (70%). In Khayelitsha few (35%) considered paraffin to be reliable and nearly all (95%) considered electricity to be reliable.

energy consumption conclusions are:

- in Langa and Guguletu, net (delivered) energy has remained similar in phases 2 and 3 at 2750 MJ/household per month;

- in Khayelitsha, net (delivered) energy has decreased from 1500 to 1250 MJ/household per month in phases 2 to 3;

- in useful energy terms a slight increase between phases 2 and 3 is noticeable 1800 to 2100 MJ/household per month in Langa and Guguletu, and in Khayelitsha a decrease from 1100 to 900 MJ/household per month over the same period;

- there has been little variation in useful energy consumption per capita in Langa and Guguletu where consumption rose from 300 to 340 between phases 1 and 2 reaching 320 in phase 3. In Khayelitsha, it has dropped from 280 to 220 MJ/household per month from phases 2 to 3;

- the proportion of household energy in the form of electricity has increased over the period of the study, in Langa and Guguletu paraffin has remained stable and in Khayelitsha gas has made way for electricity;

cost of energy services:

- in Langa and Guguletu the cost of fuels required for cooking using electricity or paraffin is similar - near 6 cents/MJ, while gas costs more, at 8.6 cents.

- in Khayelitsha, the cost of cooking using electricity, gas or paraffin is similar between 6 and 7 cents/MJ;

- in 1991 Rands the average monthly amount spent on energy services in phase 3 was R 143 for Langa and Guguletu, of which 50% was on electricity, 39% hire purchase instalments and 10% paraffin;

- in 1991 Rands the average monthly amount spent on energy services in Khayelitsha during phase 3 was R 113, of which 55% was hire purchase on appliances, 37% on electricity, and 5% on gas;

- in all areas the fraction of income used to cover the provision of energy services has grown for the poorest category of households (income less than R 1 000) to a high in phase 3 of between 20 and 22%. For the highest income category of households earning more than R 2 000, that fraction spent on energy services has decreased to 8 and 4% for Langa and Guguletu and Khayelitsha respectively.

Chapter Six

DETERMINANTS OF ELECTRICITY USE

6.1 Introduction

The determinants of household electricity consumption have been the subject of much speculation locally and internationally (see Morojele 1994). Recent local interest has been driven primarily by the need to understand the financial viability of electrification programmes (or break-even in the case of Eskom's newly electrified S1 tariff customers). Financial viability is said to depend on the "rate of electricity consumption uptake", in other words, how quickly electricity a households consumption reaches a break-even point. The magical figure in the case of the Eskom S1 tariff has, until recently, been quoted as 350 kilowatthours per month.[1] However, this break-even figure is considered to be misleading, as it does not take account of the *demand* for electricity (Thorne 1994b).

Nevertheless, for electrification planning to be effective, determinants for electricity consumption and demand (electricity use) are important for electrification planning and the level of service that is required by households, that is: which areas should get access to electricity first, and how much should they get.

Workshops on the issue, attended by the authors, have provided more than 20 such determinants. However, there has not been much work done to unravel how these determinants affect one another. Beyond the crucial question of access to fuels, is household income - widely considered to be the most important determinant. But embedded within that determinant are many sub-determinants: for example if it is the person who cooks who also earns, he/she is likely to affect the choice of cooking fuel.

This chapter explores some of the many suspected determinants of electricity use, and where appropriate compares these to results of the previous phases.

The suspected determinants investigated are:

- income;
- household size;
- gender;
- business activities from home;
- the range of fuels in use;
- type of metering device;
- period of access to electricity;
- electricity quality-of-supply;
- major electricity consuming appliances in use, such as stoves, heaters, geysers, irons and refrigerators; and
- seasonal temperature fluctuations.

[1] A figure of 537 kilowatthours has recently been quoted as the updated figure. The increase is attributed to the previously underestimated service cost for pre-payment metering (Ligoff 1994).

The method by which these suspected determinants are explored is described below.

6.2 Methods for assessing determinants

Phase 3 of this study has, in most cases, assessed the aggregate data for all three areas (and the sub-areas, such as the towns and villages in Khayelitsha), as opposed to the very disaggregated data analysis conducted in the previous phases.

In most cases possible determinants were tested with respect to the average electricity consumptions in 1993 per sampled household in the areas under study. Using a spreadsheet software package *quatropro*, the possible determinants were evaluated through regression analysis. This provides the Y-intersect and the constant, which are plotted. Also revealed are is the variance or R-squared value, the squareroot of which indicates the degree of correlation between the independent variables (possible determinants) and the dependant variable (in this case average electricity consumption per household during 1993). Where the regression provided weak correlations (low *r* - or the Pearson Product-Moment Correlation) other methods were used to assess the correlation, one of which was grouping the data in ranges and then averaging the electricity consumption within those ranges. This method was used in phases 1 and 2 of the study.

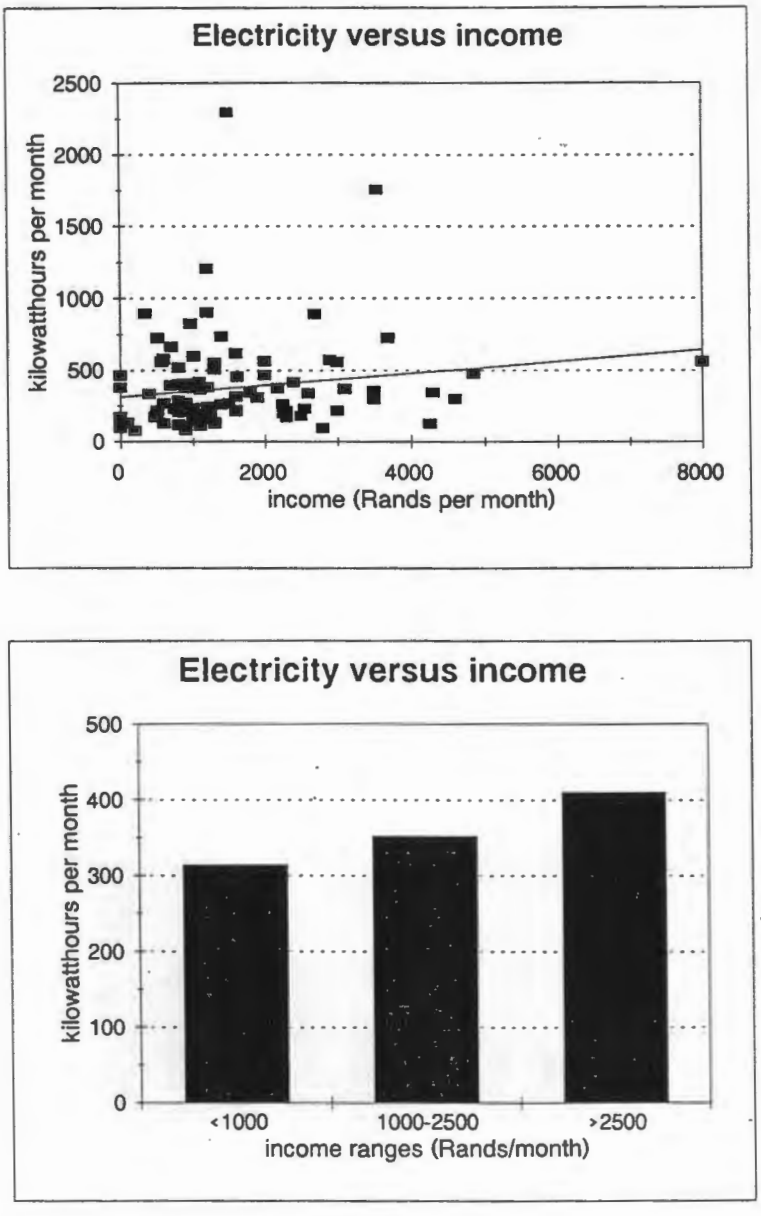
Most of the determinant analysis is done on the sample data, however in a few cases the universe of data (last explored in chapter 3) was used to assess some of the trends.

6.3 Socio-economic factors

6.3.1 Income

Income, along with "urbanisation", was suggested as one of the major determinants of electricity use in the study by Morojele (1994). Of course income would also influence the purchase of appliances and the affordability of thermal comfort, both of which will increase the demand and consumption of energy (unless insulation material or passive thermal design was utilised to increase thermal comfort).

However, a R-squared correlation of 0.025 was observed, this implies an *r* correlation of 0.16. Figures 6.1 a and b show the scatter plot, and the aggregated data of energy consumption for the groups of households earning less than R 1 000, R 1 000 to 2 500 and more than R 2 500 per month. Figure 6.1 b provides evidence that average electricity consumption increases with increasing income from 315 to 410 kilowatthours per month with the increasing income categories. Income can be considered a determinant of electricity use.

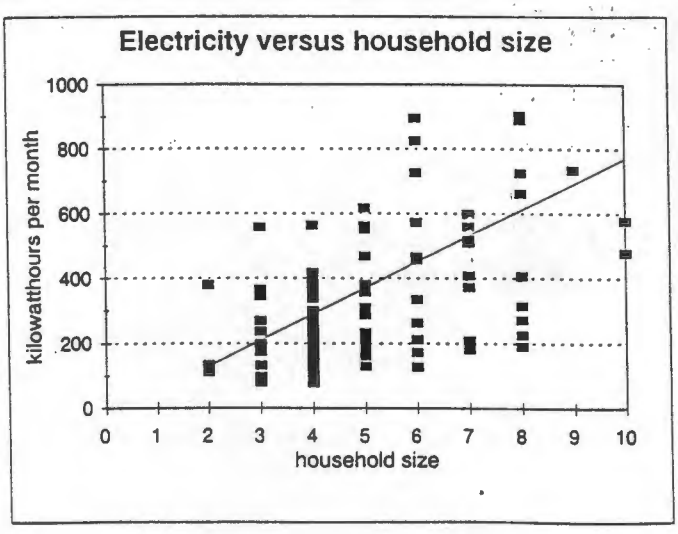


FIGURES 6.1 a and b The relationship between income and electricity use

6.3.2 Household size

In the third phase of the project, household size proved to have a stronger correlation with electricity use than in the previous two phases. The R-squared figure of 0.20 was obtained, implying an *r* correlation of 0.45. A plot was made to consider the averages for households with 2 to 9 or more members. A steadily increasing electricity consumption from 190 to 620 kWh per month for households of 2 to 7 members, was broken at 8, where 500 units per month was recorded as an average, before moving to nearly 900 units per month for households with 9 or more members.

The figures 6.2 a and b show clearly that electricity consumption increases with increasing household size. The trend in phase 3, as with the correlation with income, appears stronger than in the previous two phases.



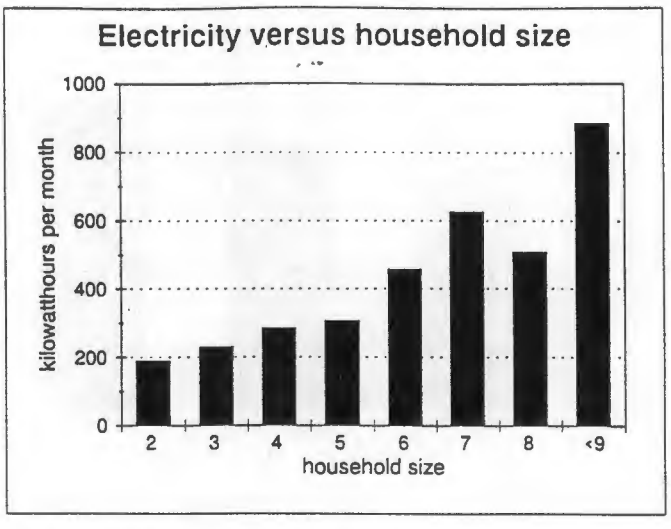


FIGURE 6.2 a and b Household size and electricity use

6.3.3 Gender

For the first time, phase 3 considered the role that the gender of the household head may have with respect to electricity use. The average monthly electricity consumption for households headed by men was 321 units. The figure for households headed by women was 466 kWh per month. The sample was further divided between household heads doing waged work and those not employed. Table 6.1 summarises the observations.

TABLE 6.1 Electricity consumption in female and male headed households

	male headed household	female headed households
waged work	298	493
not employed in waged work	388	438
average	321	466

From the figures it appears that gender may well play an important role in the use of electricity. However, why women headed households use more electricity was not explored in the survey. This aspect would need more detailed participatory research. The scope of phase 4 of this study incorporates such an emphasis.

The incomes, number of fuels, and the number of electrical appliances used, and the presence of electric stoves, electric heaters was investigated in relation to female headed households. Table 6.2 provides details of how the ownership was spread between the male and female headed households.

TABLE 6.2 Further figures on female and male headed households

	female headed households	male headed households
electric stoves used daily	73%	67%
electric heaters used daily	46%	55%
number of elec. appliances used daily	4.6	4.8
number of fuels used daily	2.5	2.4
household size	5.3	5.0
household income earned monthly	R 1 155	R 1 771

All the figures in table 6.2 point to female headed households using less electricity, other than a greater number of electric stoves used on a daily basis and the marginally higher household size. The electricity consumption therefore must be as a result of increased frequency or duration of use of electrical appliances. A surprising outcome is that the determinant of income is defied, or overridden in this comparison.

6.3.4 Businesses

Only 5 of the surveyed households were running businesses from home which used electricity. Of these businesses, 2 were shebeen/taverns, one a sewing enterprise, another a spaza, and the last sold paraffin, rented accommodation and provided transport! Other businesses included, TV sales and repairs, taxi

transport and an chicken and egg business. However, these businesses did not use electricity or were not based at the home. As with phase 2, the household which was associated with the taxi business provided the highest income, also this household spent the most money on fuels, with R 1 500 being spent on petrol alone.

The 5 electricity-using businesses run from the home used on average 792 kWh per month, while the households without energy consuming businesses used on average 354 kWh per month. The highest consumption of electricity in the sample was in the household which ran a tavern. In that household 2 298 kWh were used per month in 1993. According to the respondent, the tavern had refrigerators and electronic games. From this small sample, as illustrated in the previous two phases, electricity consuming businesses by definition use more electricity than ordinary households.

6.4 Energy service access/use possibilities

This part of the chapter considers the relationship between electricity use and:
- the number of fuels in use in the household;
- the type of metering (and billing);
- the period of access to electricity;
- the quality-of-supply of electricity; and
- the daily use of some major energy consuming appliances.

6.4.1 Fuels in use

The number of fuels in daily use was explored in chapter 4. This chapter explored the relationship between the multiplicity of fuels in use and electricity consumption. Remembering that the sample was chosen *because* it had access to electricity, the expectation was that if only one fuel was in use it would be electricity, and therefore the household could be considered to be entirely dependant on electricity. Such a household would be likely to use more electricity than those using more than one fuel.

Households using one fuel, used on average 460 kWh per month, while those using four fuels used the least electricity, consuming 250 kWh per month. Figure 6.3 describes the trend.

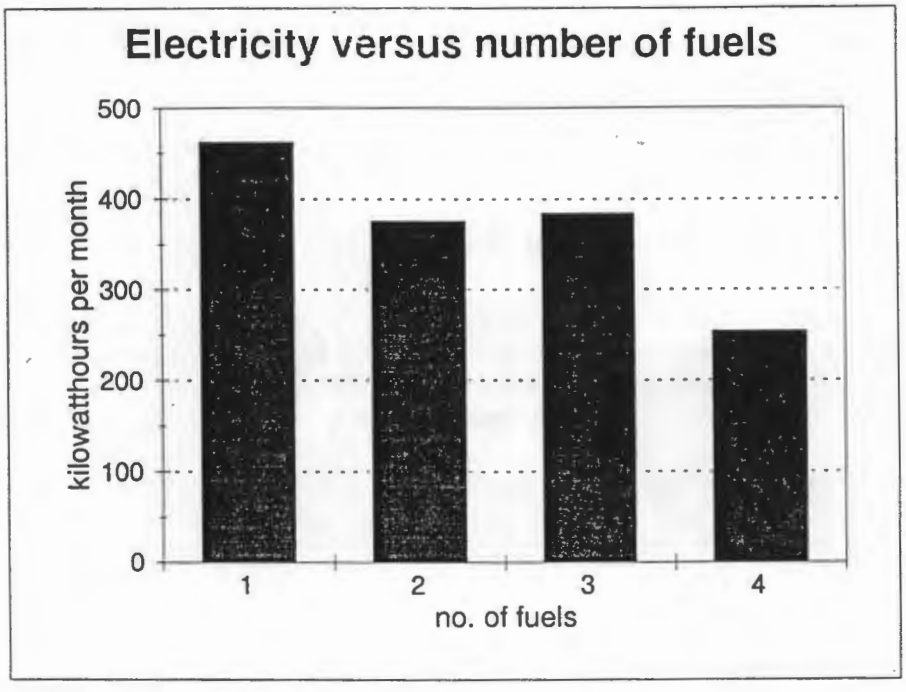


FIGURE 6.3 The number of fuels in daily use and electricity use

Lower income is recognised as a determinant of lower electricity consumption. It is also apparent that the lowest income category within the sample uses a widest range of fuels, and are therefore more likely to use less of any one fuel including electricity. Further work is needed to find out why a range of fuels are used. Is it, for example, the affordability barriers of appliances or the optimum management of energy service resources that reduce electricity consumption, or are there other reasons?

6.4.2 Type of metering device

The types of meters available in the areas studied were credit meters and pre-payment meters. The monthly electricity consumption figures, as explained in chapter 3, refer to electricity consumption in the case of users of credit meters, whereas in the case of pre-payment meter users, the consumption figures apply to electricity sales. In both cases there could be theft of electricity (through bypassing the electricity meter), but only in the case of credit meter users is there a possibility for non-payment of electricity bills.

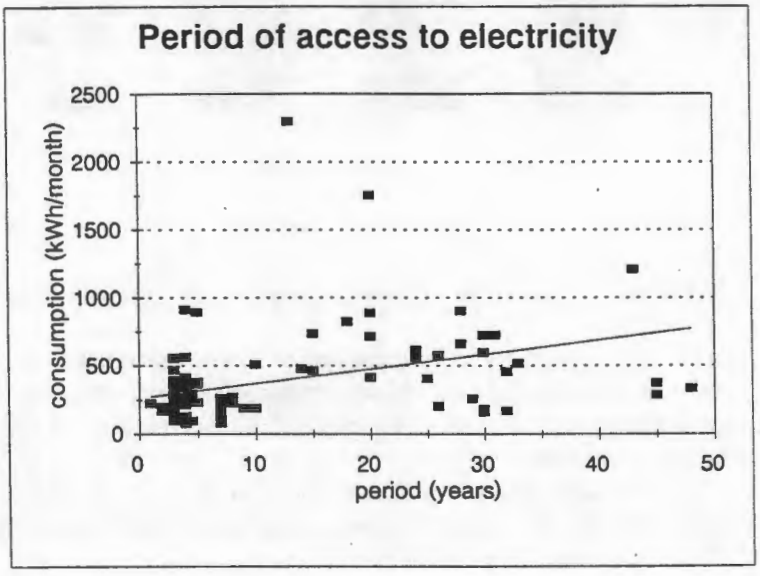
The consumption of electricity is mapped against these two types of metering technology - although there are many determinants behind the choice of metering technology. For example, the criteria by which households were provided with these types of meters in Khayelitsha is not known, and could be attributed to the perceived ability to pay for the service. That is, the income determinant. Also credit meters were installed at the beginning of the electrification project in all areas. Subsequent payment defaulters have had these meters replaced with the pre-payment types. Recently connected households in low-income areas have pre-payment meters installed whether they want them or not. Thus the period of access determinant is hidden behind

the choice of metering technology. It is also likely that the credit meter users in Khayelitsha are more wealth.

Households using pre-payment metering use on average 266 kWh per month, whereas households with credit meters use 536 kWh per month.

6.4.3 Period of access to electricity

A regression analysis on the period of access to electricity and electricity consumption indicates an R-squared figure of 0.13 and an *r* correlation of 0.36. Putting all the aggregated data into groups also provided an increasing trend with time. The scatter plot of the discreet data is provided in figure 6.4 below.



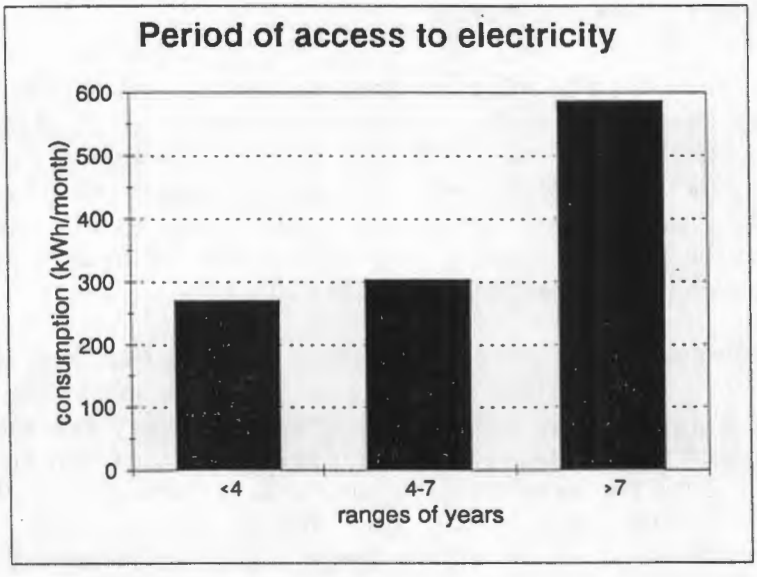


FIGURE 6.4 a and b Period of access to electricity

The remaining tests included averaging the consumption of consumers connected 3 to 36 months prior to the winter of 1993. Figure 6.5 reveals that after 15 months a monthly consumption of 250 to 275 units was reached and maintained. A similar pattern was observed in testing the summer consumption prior to the summer of 1993/4. However, in that case the average consumption reached only 150 units per month, after a similar period.

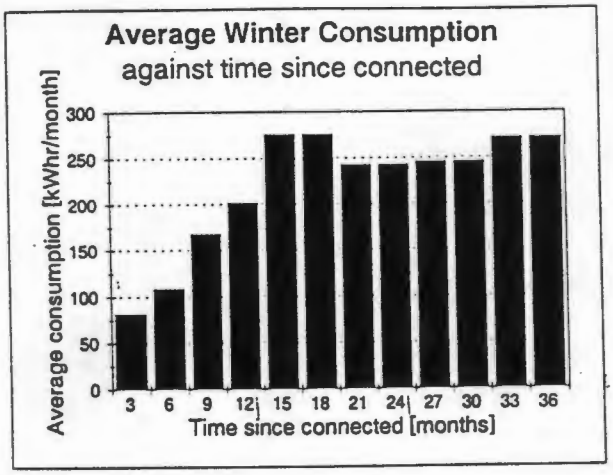


FIGURE 6.5 Period of access to electricity in Khayelitsha

Finally, the plot showing the increase in electricity connections versus average electricity consumption throughout Khayeltsha, Figure 3.9, could be used to argue that a rapid increase in new electricity customers has brought the average electricity consumption down, only because newly electrified consumers use less electricity than those who have been connected for a long time. However, such an argument could be flawed in that the newly connected may only be newly connected *because* they were adjudged in the past by electricity distribution authorities not to be capable of using increasing amounts of electricity. In other words, the electricity distributor did not connect them earlier because they were not considered to have the potential to afford sufficient electricity to make electrification profitable for the distributor.

However, it appears that the period since connection to electricity influences the consumption of electricity. This is logical in that the newly connected have may only be able to afford a few electrical appliances, and/or these are likely to be low electricity consuming services for which electricity has no competition such as lighting and television first.

6.4.4 Quality-of-supply

The one quantitative bit of information regarding the quality-of-supply, is the estimated duration of blackouts and their effect on the consumption of electricity. In phase 2 it was shown that as the perceived duration of blackouts increases, so the consumption of electricity decreases. Those that considered the

duration of blackouts to last less than 6 hours (per blackout) used the most electricity (390 units per month) while those who considered them lasting 12 hours or more used the least (145 units per month).

Figure 6.6 shows the relationship between the perceived duration of blackouts and average monthly consumption of electricity for phases 2 and 3. Phase 3 indicates no clearly discernable trend.

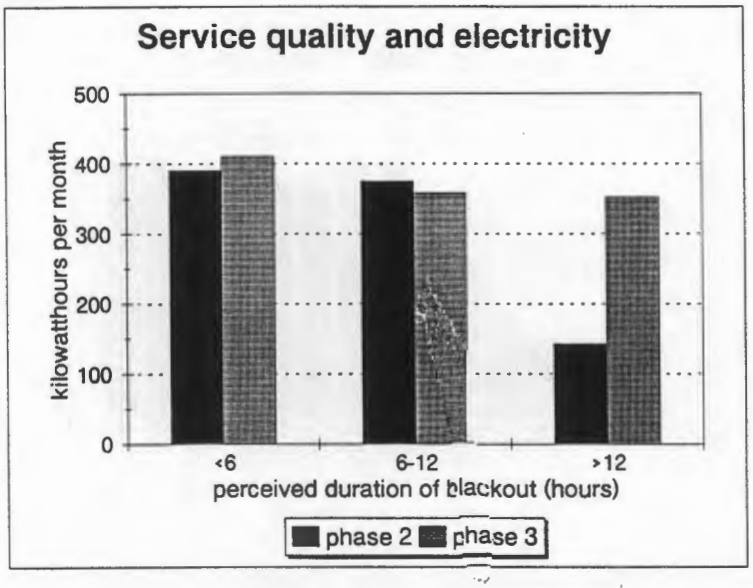


FIGURE 6.6 Perceived duration of blackouts and their relationship to the average electricity consumption

Further quality-of-supply data is provided in chapter seven below.

6.4.5 Electricity consuming appliances in use

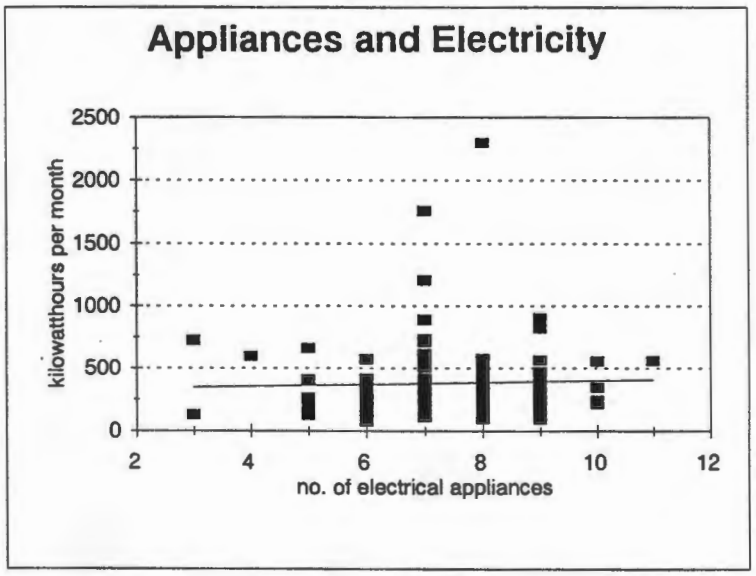
The ownership and use of electrical appliances would be expected to be a function of the income of the household. Testing how income as the independent variable correlates with electrical appliance ownership reveals a R-squared of 0.1, implying an *r* value of 0.32. From this observation, income is clearly not the only determinant of electrical appliance ownership alone.

This part of the chapter considers the effect that the ownership and daily use of all electrical appliances in the household have on electricity consumption. Included amongst these appliances are those that use very little electricity, such as radios, and those that use a lot of electricity, like geysers, stoves, space heaters, and refrigerators. Firstly the correlation between all the appliances have been tested and then high consuming appliances, and finally the large appliances are tested one by one.

In phase 2 there appeared to be a correlation between the number of electrical appliances owned by the household and the and the electricity consumption of the household. Phase 3 retested this possible determinant and found an

unconvincing R-squared value of 0.0014. This implies an *r* correlation of 0.037. By averaging the electricity consumption for households owning and using six or more electrical appliances no obvious trends could be observed. In phase 3, therefore no perceptible correlation could be observed.

Figure 6.7 a and b show the scatter and bar graphs which describe electricity consumption and appliance ownership, firstly as discrete data sets and then grouped in ranges.



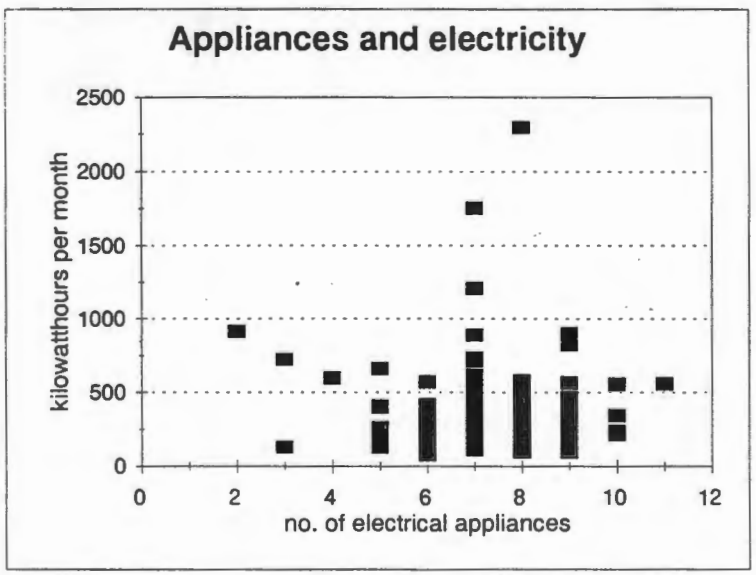


FIGURE 6.7a and b Electricity consumption and appliance ownership and use

The ownership and use of electrical appliances which consume the most energy are those which provide the thermal energy services within the household, space and water heating, and cooking all fall into this category. Lighting and entertainment (TV, radio and video) are energy services that use little electricity.

These larger energy consuming appliances, referred to as "big ticket" items by the appliance industry, are tested one by one to see if there are any significant correlations between their ownership and use, and the household consumption of electricity. Households owning and using electrical appliances which achieve each of these energy services (cooking, space and water heating) were grouped and their electricity consumptions averaged. Households using from none to all of these appliances were also grouped and compared to the previous categories of appliance users.

The exercise revealed averages only marginally higher for the ownership and use of major appliances than for those households using none of these. The relationships are reflected in figure 6.8 below.

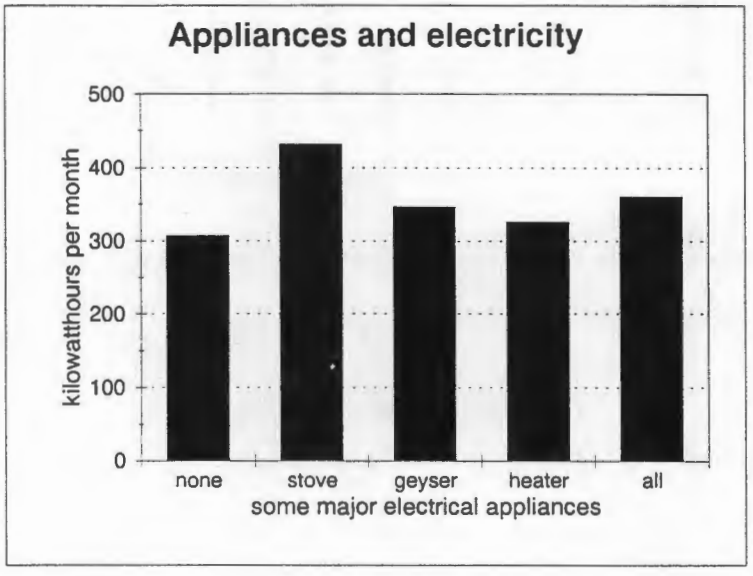


FIGURE 6.8 Major electricity consuming appliances

stoves

Those households owning stoves use more electricity than households which own any one of the other major appliances. This is to be expected with stoves doubling up as water heaters in household without special purpose appliances to fulfil this energy service (see chapter 5).

Owners and users of stoves using on average 430 units per month. This compares with the 450 and 370 units recorded in phases 1 and 2.

heaters

Households with electrical heaters use these mostly for the winter months. So while their use is widespread in the 4 to 6 months of winter, this period of use reduces the effect on the average consumption over the entire year. Households with heaters do not have a strong effect on the electricity consumption, revealing a R-squared value of 0.02 electricity consumption of. That is not to say that heaters do not contribute to electricity demand - the seasonal fluctuations in consumption of electricity observed in chapter 3 could largely be attributed to electrical heater usage. A number of the households visited in phase three of the study, and notably those in Khayelitsha where pre-payment metering is prevalent, referred to electrical heating as using too much electricity. It appears that while thermal comfort is important (considering the penetration of electrical and paraffin heaters) this service is carefully managed in Khayelitsha.

In phase 3 households with electric heaters used on average 330 units per month, this compares with the 770 and 450 units per month in Langa and Guguletu and in Khayelitsha 440 and 400 units per month in phases 1 and 2 respectively.

geysers

The ownership of geysers in Khayelitsha is high. This fixed appliance was in almost all cases installed when the house was built, there have been few refits since then. The relationship between ownership of geysers and electricity consumption is low, with an R-squared figure of 0.015, this implies an *r* value of 0.12. Households with geysers use on average 350 units per month, which compares with 340 and 360 units per month for all households using them in phases 1 and 2. It would be expected that geyser ownership and use would affect electricity consumption more dramatically. But as ownership, with three exceptions, is limited to Khayelitsha, the effect of period of access to electricity, the type of metering technology, the size of the household, also affect the comparative level of consumption amongst geyser owners.

irons

The correlation between the frequency of ironing and electricity consumption is low.

fridges

The ownership and use of fridges provides a low correlation.

6.5 Other possibilities

There are many determinants which could effect electricity consumption, and there are many combinations of these determinants which could reveal combined effects. With limited statistical techniques, possible determinants have been revealed, others which showed strong correlations in previous phases have shown little correlation in phase 3. There is a need for an in depth statistical study, and some more careful data logging of household circuits to identify determinants more accurately.

However, one determinant that is recognised as having a major effect on electricity demand, and hence consumption, is the ambient temperature. For three years the peak demand for electricity has typically co-incided with the evening of the coldest night of the year in the Pretoria, Witwatersrand, Vereeniging area. Eskom's Load Research has also provided data which shows that the relationship between minimum temperature and electricity demand is a linear one when considering bulk demand for electricity in Soweto (Surtees 1994). Ambient temperature, from the evidence collected by Eskom and collated by Morojele (1994) has a strong influence on the demand for electricity, and hence consumption.

6.5.1 Seasonal temperature fluctuations

The seasonal fluctuations in consumption are apparent in the average consumption figures of chapter 3. However, phase 2 revealed that low monthly average minimum temperatures measured at DF Malan airport corresponded with high electricity consumption in Khayelitsha. This was attributed to greater water and space heating and lighting loads.

Figure 6.9 describes the trend in electricity consumption in relation to the average minimum temperature measured at DF Malan airport.

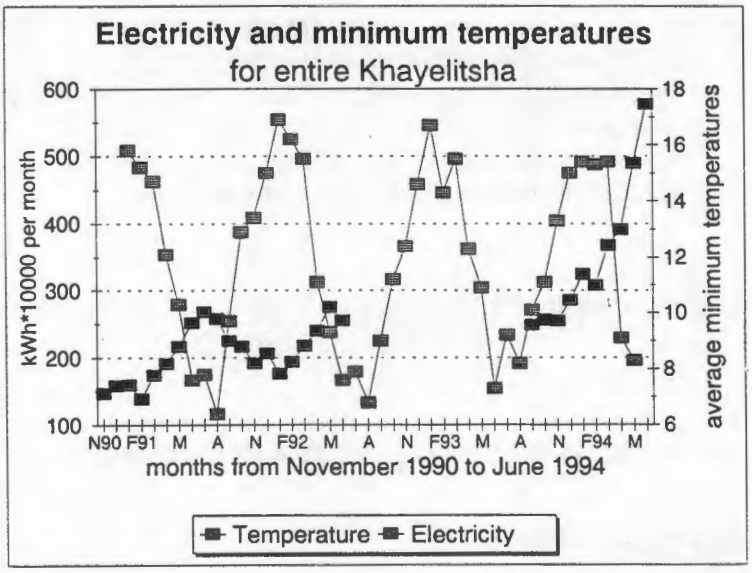


FIGURE 6.9 Average monthly electricity consumption and average minimum temperatures in Khayelitsha

6.6 Conclusions

The following are the conclusions to this chapter on determinants of electricity consumption during phase 3:

- income appears to be a determinant of electricity consumption;
- household size appears to be a determinant of electricity consumption;
- households headed by women, despite earning less than their male headed counterparts, use considerably more electricity;
- there were only 5 electricity consuming businesses run from home in the households. These used considerably more electricity than households without these activities;
- the greater the variety of fuels used in a household, the lower the amount of electricity consumed;
- households with credit meters use more electricity than households with pre-payment meters;
- the period of access to electricity determines the quantity of electricity which a household consumes;
- households that perceive the duration of blackouts to be the longest consume the least electricity;
- phase 3 contradicted the previous phases by revealing only a marginal difference between the quantity of electricity used and the ownership of major electrical appliances; and
- the seasonal effects on ambient temperature effect the use of electricity. The lower the average minimum temperatures the higher the average electricity consumption for all consumers in Khayelitsha.

Chapter Seven

ATTITUDES OF CONSUMERS IN LOW INCOME AREAS TO ELECTRICITY

7.1 Introduction

This chapter presents information on the attitudes and perceptions of households towards the delivery of electricity services. It compares data gathered in phase 3, with data gathered in previous phases of the study.

Specific outputs include:

- attitudes towards the quality-of-supply, and the distribution authority;
- perceptions of the affordability of electricity and the fairness of the tariff;
- attitudes towards supply technologies (electricity billing, purchasing and metering systems); and
- aspirations with regard to future electricity consumption.

7.2 Attitudes to electricity supply

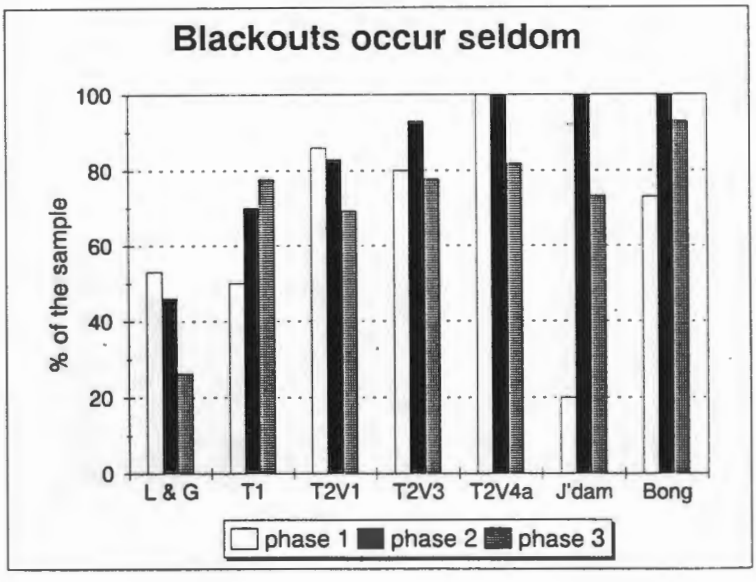
7.2.1 Perceptions of the quality-of-supply

In phase 1 perceptions on the frequency of blackouts was considered a useful indicator of the quality-of-supply of electricity. Phases 2 and 3 followed the lead of phase one, by continuing to explore the frequency and perceived duration of blackouts on an area by area basis.

The method of establishing perceptions of the quality-of-supply was to ask whether households described blackouts as occurring never, seldom or often. In phase 3 only one person suggested that blackouts never occur. Most of the sample suggested that they occur seldom, while an increasing number complain of the blackouts occurring often.

Between phases 1 and 2 there appeared to be an improvement in the reliability of the electricity service in most areas. The exceptions then were town 2 village 1, Langa and Guguletu, where there was a increase in the perceived frequency of blackouts. The problems that were experienced in phase 1 for the areas of Jonkersdam and Bongweni, were clearly resolved or households in the sample have become more tolerant to frequent blackouts. Reliability of electricity supply in town 1 is also perceived to be improving. Households in Langa and Guguletu as well as town 2 village 1 perceive the quality-of-supply to be deteriorating steadily.

Figures 7.1 a and b show the perception of the frequency of electricity blackouts.



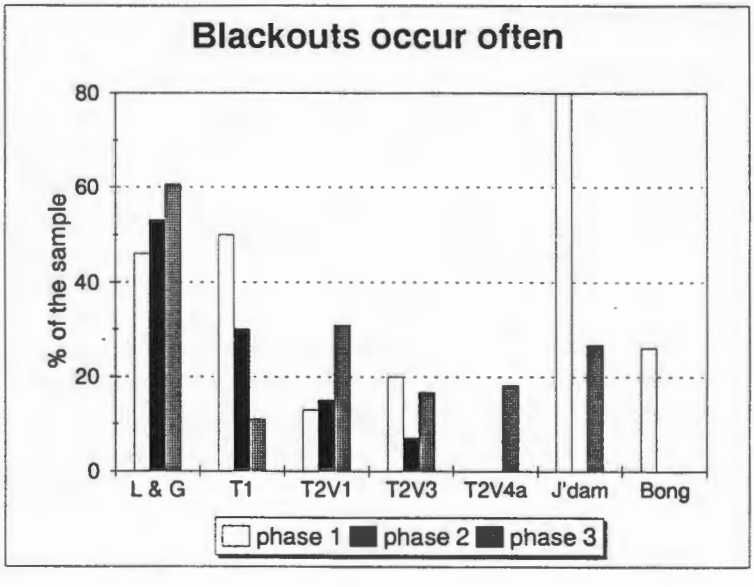


FIGURE 7.1 a and b Perceived frequency of blackouts

The perceived duration of blackouts were highest in town 2 village 1 and Langa and Guguletu in phase 2, where the average time to reconnect electricity supplies was perceived to be 16 and 14 hours respectively. Phase 3 recorded 15 hours as still the average duration of blackouts, with town 2 village 1 recording a reduced figure of 8 hours. The average for town 2 village 3 was just over 10 hours.

Figure 7.2 shows the perceived duration of blackouts.

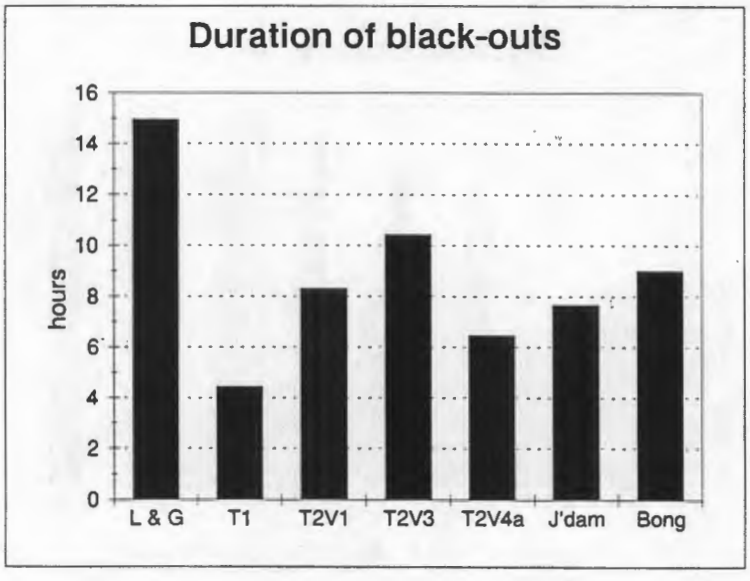


FIGURE 7.2 Perceived duration of blackouts

7.2 Perceptions of the distribution authority

Figure 7.3 shows the percentage of households in each area that have had occasion 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. Phase 2 showed a marked reduction in the number of call outs in all areas except for Langa and Guguletu.

In phase 3, with the exceptions of Langa and Guguletu and town 2 village 4a, households called the distribution authority less frequently than in phase 1. However, the figures in all areas show an increased call-out frequencies compared to phase 2. These responses concur with the perceived frequency of blackouts illustrated in figure 7.1 above.

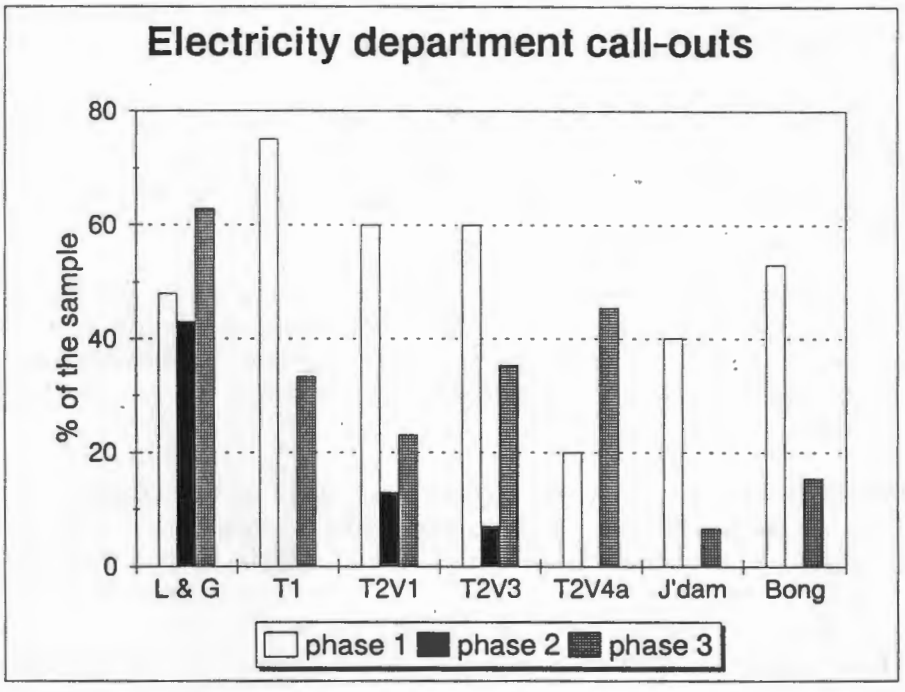


FIGURE 7.3 Electricity department call outs[1]

Figure 7.4 gives an indication of the attitude of the electricity distributor to households complaints. In all areas, with the exception of Langa and Guguletu (45%), the complaints or queries of respondents appear to have been handled positively.

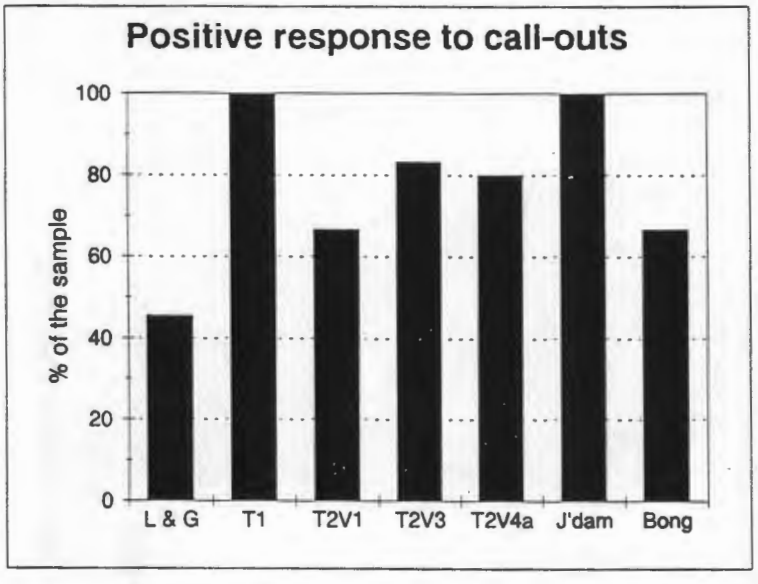


FIGURE 7.4 Positive responses to call-outs

[1]In requesting the information that was used to compile these diagrams, respondents were not asked to limit the time frames of their experience, but to report on their cumulative experiences.

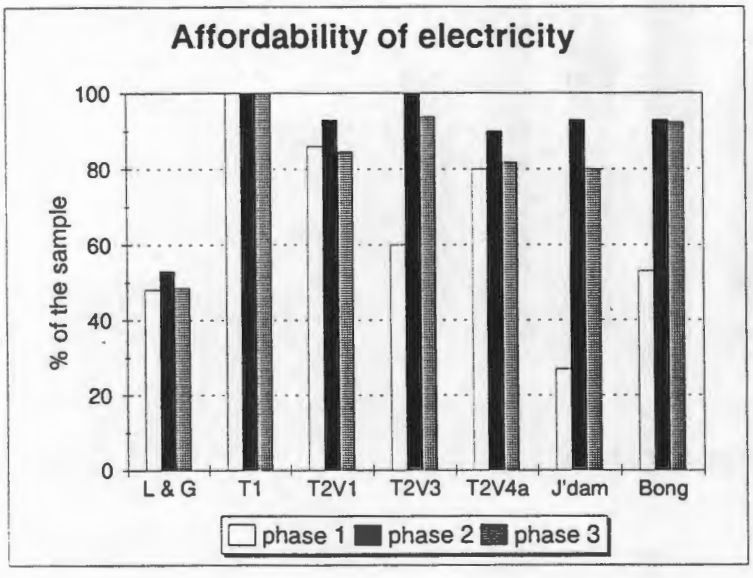
7.3 Perceptions of the affordability of electricity

Figure 7.5 indicates responses to the question: "is electricity affordable?", in different areas of Khayelitsha, and in Langa and Gugulethu. In phase 1, perceptions that electricity was unaffordable were prevalent in Jonkersdam, Bongweni, Langa and Guguletu.

These were all areas where credit meters are installed in households. And as explained in chapter three, many of these households are deeply in arrears on the payment of their electricity accounts. In Langa and Guguletu this is despite a lower tariff than that experienced by pre-payment meter customers in Khayelitsha.

Phase 2, reports that in all areas other than Langa and Guguletu, more than 90% of the sample believe that electricity is affordable. In Langa and Guguletu, 53% of the sample believed electricity to be affordable, despite the tariff being lower there than in Khayelitsha. The trends observed in phase 3 reflect closely the observations in phase 2, however, there is a slight reduction in the number of households who believe electricity to be affordable in all areas except town 1 and Bongweni.

The concept of affordability is a complex one reflecting the costs of the electricity service and ability to pay, in first cost and life-cycle cost terms. The issue of arrears amongst those with credit meters, has clearly affected the perceptions, nevertheless, as seen in chapter 6, credit meter customers use nearly twice as much electricity as pre-payment meter customers. One of the prevailing perceptions with regard to pre-payment meters, as will be illustrated later in this chapter, is the mechanism by which households manage consumption of electricity within a restricted budget. The threat of disconnection amongst the consumers in arrears, must also have an effect on perceptions of the affordability of electricity.



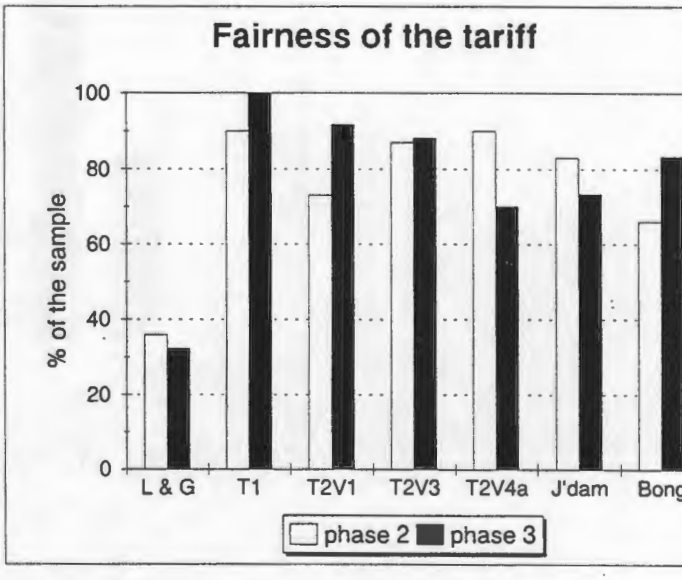


FIGURE 7.5 The affordability of electricity

In both phases 2 and 3 fewer households in the sample believed 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 on buying cards, the shop over charges for the number of units that are bought. Bills were too high was another popular response.

These responses to the fairness of the tariff were echoed in phase 3, where, with the exception of Langa and Guguletu, between 70 and 100% of all customers considered the tariff to be fair. No one considered electricity to be too cheap.

7.4 Metering Systems

Households were questioned on their attitudes towards their electricity meters. None of the respondents reported that their households had any control as to where these meters were located within their dwellings, nor on the type of meter which was installed.

In this section, information is provided on those with credit meters, and those with pre-payment meters (also known as budget energy controllers (BECs) or electricity dispensers (EDs)).

7.4.1 Credit meters

The percentage of those with credit meters who have experienced a meter failure was very low in phase 1, however by phase 2, those who had experienced faults with their meters in Langa had grown from 13 to 55%. There was an increase in faults experienced in Guguletu from 6 to 11%, while in Jonkersdam and Bongweni no faults were reported.

In phase 3, 53 of the respondent households acknowledged having credit meters. Of these 41% admitted having been disconnected at one time or another as a result of accumulating arrears. This was down from the 55% who admitted being disconnected in phase 2. 24% wanted to change their metering system to a pre-payment meter. This is down from the 49% who admitted disliking credit meters in phase 1. Some of these customers have already moved to pre-payment metering as distribution authorities in both areas have adopted policies to replace credit by pre-payment meters. With 62% of the respondents admitting being in arrears, many must be in line for the technology switch to pre-payment meters (see chapter 2).

However, those who do have credit meters suggested that they were safe (88%), their appearance was satisfactory (82%), some say they break often (31%), and about half considered the credit system easier to manage with respect to the household budget (52%). However, only 36% of the sample were confident that the information on the bills was correct.

Figure 7.6 summarises some of the aspects of credit metering mentioned above.

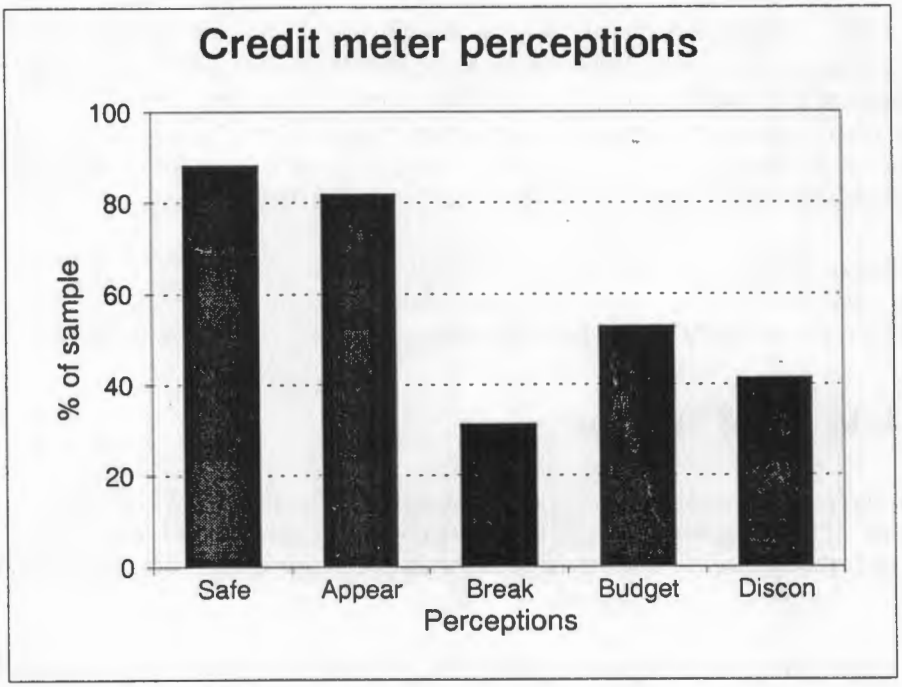


FIGURE 7.6 Reasons for using credit metering

7.4.2 Pre-payment meters.

The percentage of those with pre-payment meters who have experienced one or more meter failures by phase three, had reached 23%. Failures were sorted into meter problems and card problems (where a card did not work when fed into the meter). Meter failures are evident in all areas of Khayelitsha. However, there has been a large reduction in the number of households reporting these failures. In phase 3, 30% of the respondents reported having one or more problems with faulty cards.

In phase 1, 80% of all 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.

Despite the problems, which from the respondents perspective appear to be decreasing, pre-payment metering is popular amongst electricity end-users. Figure 7.7 describes the card or pre-payment meter perceptions. It shows that nearly all of the respondents consider them safe, reliable, and easy to budget for. Almost none think the meters are noisy, break often, or are easy to fix once broken.

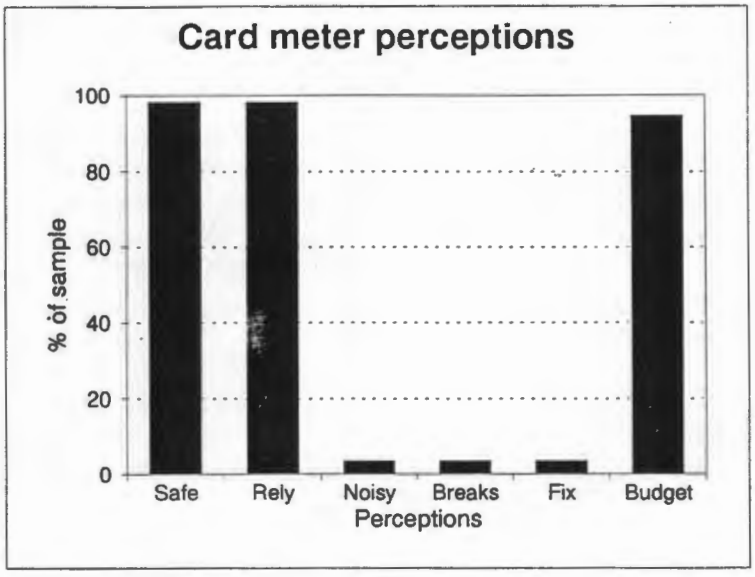


FIGURE 7.7 Card or pre-payment meter perceptions

In phase 2 more than 50% of the respondents reported keeping spare cards in case their card runs out at an inconvenient time. In phase 3 this was far lower, with only 19% reporting keeping spares.

The frequency of purchases was reported to be on average just over 2 per month, of amounts averaging R 43.75 (see chapter 3 for a detailed pre-payment card purchase behaviour). Phase 2 showed that respondents within Khayelitsha, with the exceptions of those in Bongweni and Jonkersdam, (who had obtained pre-payment meters as a result of the Lingelethu West City Council's policy on arrears), bought at a frequency of between 1.5 and 2 times per month. However, in Bongweni and Jonkersdam the frequency was closer to 1. In phase 2 there was speculation that there was a relationship between the frequency of purchases and distance from the vending point - during phase 2 the vending infrastructure of both of these areas was lagging behind the implementation of pre-payment meters there, that is no vending had been set up in the vicinity of Bongweni and Jonkersdam.

In all there were 2 cases of respondents preferring credit metering above pre-payment metering. Eskom, and their Phambili Nombane partners, are intent on replacing all credit meters in Khayelitsha, and have consulted the community representatives in this regard.

A final note on the pre-payment issue is that all users of this technology in Khayelitsha are paying the equivalent of an Eskom S1 tariff, which was designed to recover the cost of electricity supply and the necessary infrastructure. While S1 may crudely mirror the costs of infrastructure, there is no component of this tariff which is related to demand, as is the case in bulk tariffs. This is despite the cost of infrastructure being sensitive to After Diversity Maximum Demand (ADMD) within urban settings. Consumers with low electricity demand are therefore disproportionately penalised by this tariff. A further cause for concern with this tariff, is that existing pre-payment meter customers have already paid considerable contributions towards the cost of their electricity connections, prior to Eskom taking over the rights of supply.

7.5 Aspirations related to electricity consumption.

Figure 7.8 shows the proportion of the sample who would like to use more electricity. Twelve of the respondents who wanted to use more electricity suggested that the they would like to use more by being able to use more appliances at any one time. By this response it appears that there are still many households in Khayelitsha with load-limited supplies. Some other respondents complained that their desire to use more electricity was limited by lack of access to appliances.

However, figure 7.8 gives a clear indication that in all areas people's aspirations to use more electricity have diminished from a ranged between 80 to 90%, to a range between 20 to 30% The respondents in Khayelitsha town 1, Langa and Guguletu have remained below 50% in both phases.

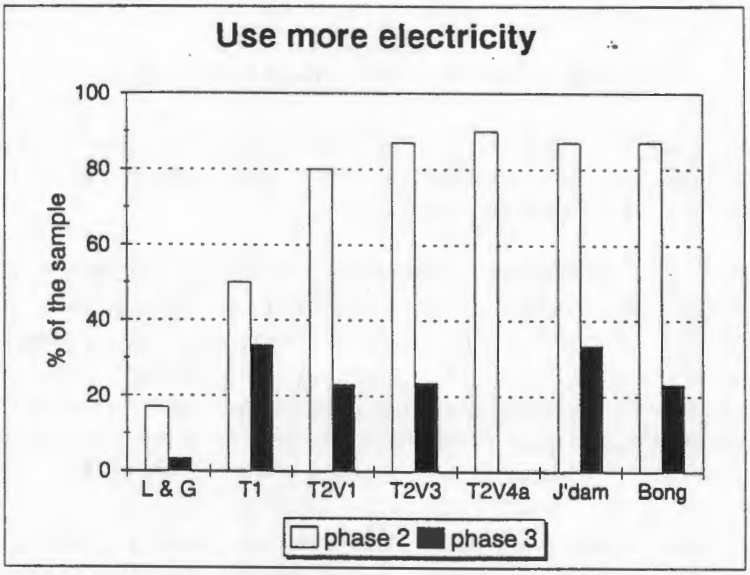


FIGURE 7.8 Respondents who would like to use more electricity

In contrast to increases in the number of those who want to use more electricity was the increase of those who wanted to use less. In all areas except for Khayelitsha towns 1 and 2 village 4a, the aspiration to use less was clear. In Langa and Guguletu, almost 90% of the sample wanted to use less electricity. In phase 2, 66% of respondents in Langa and Guguletu wanted to use less electricity.

Those who wanted to use less electricity suggested that education or guidance would assist them in using less. Some respondents with credit meters said that card meters would assist in reducing electricity consumption. It should be noted here that Langa and Guguletu's tariff is nearly 20% lower than the tariff for pre-payment/card meter users in Khayelitsha.

The entire sample would find education around electricity usage useful.

Figure 7.9 shows the number of households who would like to use less electricity.

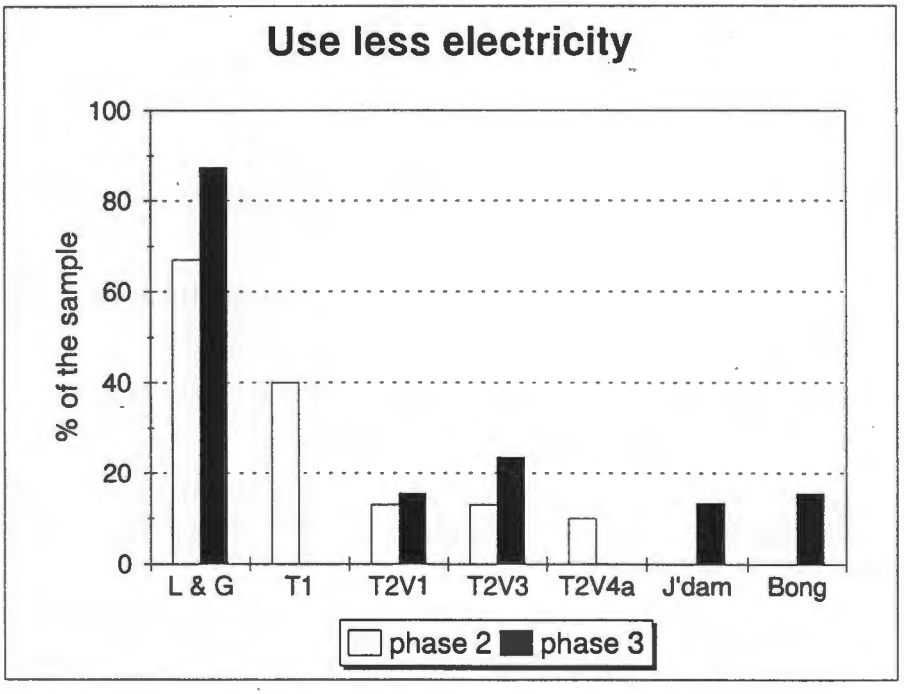


FIGURE 7.9 Respondents who would like to use less electricity

7.6 Conclusions

The following points have emerged from this chapter:

- the perceived frequency of blackouts in Langa and Guguletu has increased, with 60% of respondents in stating that blackouts occur often. The frequency of blackouts has been reduced in Khayelitsha in all areas except town 2 villages 2 and 4a;

- on average blackouts are perceived to last in excess of 4 hours - in Langa and Guguletu the average perceived duration of 15 hours is the longest;

- 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 62% 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 received on calling out this authority, but in Langa and Guguletu only 45% suggested the response was positive;

- most households find electricity affordable. In all areas the perception that electricity is affordable has increased since phase 1. The households which perceive electricity to be un-affordable are in areas where credit meters are the dispensing technology; for example, in Langa and Guguletu only 50% believe electricity to be affordable. This could be a reflection of the arrears run up by many in these areas. Most people believe the electricity tariff to be fair;

- 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. Even fewer believe that their electricity bills are correct;

- pre-payment meters in Khayelitsha had a poor (but improving) record of reliability. In Langa and Guguletu, where the electrical infrastructure is old, credit meter faults are reportedly on the increase;

- the majority of pre-payment meter users appreciate the control that these meters give them over the amount of electricity that they consume;

- none of the households in the sample had any choice as to where their meters were installed inside their dwellings;

- between phases 2 and 3 there was an increase in the number of respondents who would like to use less electricity, and an rapid decrease in those who would like to use more; and

- all respondents would find education on how to use electricity useful.

Chapter Eight

CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

This short chapter concludes this report by drawing together some of the commenting on the state of electrification in Khayelitsha, Langa and Guguletu, drawing on the main findings and some of the policy implications of these, and finally offering some direction for further phases of this study.

The chief value of this study is it's longitudinal nature. For three consecutive years the electricity consumers in three large townships in the Cape Metropole (Langa, Guguletu and Khayelitsha) have been studied in order to reveal, particularly, but not exclusively, their behaviour with respect to electricity. The study has observed the trends in electricity use amongst the universe (all of the electricity consumers, where this data has been available) and a sample of 108 to 118 selected consumers. These households have been revisited and interviewed and asked questions about their energy related behaviour. The data collected has been presented in a manner that reveals trends.

Phase 3 of this study has attempted to ask questions from an end user's perspective. The major aim has been to develop an understanding of how and why different fuels and appliances are used to fulfil specific energy services. The insights gained from the information may be of interest to those involved in policy debates and those interested in how consumers make decisions, such as suppliers and distributors of fuels and appliances.

A rewarding aspect of the study has been the dissemination of technical information to community based organisations. Throughout the very dynamic period of study in all three areas, a key aim has been to provide information that is useful in maximising the benefits of electrification in South Africa.

8.2 Background

The two older areas studied, Langa and Guguletu, were initially chosen as examples of more established low-income (sub-economic) areas that have enjoyed access to electricity for a considerable time - on average more than 20 years. These areas have a high level of access, with 72 and 90% of households using electricity respectively, despite high levels of disconnections being reported (18 000 per month). However, while access has remained at a high level, the use of electricity, and energy services in general, has been erratic. The high level of arrears (and the vacillations of Council policy to address it), and the alleged poor quality-of-service have contributed to uncertainty, and the provision of stand-by fuel alternatives. Arrears owed by residents in these areas stand at R 21 million. The August 1994 announcement of the Regional Premier, that there is to be a moratorium on prosecutions for service arrears means that the scrapping of payment arrears, as advocated by the civics, is one step closer to becoming a reality. The Cape Town City Council has applied to the State for R 12 million in assistance to upgrade the service in Langa and Guguletu.

Meanwhile the Council's electricity trading surplus was R 63 million for 1992/93.

In Khayelitsha, the level of access has been revolutionised in the past 12 months. Until recently only 5 000 of Khayelitsha's 70 000 households have had access to electricity. The right of electricity supply to Khayelitsha was passed from Lingelethu West City Council to Eskom in 1993 and subsequently to their agents, Phambili Nombane (a French, British and South African consortium). Their mandate is to electrify all the remaining households within 3 years at the lowest possible cost. The level of access to electricity had nearly doubled by March 1994. Eskom's electrification effort has so far concentrated on completing the electrification of the formal houses, while Phambili Nombane has been making a start on town 3 village 5 and site C residents, who live in planned informal dwellings (site-and-service). Phambili Nombane is confident of reaching their connection goals, employing an aerial bundle conductor overhead system and pre-payment metering. The labour based/intensive construction methods have created opportunities for local labour and subcontractors.

8.3 Electricity consumption

The household electricity consumption data records from Council and Eskom only approximates actual electricity use. In Langa and Guguletu the electricity consumption data is taken from the records of monthly bills, and in Khayelitsha pre-payment electricity sales. Both of these sources not entirely accurate reflections of actual use. In the former case, the reading of meters does not necessarily occur at exactly monthly intervals and the consumption is occasionally estimated when access to the meter is denied. In the latter case, the monthly purchases overlap so averages and particularly frequency distributions could be inaccurate. In addition, Eskom and Phambili Nombane refer to a high degree of electricity losses (these are allegedly non-system losses, or theft). This observation is apparent when the pre-payment meter purchases are compared with the bulk electricity supplied to the area. This is apparent from the Khayelitsha data used in phase 3 where only 20 to 30% of bulk electricity fed to the area could be accounted for in electricity sales. The phase 3 study did not manage to get the consumption of the credit meter customers in Khayelitsha, which although few in number do consume considerably more electricity than their pre-payment meter neighbours. However, all credit meters will soon be replaced with pre-payment meters.

In all the areas studied, the average electricity consumption of the universe has decreased from phase 2. The decrease in the universe is mirrored in the samples in all three areas which show similar trends. In Khayelitsha, the trend is attributed to the large and rapid increase in the number of households which have been electrified during phase 3. This increase and the extent of theft (or meter faults) may account for the 15% of consumers who recorded no electricity purchases in February 1994 and the 50% who consume below 100 units per month. In Langa and Guguletu the improved collection of arrears, and the threat of disconnection, appear to have affected the consumption of electricity.

In all areas the consumption and seasonal trends of the sample are reflected in the universe. In Khayelitsha during phase 3 the gap between the sample and the universe has broadened following an average monthly decrease in the

electricity consumption of the universe from 200, 244 to 209 from phases 1 through to 3.

The 50% of consumers who buy electricity in amounts equal to, or less than R 5 and the 70% who purchase electricity more frequently than one a week, provide compelling evidence that the pre-payment metering systems allows for frequent small purchases of electricity, and electricity becomes affordable to end-users with small and irregular incomes. In both Langa and Guguletu there are increases in the categories of electricity users who have not paid anything for electricity in 1993, and those who have reduced their arrears in 1993. The category of those paying, yet who's arrears have increased, has been reduced.

In an effort to treat all customers equitably the Council has announced that their entire 250 000 domestic customer base are to have pre-payment meters installed. They have also announced that customers in arrears will have the opportunity of paying half this month and half the next or accepting pre-payment metering now and paying an extra 14% to recoup arrears over and above the standard domestic tariff. The latter proposal could equitably resolve some of the tensions surrounding the arrears issue in the council area of supply. The result would be a higher tariff in Langa and Guguletu, but which is still lower that the standard Eskom S1 tariff used in Khayelitsha!

8.4 Household energy services

Chapter 5 is the heart of the report. It attempts to understand household energy services from the end-user's perspective, uncovering firstly which energy services are employed in the household, the appliance and fuel combinations utilised, how these appliances were acquired, and why these combinations are used.

The chapter did reveal some inconsistencies when the data in this section is compared with that from previous phases. This was particularly relevant to ownership of electric space heaters, washing machines, and hire-purchase allocations. Whether these variations are as a result of real movements or enumerator/data capture changes/discrepancies needs to be tested against an acceptable margin of error.

Between 80 and 100% of all respondents used the following household energy services: lighting, cooking, ironing, refrigeration, entertainment, water heating, and clothes washing.

8.4.1 Fuels in use

Only 3.5% of the sample use electricity exclusively, most use 2 (56%), others use 3 (35%) and 4 (5%) fuels. In Langa and Guguletu, respondents considered electricity to be as reliable as paraffin (70%). In Khayelitsha few (35%) considered paraffin to be reliable and nearly all (95%) considered electricity to be reliable.

8.4.2 Fuel and appliance mixtures

There has been a decisive move towards electric stoves (77 and 66% for Langa/Guguletu and Khayelitsha respectively). In Khayelitsha there is

increasing use of electric bar heaters (66%), and a reduction in paraffin heating. In Langa and Guguletu space heating with paraffin (57%) is higher than heating with electricity (24%).

Geysers are utilised for water heating by most Khayelitsha households (70%), while only a few have electric geysers in Langa and Guguletu (less than 10%) water heating is achieved using cooking stoves and kettles there. Kettles are owned by the majority of households (55 to 65%).

All households in the sample use electricity for lighting, and most (more than 80%) use candles, and some paraffin (8 to 20%) as a back-up. All entertainment "appliances" are electrically powered. In Khayelitsha, these include TVs (90%), hi-fis (50%) and radio (40%), while in Langa and Guguletu these include TVs (90%), radio (70%) and hi-fis (40%).

Almost all households wash clothes by hand (85 to 90%), with only a few owning washing machines (10%). The majority of households use electric irons (more than 95%). The ownership of refrigerators is increasing in Khayelitsha (90%) the same number as are owned in Langa and Guguletu.

8.4.3 Energy service preferences

Households prefer the use of paraffin and gas for the heavier thermal energy services (such as cooking, water and space heating) in terms of cleanness and safety, but find the latter cheaper in terms of fuel and appliance purchases. All fuels are considered similarly reliable, gas is favoured above paraffin in terms of cleanness, and paraffin is the favourite multi-purpose fuel.

The larger appliances are commonly purchased new on hire-purchase terms or bought second hand for cash, while small, less expensive items, tend to be purchased new on cash terms.

8.4.4 Energy consumption

Net and useful energy consumptions has declined in both Khayelitsha and Langa and Guguletu, with the exception of the latter where useful energy increased slightly to 2 100 MJ per household per month. The corresponding figure for Khayelitsha is 900 MJ, mainly because of smaller house hold sizes.

Importantly, the proportion of household energy contributed by electricity has increased over the period of the study. In Langa and Guguletu, paraffin has remained stable and in Khayelitsha gas has made way for electricity. In Langa and Guguletu electricity accounted for 74% of the energy used in the household; in Khayelitsha this was 78%.

8.5 Cost of energy services

In Langa and Guguletu the cost of fuels required for cooking using electricity or paraffin is similar - nearly 6 cents/MJ, while gas costs more, at 8.6 cents. In Khayelitsha, the cost of cooking using electricity, gas or paraffin is between 6 and 7 cents/MJ.

In 1991 Rands the amount spent on energy services in phase 3 was R 143 for Langa and Guguletu, of which 50% was on electricity, 39% hire-purchase instalments and 10% paraffin. During the same period in Khayelitsha R 113 was spent on energy services. 55% of which was hire-purchase on appliances, 37% on electricity, and 5% on gas.

In all areas the amount of money spent on energy services increased from that spent in phase 2, while the fraction of income used to cover the provision of energy services has grown for the poorest category of households (income category less than R 1 000) to a high in phase 3 of between 20 and 22%. For the highest income category of households earning more than R 2 000, the fraction spent on energy services has decreased to 4% for Langa and Guguletu and 8% for Khayelitsha. Generally, energy consumption has declined, but the poorest are spending larger factions of incomes on energy services.

8.6 Determinants of electricity consumption

Various methods were used to consider whether electricity use was "dependant" upon a range of "independent variables". A linear regression was applied to and is shown on the data scatter plot, and an R-squared variance, and an Pearson Product-Moment Correlation (*r*) calculated. When this revealed low correlations a second method was applied which included dividing the independent variable into ranges and averaging the electricity consumption of all sampled households within that range. This method did yield some trends, though they were not tested statistically, neither was there any attempt to combine the multiplicity of determinants.

The study observed that increases in income, household size, and the period of access to electricity are all considered as determinants of electricity consumption, all lead to increases in electricity consumption. There were only 5 electricity consuming businesses run from home in all areas surveyed. These used considerably more electricity than households without these activities.

Households headed by women, despite earning less than their male headed counterparts, use considerably more electricity. Also the greater the variety of fuels used in a household, the lower the amount of electricity consumed. Likewise, households that perceive the duration of blackouts to be the longest consume the least electricity.

Finally, the seasonal changes of ambient temperature effect the use of electricity. The lower the average minimum temperatures the higher the average for all consumers.

8.7 Perceptions of the electricity service

The main negative perceptions of electricity are that blackouts occur often. This perception is increasing in Langa and Guguletu, where on average, these are considered to have a duration of 15 hours. In most areas of Khayelitsha the perceived frequency of blackouts is down, while in all areas the average duration of the blackouts is considered to be in excess of 4 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 received.

The overwhelming majority of respondents considered electricity affordable and the tariff fair. In all areas the perception that electricity is affordable has increased since phase 1. Those who perceive electricity to be unaffordable are those households serviced with credit meters. This could be a reflection of the arrears run up by many in these areas.

Only 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. The majority of pre-payment meter users like the control that they provide in managing electricity consumption. There is an increase in the number of respondents who would like to use less electricity, and a significant decrease in those who would like to use more. All respondents would find education useful on how to use electricity.

8.8 Recommendations

The recommendations of this report are of two sorts; the first relate to the recommendations for phase 4 of the study and other policy research activities, and the second are those which may apply to the electricity distribution industry.

8.8.1 Research recommendations

The most obvious recommendation for continued research is to extend the longitudinal data collected in the first three phases of this study. In other words continued tracking is at the heart of this project, and should remain so. The research techniques which have been employed have improved over the phases and similar, but better and more reliable data is being collected.

It is recommended that the study, while continuing to gather the longitudinal data, also attempts to probe the energy service decision making process in order to get a firmer grasp of why decisions are made. Participatory research methodology may facilitate this process, and certainly provide a more textured research product.

Specific to the question of determinants is the gender dynamics within the household and how this affects energy use patterns. Phase 3 tested the relationship between household electricity consumption and the gender of the household head. Women headed households were shown to have a higher electricity consumption, although they were poorer. This area should be pursued - the implications for electricity distributors are that women headed households, though poorer than their male headed counterparts, may be stronger candidates for early electrification in the case where "electrical" uptake is all important. This is an example of the type of information which would make this study of greatest use in maximising the benefits of the process electrification. Another area that the study has failed to explore adequately is the level of energy poverty (or suppressed demand) that exists. The question

of whether energy services are being fulfilled, for example would indicate the level of energy poverty.

Finally, there are two areas which are arguably outside of the scope of this study, and they include: electrification and employment potentials (both up and down stream) and the process of electrification and democracy. The negotiating procedure, and the employment aspects of electrification are both areas which need refining if the key programmes and basic principles of the Reconstruction and Development Programme are to be met. The process of delivery should promote democratic exchange and build technical capacity amongst recipients of electricity, and understanding and trust between distributors and their clients. This is all the more important when one considers that it is the customer of electricity who at the end of the day directly or indirectly pays for the service, the poles, the power stations and the salaries of the staff of the distributor. The authors contend that this process of service delivery should also contribute to a model of good practice. It is possible that professional facilitation mandated to bring stakeholders to the table, and to ensure effective communication process would assist in the development of such a model, which could be relevant to the provision of other services.

8.8.2 Conclusions/policy options for distributors

The first major conclusion for electricity distributors is that the growth in consumption does not appear to be continuous as expected despite the rapid penetration of electrical appliances. Electricity consumption in Khayelitsha appears to have levelled off although this conclusion might be tempered by the fact of increased new consumers. It appears unlikely from the Khayelitsha data that the level of consumption that would result in a breakeven at the figure of 350 units per month will be reached soon. The cost of electrification, and the electrical service therefore, needs to be reduced, failing which the tariff needs cross-subsidy. The one area of uncertainty is the alleged level of meter by-passing in Khayelitsha which may severely affect this conclusion. In fact the extent of electricity non-system losses (only 20 to 30% of Khayelitsha's electricity is being paid for) would suggest that actual household consumption could be 3.3 to 5 times the 209 average. This implies consumptions of 700 to 1 050 kWh/month, which are unlikely.

A conclusion which needs to be emphasised is that even in areas which have been electrified for a long time, there is multiple fuel use. This need not mean that there is competition for electricity which needs to be (or even can be) brushed aside using saturation marketing. It may mean that people have settled on preferences, which suit their energy service needs within income constraints. It is even possible that a mix is desirable to the distributor, particularly if the heavier thermal loads like cooking, water and space heating are being fulfilled by other fuels, thus reducing peak demand for their product. Encouraging a fuel mix could in fact be an effective demand-side management strategy.

The next conclusion for distributors relates to the perceptions of fuels and appliances. From the responses to the question of why the different fuels and appliances are used, it is clear that electricity enjoys priority in terms of cleanness, safeness and so on, but in terms of cheap fuel and appliances, and the multiple utility of the fuel and appliance combinations, it is not as popular

as paraffin, and to a lesser extent, gas. With decreasing household incomes and energy consumption, and a large fraction of income already being spent on hire-purchase instalments, clearly there is a role for reducing the perceived affordability barriers of electric energy services.

The pre-payment meter and the S1 tariff structure appear to be effectively reducing the barrier to the affordability of electricity, but electrical appliances are still expensive. It is realised that there are considerable problems with pre-payment metering and the associated rate of theft of electricity, but it may be possible to consider using the tariff as a collection mechanism for the purchase of appliances. For example, an incremental payment on the tariff could facilitate the purchase of an efficient and durable (possibly labelled/marked) appliances, which would provide benefits for the end-user and the electricity distributor.

The number of "out-of-use" electric appliances appears to indicate opportunities for appliance repairers. Distributors could play a role in facilitating the learning of this skill.

Finally, there is a recommendation for the distributor in relation to the issue of arrears. When it is considered that in Langa and Guguletu the average household level of arrears is over R 2 000, it is apparent that this cannot be just paid back in two months. It is likely that some of the poorest households carry the heaviest arrears burdens. Yet arrears have to be reduced, and if there is a culture of non-payment for services this too must be addressed. To write-off arrears, if this is the plan, will be to give a signal that non-payment in the past was is condoned. To some extent it could be argued that the quality-of-supply to some of the areas where service arrears are the highest was so poor that they were not worth paying for. Yet households continued to consume these services, despite the quality-of-supply, while some paid and others risked disconnections and prosecutions by not paying, or paying just enough to stay connected, while promising to pay debt collection agencies regular amounts. Changes in collection policies and the mistrust of electricity bills and collection processes have contributed to a muddled situation which needs clarity.

The choices are that if you want households to pay for services directly, to write-off arrears will not affirm that aim in the long term. The suggested policy of installing prepayment meters and adding surcharge makes more sense, but, recognition must be taken by distributors of the quality-of-supply in the past and the political protest element of arrears in reaching an equitable solution.

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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, and during the second half of 1992. 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: . . . . . [ ][ ]

Address: . . . . . [ ]

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?

4. Do you make the decisions regarding the buying of fuel?

Yes	No	If no, who does?

5. How long have you been at this address (in years)?.....

6. Do you own the house and plot? .....

   if no, then please indicate what type of tenure you have .....

B. ENERGY SERVICE QUESTIONS

1.0 Introductory questions

Which of the following energy services have you got? (please put a cross in the right place.)

Cooking	Space Heating	Water Heating	Lighting	Entertainment[1]
Clothes Washing	Refrigeration	Ironing	Small Business	Electric Tools

others:. . . . . .
why is there a difference between what you want and what you have got?

. . . . . .

. . . . . .
which fuels do you have easy access to?

fuel	access? (yes or no)	price per unit	Quantity per month	Total expenditure	Reliable supply?	Where do you buy?
paraffin						
gas						
electricity						
wood						
candles						
dry cell batts						
car batts						
coal						
others?						

Which fuel do you prefer? . . . . . .
Would you be willing to record your energy use on a daily basis for the next month?
if yes, please complete the date and amount of each fuel bought on the table below.

---

[1] Television, Hi-Fi and Radio

1.1 Cooking and reheating food

Which of the following do you use for daily cooking/reheating:

	open fire	gas ring/ stove	primus /beatrix	electric hot-plate	electric stove	electric microw ave	electric frying pan
daily							
how often per month?							

any others:. . . . . (toaster/etc)

how did you get the above appliance/s?

gift/ inherited	2nd hand, bought for cash	2nd hand, installments	new, bought for cash	new, bought on HP	renovated from scrap	self built

others?. . . . . .

why do you use this appliance/fuel combination for cooking? (order from 1 to 3)

	clean	reliable and convenient	safe	cheap fuel	cheap appliance	[2]multi-purpose
paraffin & beatrix/primus						
gas & ring/stove						
electricity & hot plate/stove						
wood & stove/open fire/brazier						
coal & stove						
others						

other reasons for using these combinations? . . . . . .

which of these would you like to change?. . . . . .

have you recently (in the last 12 months) changed you cooking appliance or fuel?. . . . . .

if yes, why did you change to the new appliance/fuel . . . . . .

do you think you could do this energy service cheaper with other fuels and appliances? hov

. . . . . .

[2]multi-purpose for example, cooking and space heating at the same time (if people do use cooking for other services please write in which other services are being acheived.)

1.2 Space Heating

Which of the following do you use for space heating:

none	paraffin heater	open fire	gas heater	electric 1 or 2 bar	electric blower	electric oil filled

any others:. . . . . .

if you do not use a space heating appliance how is your house heated: . . . . . .

. . . . . .

when do you use space heating?. . . . . .

how did you get the above appliance/s?

gift	2nd hand, bought for cash	2nd hand, installment	new, bought for cash	new, bought on HP	renovated from scrap	self built

others?. . . . . .

why do you use this appliance/fuel combination for space heating? (order 1 to 3).

	clean	reliable and convenient	safe	cheap fuel	cheap appliance	multi-purpose
paraffin heater						
gas heater						
electricity & 1/2 bar heater, blower, oil filled heater						
wood & stove/open fire						
coal & stove						
others						

other reasons for using these combinations? . . . . . .

which of these would you like to change, and why?. . . . . .

have you recently changed your space heating appliance or fuel? . . . . . .

if yes, why did you change to the new appliance/fuel . . . . . .

do you think you could do this energy service cheaper with other fuels and appliances? how?

. . . . . .

1.3 Heating water

Which of the following does your household use for heating water in which to wash themselve

none	paraffin cooker	open fire	gas stove	electric hot-plate	electric stove	electric geyser	electric kettle

any others:. . . . . .

if you do not use any specific water heating appliance, how do you heat water for washing:.

. . . . . .

how often do you heat water for these purposes?. . . . . .
how did you get the above appliance/s?

gift	2nd hand, bought for cash	2nd hand, installment	new, bought for cash	new, bought on HP	renovated from scrap	self built

others?. . . . . .
why do you use this appliance/fuel combination for water heating? (order 1 to 3).

	clean	reliable and convenient	safe	cheap fuel	cheap appliance	multi-purpose
paraffin cooker						
gas cooker						
electric stove or hot plate						
wood & stove/open fire						
electric geyser						
others						

other reasons for using these combinations? . . . . . .

which of these would you like to change, and why?. . . . . .

have you recently changed your water heating appliance or fuel? . . . . . .

if yes, why did you change to the new appliance/fuel . . . . . .

do you think you could do this energy service cheaper with other fuels and appliances? how

. . . . . .

1.4 Lighting

Which of the following do you use for lighting:

	paraffin lantern	gas lantern	electric light	candles
daily				
in emergencies				

any others:. . . . . .

for how many hours a day do you use lighting?. . . . . .
how did you get the above appliance/s?

gift	2nd hand, bought for cash	2nd hand, installment	new, bought for cash	new, bought on HP	renovated from scrap	self built

others?. . . . . .
why do you use this appliance/fuel combination for lighting? (order 1 to 3).

	clean	reliable and convenient	safe	cheap fuel	cheap appliance	multi-purpose
paraffin lantern						
gas lantern						
electric light bulb (normal)						
electric light bulb (fluoresecent)						
electric light bulb (phase 2 gift)						
candles						

other reasons for using these combinations? . . . . . .

which of these would you like to change?. . . . . .

have you recently changed your lighting appliance or fuel? . . . . . .

if yes, why did you change to the new appliance/fuel . . . . . .

do you think you could do this energy service cheaper with other fuels and appliances? how?

. . . . . .

1.5 Entertainment

Which of the following do you use for entertainment:

	Radio	TV	Hi-fi	video
daily				
occasionally				

any others:. . . . . .

for how many hours a day do you use entertainment?. . . . . .
how did you get the above appliance/s?

gift	2nd hand, bought for cash	2nd hand, installment	new, bought for cash	new, bought on HP	renovated from scrap	self built

others?. . . . . .
why do you use this appliance/fuel combination for entertainment? (order 1 to 3).

	clean	reliable and convenient	safe	cheap fuel	cheap appliance	multi-purpose
all on car battery						
all appliances on a generator						
all on grid electricity						

other reasons for using these combinations? . . . . . .

which of these would you like to change?. . . . . .

have you recently changed your entertainment appliance or fuel source? . . . . . .

if yes, why did you change to the new appliance/fuel . . . . . .

do you think you could do this energy service cheaper with other fuels and appliances? how

. . . . . .

1.6 Clothes washing

Which of the following do you use for clothes washing and drying:

	self by hand	neighbour's washing machine (w m/c)	launderette	wash at work	own/shared/co-owned w m/c	hire someone
daily						

any others:. . . . . .

how often do you do the clothes washing?. . . . . .
if you have a washing machine or drier, how did you get the it?

gift	2nd hand, bought for cash	2nd hand, installment	new, bought for cash	new, bought on HP	renovated from scrap	self built

others?. . . . . .
why do you use this method of clothes washing? (order 1 to 3).

	clean	reliable and convenient	safe	cheap fuel	cheap appliance	multi-purpose
self hand washing						
launderette						
washing at work						
neighbour's w m/c						
own/shared/co-owned w m/c						
hire someone						

other reasons for using these combinations? . . . . . .

which of these would you like to change?. . . . . .

have you recently changed your clothes washing method? . . . . . .

if yes, why did you change to the new method? . . . . . .

do you think you could do this energy service cheaper with other fuels and appliances? how?

. . . . . .

1.7 Ironing

Which of the following do you use for heating an iron:

none	paraffin cooker	open fire	gas stove	electric hot-plate	electric stove	electric iron

any others:. . . . . .

how often do you iron?. . . . . .
how did you get the above appliance/s?

gift	2nd hand, bought for cash	2nd hand, installment	new, bought for cash	new, bought on HP	renovated from scrap	self built

others?. . . . . .
why do you use this appliance/fuel combination for ironing?
(order the reasons from 1 to 3, the most important being 1)

	clean	reliable and convenient	safe	cheap fuel	cheap appliance	multi-purpose
paraffin cooker						
gas cooker						
electric stove or hot plate						
wood & stove/open fire						
electric iron						
others						

other reasons for using these combinations? . . . . . .

which of these would you like to change?. . . . . .

have you recently changed your ironing appliance or fuel? . . . . . .

if yes, why did you change to the new appliance/fuel . . . . . .

do you think you could do this energy service cheaper with other fuels and appliances? how

. . . . . .

Do you share an electric iron with your neighbours? . . . . . if yes how many? . . . . .

1.8 Refrigerating food

Which of the following do you use for refrigerating food:

	none	neighbour's fridge	own fridge	neighbour's fridge or freezer	own/shared/co-owned fridge or freezer
daily					

any others:. . . . . .

if you have no refrigerator how do you keep your food: . . . . . .

if you have a refrigerator or freezer, how did you get it?

gift	2nd hand, bought for cash	2nd hand, installment	new, bought for cash	new, bought on HP	renovated from scrap	self built

others?. . . . . .

why do you use this method of refridgeration? (order 1 to 3).

	clean	reliable and convenient	safe	cheap fuel	cheap appliance	multi-purpose
electric fridge						
gas fridge						
paraffin fridge						
neighbour's fridge						
other						

other reasons for using these combinations? . . . . . .

which of these would you like to change?. . . . . .

have you recently changed your refrigerator? . . . . . .

if yes, why did you change it? . . . . . .

do you think you could do this energy service cheaper with other fuels and appliances? how?

. . . . . .

1.9 Out-of-use appliances

Please list out-of-use or seldom usesd appliances and the reasons for them being out of use.

appliance	reason for being out of use
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

1.10 General Energy Service

Is there anything you would like to say concerning the fuels and appliances you use?

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

C: 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. 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? . . . . . .

3. Composition of household (ie. all those who use same electricity). Fill in the following table:

Name	Relationship to household head	Sex	Year of birth	Education level reached	At home during the day?	Employed?		*Type of occupation? (part/full time or casual employment, scholar, retired, self-employed, domestic worker (in someone else's home) housework (in your own home), etc.)*	Estimate of income per month	**How do they get to the place of work/ occupation? (car, bus, taxi, train, walk, bicycle, etc.)*
						Yes	No			
Head:										
Spouse:										

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

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.				

6. Businesses

6.1 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: . . . . .

D. Metering Systems

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

Credit meters (bill at end of month)	Card (pre-payment) meters

2. How much did you pay to get electricity?. . . . . .when? . . .

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

   - of the type of meter? . . . . . .

If respondent has a card meter, skip question 2.1

3. Does your house have tubing (housewiring)? . . . . . .
4. if you have no tubing and have extension wires have the use of these ever resulted in accidents? . . . . . .

2.1 Credit Meters:

List advantages and disadvantages of credit metering system:

	yes	no
is it safe?		
does it look better?		
breaks often?		
easier to budget?		

2.1.1 Has the electricity to your house only (not a black out) ever been disconnected? .....

For how long? .....

Why? .....

2.1.2 How often is your meter read? .....

2.1.3 How often do you receive bills? .....

2.1.4 How much was your last electricity bill?: .....

2.1.5 Is there sufficient information on your bill? .....

2.1.6 For bills, which is your preferred language?. .....

2.1.7 Do you think that your bills are correct? .....

2.1.8 Are you in arrears on your electricity payments? if so by how much? .

2.1.9 Where do you usually pay your account? .....

2.1.10 Would you prefer a card meter? Why? .....

2.1.11 Other comments: .....

.....

.....

If respondent has credit meter, and question 2.1 has already been answered, skip question 2.2

2.2 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?		

2.2.1 Has your meter ever stopped working? .....

Why? .....

2.2.2 When do you usually buy cards? .....

2.2.3 Access to cards

How much 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?	
Does the sales point give you the number of units you pay for?	
Do you keep a spare card?	
Who usually buys the cards?	

Would you prefer a credit meter system? Why?.....

3. Perceptions of electricity tariffs:

3.1 Do you find electricity affordable?

Yes	No	If no, why?

3.2 Would you consider buying electricity at a cheaper rate if it meant that you could use none or very little at certain times?. . . . . .

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

3.4 Would you like to use less electricity? How? . . . . . .

3.5 Would you like to use more electricity? How? . . . . . .

4. Electricity Blackouts

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

Often	Seldom	Never

4.2 For how long at a time is electricity off? . . . . . .

4.3 Does this cause problems? . . . . . .

4.4 What kind of problems? . . . . . .

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5. Service Complaints

5.1 Have you ever called, written or visited the electricity department with a problem? . . . . . .

5.2 How receptive were they to your problem? . . . . . .

E. GENERAL

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

	Estimated money every month
Sent by family living away:	
Pensions:	
Rent from tenants:	
Income from stokvels (what is the size of the stokvel):	
Other (specify):	

2. 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:	
All appliances	
All fuels:	
Others (specify):	

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

. . . . . .

Which ones? . . . . . .

4 What contributes to these variations?. . . . . .

. . . . . .

F. Final Questions and thanks

1. Any other comments about energy services in your area that you think the research should address? .....

.....
.....
.....
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.....
.....
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.....
.....
.....

2. Would you find education about electricity usage useful?. .....

3. Can we come and ask you more questions in other surveys in the future? .....

4. Did you find the report back called "Electricity" during our last visit useful? please comment. .....

5. Did you find the efficient lightbulb a good gift? please comment on your experience of this gift to date. .....

.....

Thank you very much for your time and trouble in answering thi questionnaire!

name:. . . . . questionnaire number: . . . . .

date	gas (kgs)	paraffin (litres)	candles (number)	wood (pieces)	coal (kgs)	other s

name: . . . . questionnaire number: . . . .

date	gas (kgs)	paraffin (litres)	candles (number)	wood (pieces)	coal (kgs)	other s