Constraints on the Wide Dissemination of Photovoltaic Solar Home Systems in the Rural Areas of South Africa

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Dedication

I wish to dedicate this thesis to my Wife, Agnes Magilindane whose love, comfort, support and patience has been my main anchor during my studies.

"Ndithi eNkosi Mkhwemnte!! Dabane!!"

Declaration

I, Funekile Magilindane, submit this thesis to the University of Cape Town in fulfilment of the requirements for the degree of the Master of Philosophy. I declare that, unless otherwise acknowledged, this is my original work and that it has not been submitted in this or similar form for a degree at any University.

Signed by candidate

F. Magilindane

24th day of JULY 2003

Abstract

Renewable energy is becoming a key policy issue in the energy sector in most countries in the world. Considering various energy options, renewable energies are seen to be ecologically sustainable and they contribute towards conservation of fossil fuels as well as the environment. The use of renewables on a more significant scale than at present is very likely to replace a further significant proportion of fossil fuel use, thereby reducing the associated environmental impacts.

The renewable energy sources of importance to South Africa are solar, wind and hydro-energy and energy derived from biomass. The focus of the paper however, is on domestic PV-based Solar Home Systems (SHSs). This is mainly because the principal technology being considered for household electrification in the remote rural areas at present in South Africa remains SHSs.

Previous studies, however, indicate that for a variety of reasons, large-scale SHS implementation has been very difficult to achieve in South Africa. For a number of years, extensive efforts have been made in the research and implementation of solar energy technology, and it was widely anticipated that the actual numbers of installations would have assumed very high figures by now. But this has not been the case. The largest obstacles to the wide dissemination of SHSs have been singled out, namely: the high capital investment often required for installation (which makes it very difficult for the rural households to afford the systems); and the expectations for grid electricity.

The paper argues that although affordability and grid expectations, no doubt, constrain the wide dissemination of SHSs, other factors play an equally important role. It is argued that a plethora of interlocked and mutually inclusive factors constrain the widespread use of SHS. These include factors such as: negative perceptions amongst potential users – arising from lack of system maintenance and consequent system failure; and socio-cultural dynamics. These had not been given much attention in the literature on SHS applications and programmes, yet they have enormous impact on the daily use of energy.

Acknowledgement

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There are many others who have contributed to the success of the study and I am thankful to you all. Specifically, I would like to express my sincere gratitude to the following:

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Abbreviations and Acronyms

A	Ampere
AIDC	Alternative Information and Development Centre
ANC	African National Congress
CPA	Cape Provincial Administration
DC	District Council
DME	Department of Minerals and Energy
EDRC	Energy and Development Research Centre
EC	Eastern Cape
GHG	Greenhouse Gas
HH	Household
HHH	Household Head
IDT	Independent Development Trust
JV	Joint Venture
KFC	KwaZulu Finance Corporation
kWh	Kilowatt-hour
LPG	Liquified Petroleum Gas
MEC	Mafefe Electricity Committee
NELF	National Electrification Forum
NER	National Electricity Regulator
PV	Photovoltaic
RDP	Reconstruction and Development Programme
REFSA	Renewable Energy for South Africa
RAPS	Rural Area Power Solutions
SELF	Solar Electric Fund
SES	Solar Engineering Service
SHS	Solar Home System
UCT	University of Cape Town
UIF	Unemployment Insurance Fund
VEC	Venda Electricity Committee
W	Watt
Wh	Watt-hour
WPEPSA	White Paper on Energy Policy for the Republic of South Africa

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CHAPTER ONE - INTRODUCTION

1.1 Background/Rationale

'The provision of adequate supplies of energy in suitable forms and at acceptable prices is an essential prerequisite for most development activities.

Not only is energy essential for development, but for all basic needs of survival, such as cooking, water pumping and food production. After basic needs have been met, greater levels of energy are required in order to improve quality of life. Energy can be considered as a prerequisite for development' (McNelis et al – cited by Green & Erskine 1998: 222).

This research topic falls under a broader project titled: "Renewable Energy Use in South Africa: Limits and Prospects", which was recommended to students by Professor Davidson of the EDRC. Renewable energy is becoming a key policy issue in the energy sector in most countries in the world. Considering various energy options, renewable energies are seen to be ecologically sustainable and they contribute towards conservation of fossil fuels as well as the environment.

Today, the energy-related problems that hit the headlines most often and which loom large in the public consciousness are environmental ones. Many of these problems are largely a result of large-scale fuel use. And one of the most significant problems appears to be that of 'global warming' – a gradual increase in the global average air temperature at the earth's surface. It is believed that 'global warming is probably taking place at a rate of around 0.3 degree Celsius per decade, and that it is caused by increases in the concentration of so-called 'greenhouse gases' in the atmosphere' (Boyle 1996: 19). The most significant single component of these greenhouse gas emissions is carbon dioxide, released by the burning of fossil fuels like coal. Coal burning creates more carbon dioxide per unit of energy released than is the case, for instance, with gas and oil, and more sulphur dioxide and nitrogen oxides (Boyle 1996). In South Africa, coal contributes approximately 80 per cent of primary energy use, about half of which is consumed in the production of electricity by Eskom (Van Horen et al 1993).

Another side effect of the burning of fossil fuels is acid rain, formed when gases such as sulphur dioxide and nitrogen oxides – which are released when fuels are burned, combine with water in the atmosphere to form sulphuric acid and nitric acid (Boyle 1996). The acidic rain which may result from this combination can cause damage to plant and aquatic life, and can erode buildings and corrode metal objects (Boyle 1996).

Apart from these environmental problems, possibly the most serious environmental impact stemming from energy use patterns in South Africa occurs in the household sector, where unelectrified households rely mainly on wood, coal and paraffin. The exploitation and use of these fuels is one of the most widespread and difficult environmental issues to address in South Africa. The main problem is attributed to the lasting environmental degradation caused by unsustainable harvesting practices and the health effects of traditional cooking practices – especially impacting on women and children. Research has indicated that one of the highest causes of infant mortality is from acute respiratory illness associated with the inhalation of wood smoke, and that women and children still have to bear the problem of obtaining water and wood (Eberhard & Van Horen 1995).

Davidson (2000) points out that a large number of people have argued that despite the environmental benefits of renewable energies, their use is fairly limited due to technical and economic constraints. This implies that, compared to their alternatives (e.g. paraffin and candles), renewables such as photovoltaic (PV) solar home systems, are expensive and often unaffordable for many rural households for which the systems are intended; and they often provide limited energy supplies or they deliver a far more restricted level of service to householders.

1.1.1 Renewable energy defined

Renewable energy sources are broadly defined as those sources of energy available to us that arise from natural processes and are regularly replenished (Boyle 1996). The sun is the primary renewable energy source available, and by far the most readily accessible in South Africa. In fact, the whole of Africa is well endowed with sunshine

all year round. It has been established that the annual global solar radiation average is about 5.5kWh per square meter per day for South Africa, compared to about 3.6kWh per square meter per day for parts of the United States and about 2.5kWh per square meter per day for Europe and the United Kingdom, making the local resource one of the highest in the world (DME 2002).

Solar radiation can be utilised directly as heat or light, and also as secondary forms of energy through its interaction with the natural environment, by employing suitable devices (Boyle 1996). Secondary forms of renewable energy that derive from the sun include electrical energy. For electricity generation, photovoltaics can be used at small, medium and large-scale, with different technologies emerging both for small to medium scale stand-alone application and for large-scale grid connected application (Boyle 1996). The photovoltaic (PV) effect is applied for powering the telecommunications network (both conventional and cellular telephony), in small-scale remote stand-alone power supplies for domestic use, for game farms, household and community water pumping, as well as for the powering of small-scale cottage industries and numerous other applications (Boyle 1996). According to the White Paper on the Promotion of Renewable Energy and Clean Energy Development, 'installed PV has solar to electric efficiencies in excess of 8 per cent and typical load factor of 22 per cent. The installed PV capacity is estimated at just over 8 MWp'(DME 2002).

1.1.2 Renewables have a potential to reduce some energy-related problems

Human energy uses have already breached the carbon dioxide absorptive capacity of the planetary system. Already over the past five years, extreme and unstable weather conditions have caused the deaths of more than three million people (AIDC 2002). Unless fossil fuel consumption is reduced radically, 'the earth's temperature could, by the year 2100, rise by as much as six degrees above the base 1990 level' (AIDC 2002: 7). Such an increase would lead to (AIDC 2002: 7):

- Acute water shortages, declining food production and the proliferation and spread of deadly diseases such as malaria;

- The rise of sea levels which would engulf vulnerable small island nations, mainly in the Pacific, Indian Ocean and the Caribbean, and affect about 37% of the world's population living within 100 km of coastlines. 13 of the world's 19 mega-cities with populations of more than 10 million, most of them in the Third World, are within threatened coastal regions.

The use of renewables on a more significant scale than at present is very likely to replace a further significant proportion of fossil fuel use, thereby reducing the associated environmental impacts. Most of the renewable sources of energy do minimal damage to the environment, and almost none of them give off gaseous or liquid pollutants during operation. Renewable sources are quite secure and inexhaustible, in that there is no problem of reserves being depleted. Wood fuel is also a renewable resource if the rate at which it is consumed is no greater than the rate at which it is renewed (indoor air pollution arising from wood combustion however, is associated with health risk – a problem which can be alleviated by introducing fuel-efficient stoves with chimneys to improve indoor air quality).

1.1.3 White Paper on Energy Policy for the Republic of South Africa (WPEPSA) supports the development of renewable energy technologies

It comes as no surprise therefore that the WPEPSA supports the development of renewable energy technologies. The Energy White Paper identifies five key objectives that energy policy must pursue (DME 1998: 8-13):

- **Increased access to affordable energy services.** Government will promote access to affordable, adequate and secure energy services for disadvantaged households, small businesses, small farms and community services;
- **Improved energy sector governance** to ensure that policies are sympathetic to the needs of a wide range of stakeholder communities, and to achieve greater integration in energy policy development and energy services delivery;
- **Stimulating economic development** by encouraging fair competition within energy markets by means of targeted interventions through appropriate mechanisms;

- **Management of energy-related environmental impacts.** Government will promote access to basic energy services for poor households to ameliorate negative health impacts arising from the use of certain fuels and will establish broad national targets for the reduction of harmful energy-related emissions; and
- **Securing energy supply through greater diversification.** Government will pursue energy security by encouraging a diversity of both supply sources and primary energy carriers.

According to the Energy White Paper, each of these objectives translates into short, medium and long-term priorities that include the active integration of the renewable energy technologies into the country's energy economy wherever it makes economic sense to do so (DME 1998: 13-15). Government's overall vision for the role of renewable energy in its energy economy is (DME 2002: 1):

> An energy economy in which modern renewable energy increases its share of energy consumed and provides affordable access to energy throughout South Africa, thus contributing to sustainable development and environmental conservation.

Taking into consideration perceptions that exist in South Africa – that renewable energy is only suitable for small-scale applications - the Energy White Paper presents a number of policy guidelines 'based on an understanding that Renewables are energy sources in their own right, are not limited to small-scale and remote applications, and have significant medium and long-term commercial potential' (DME 1998: 71). In terms thereof government undertakes to (DME 1998: 70-73):

- 'Provide focussed support for the development, demonstration and applications of Renewable Energy sources for both small and large-scale applications';
- 'Support Renewable Energy Technologies for application in specific markets on the basis of researched priorities';
- 'Facilitate the production and management of woodlands through a national social forestry programme for the benefit of rural households where appropriate';

- 'Promote the development of appropriate standards and guidelines and codes of practice for the correct use of Renewable Energy Technologies'; and
- 'Establish sustainable information systems of Renewable Energy Statistics, where justifiable, and will assist in the dissemination thereof'.

The renewable energy sources of importance to South Africa are solar, wind and hydro-energy and energy derived from biomass. The focus of this paper however, is on domestic Photovoltaic-based Solar Home Systems (PV-based SHSs). This is mainly because the principal technology being considered for household electrification in the remote rural areas at present in South Africa remains solar home systems.

1.1.4 Photovoltaic-based Solar Home Systems

Efforts to provide the majority of people in South Africa with electricity began in 1991, and were soon followed by the formation of the National Electrification Forum (NELF) of 1991-1993 (Wamukonya 2000). The NELF was a series of consultative meetings of a wide spectrum of stakeholders in the field of electricity provision and consumption (Kotze 1999), that resulted from the political liberalisation of the late eighties, which triggered the political restructuring process that commenced in 1990. NELF focused on the inequities in access to electricity services, specifically in the household sector (Kotze 1999). It developed a range of scenarios for the national electrification programme, including the electrification of 2.5 million households by the year 2000 – a target which was included in the ANC government's Reconstruction and Development Programme (RDP) target (Cowan et al 1996). The electrification of households is seen as essential for improving quality of life while simultaneously building productive economic capacity through access to services such as entertainment, lighting, home-based industries and small scale agriculture (DME 1998). The target highlighted the government's commitment to increase access to electricity to previously disadvantaged populations.

The target has been exceeded. In the period 1994 to 1999, a total of 2 738 545 households were provided with electricity, increasing the electrification level from

about 36 per cent in 1994 to about 68 per cent at the end of 1999 (DME Annual Report 2000/01). By the end of the year 2000, this number had increased to about 3 135 564, which represents a 70 per cent electrification rate for households in South Africa (DME Annual Report 2000/2001).

However, the principal beneficiaries have been in the urban areas. The high level of electrification in the urban areas is mainly attributed to the fact that these areas are easier and cheaper to electrify. With about 54.3 per cent of rural households still without electricity (DME Annual Report 2000), electrification in the rural areas still lags far behind. There are a number of factors contributing to the low levels of grid electrification in the rural areas, including (DME Annual Report 2000/2001: 2):

- High costs of grid electrification in remote rural areas;
- Low consumption levels; and
- Lack of big anchor consumers

Banks et al (2000) have confirmed this in their argument that, although the grid extension programme is expected to continue for some time, many of the areas yet to be electrified are remote, with dispersed household settlement patterns, and would be costly to provide with grid electricity. It was established that for these households, the most cost effective option for basic electricity supply is off-grid electrification using either solar home systems or isolated 'mini-grid' systems (Banks et al 2000). Off-grid electrification is perceived to provide a fine solution to meet the high-quality energy needs of householders who do not have access to grid electricity. And the National Electricity Regulator (NER) has responded to this challenge 'by allocating 45 per cent of electrification funding for the year 2001 to projects in rural areas, in comparison to 40 per cent in 2000 and 26 per cent in 1999' (DME Annual Report 2000/20001: 2). It remains to be seen whether or not this approach will improve the level of electrification in the rural areas.

Previous studies indicate that for a variety of reasons, large-scale solar home system implementation has been very difficult to achieve in South Africa. Cowan et al (1996) argue that, although an estimated 40 000 to 60 000 SHSs have been installed on a

commercial basis, without government involvement or subsidies, this fairly developed private market was undermined substantially when Eskom embarked on its 'Electricity for All' campaign. Morris (cited by Banks 1998: 2) states, 'since the start of the national electrification programme (1992), sales of domestic PV systems to rural communities have dropped significantly'. The grid electrification planning and the expectations of rural communities regarding the planning is seen as the most dominant factor in the demand for SHS (Cowan et al 1996). It is believed, however, that these expectations will decrease in the long term (Cowan et al 1996).

Typically, a solar home system provides electrical energy for three or four lights, a monochrome television set and radio or hi-fi set (Banks 1998). It is not normally used for cooking or heating, as it is too expensive to generate and store the large amounts of energy required, and it is unlikely to significantly impact income-generation potential. While refrigeration can be cost effective using photovoltaic-based SHS, it is expensive and is usually restricted to high-value situations, such as vaccine refrigeration, and gas-powered refrigeration is usually more economical for domestic or retail applications (Banks 1998).

Only small solar home system projects have been implemented in South Africa so far. These include a private, commercial non-subsidised SHS dissemination pilot project at Maphephethe; the provision of an integrated energy package at KwaBhaza by Eskom and Total; a District Council initiative to supply farm workers with SHS in the Free State Province; two other joint ventures: one between the Bavarian government and the DME at Folovhodwe, and the other between Shell and Eskom in the Eastern Cape (the Eskom-Shell JV has been the largest project to date, with 6000 SHSs installed in the first phase) (Thom et al 2000).

This paper will argue that other factors beside economic and technical ones determine householders' decision to invest on particular energy sources. And as may be observed from Davidson's statement, and as literature review will demonstrate, not much attention has been paid to other factors, such as negative perceptions amongst potential users – arising from lack of system maintenance and consequent system failure; and socio-cultural dynamics in relation to SHS, for instance - yet these have

an enormous impact on the daily use of energy. As Mehlwana and Qase (1999) argue, energy use, especially in low-income households, should not be understood in isolation from the wider socio-cultural context. Consumption is always and everywhere socially and culturally constituted. Perhaps this lack of interest in socio-cultural aspects is borne out of the fact that (Bank 1999: 88):

> In the scientifically-orientated energy policy world it is alleged that progress can only be achieved when *facts* replace *values* [...] In policy discourse, needs are necessarily separated from wants and desires, luxuries that are viewed as non-essential and subjective. The purpose of policy is to address people's *real* needs on the basis of the objective facts. The accumulation of these facts in the energy field [...] usually takes the form of aggregate statistics – statistics on individual and household income, on fuel related expenditure, on fuel efficiency, on the supply and demand of fuel products and so on. The empirical knowledge which informs energy policy is seldom based on thorough-going cultural or social analysis [...] because it is believed that effective policy formulation should be based on the satisfaction of people's objective needs rather than their whims and fancies. This quest for standardised, measurable and absolute facts requires that culture be airbrushed out of the picture.

1.2 Objectives

The broad goal of this project is to explore constraints that influence energy use at the rural household level and to extend insight into the factors that determine household energy use. The main focus though, is to establish householders' perceptions of and experiences with SHSs, ascertain how acceptable the solar home system is to those living in rural households of South Africa, and to investigate key barriers to the widespread and accelerated dissemination of the system, with special interest to socio-cultural factors pertaining to the widespread use of the solar home system.

1.3 Research design and methodology

The specific aims of the study which will help meet these objectives include:

- Reviewing the available body of knowledge to see how other scholars have investigated the research problem that we are interested in (scanning the secondary sources of information on the topic). One of the key elements would be to review

key features of the pilot projects implemented in South Africa. And a comparison with the 2.5 Ampere grid electricity pilot projects in Mafefe and Tambo villages will be useful. One of the reasons why this study is seen as useful is that, recently, the 2.5A supply has been compared with the SHS option regarding its capabilities. The experience from early implementation will be assessed and emerging lessons applicable to future project design and evaluation will be spelled out.

- In order to get a deeper level of understanding and establish householders' perceptions of and experience with SHSs, face-to-face individual interviews were conducted. Individual interviews are seen to be advantageous in that they provide more depth and detail about the opinions and experiences of any given participant – and compared, for instance, to Focus Group Interviews, they give the interviewer more control (Babbie & Mouton 2001). This approach is also perceived as quite useful – particularly in this situation, where there have been surveys of people using SHSs. In this way, one is able to add on to the value of the survey research. The interviews have been conducted with the aid of an open-ended questionnaire that looked in detail at various aspects of energy utilisation and probed opinions and experiences about the solar technology (see questionnaire in Appendix).

- Another important method used to generate data in this project has been participant observation. This method is quite useful in that it makes it possible to capture the 'non-verbal behaviour' of research participants. The researcher is able to perceive ongoing behaviour or interaction as it occurs, record people's actions and behaviour in their natural environment, and observe discrepancies between what the research participant says and does. That is where the bulk of the research effort will go – interviewing and observation (both SHS users and non-users).

1.4 Central arguments informing the study

The cross-cutting issues that inform this study have strong policy implications at the household level. These issues include:

- Solar Home Systems continue to be seen as the most cost-effective option for the electrification of remote rural areas in South Africa, despite the fact that their

implementation has been very difficult to achieve. The two largest obstacles to the wide dissemination of SHSs have been singled out, namely: the high capital investment often required for installation; and the expectations for grid electricity (see, for instance, Cowan et al 1996).

- 'Rolls Royce systems are supplied to customers requiring bicycles' (cited in James 1997:1). Lessons from 2.5Ampere pilot projects, and appropriateness and acceptance of current-limited supplies.
- Linked to this is the issue of technical problems regarding the widespread use of SHSs and the desirability, hopes and expectations of "real" electricity. Is it appropriate to argue that poor rural households require electricity for just lighting and media?
- Relationship between energy sources used in the rural areas, their role and desirability, their usage patterns, appliance ownership and desirability, the relationship between appliances and energy sources, and attitudes to energy sources.
- Influence of income on the use of fuels. Decisions made regarding household energy cannot be satisfactorily explained by income alone. People in the rural areas are poor, with income often obtained from welfare pensions or remittances by family members working in the cities.

1.5 Chapter Outline

To grapple with the central arguments highlighted in 1.4 above, the rest of the research project is divided as follows:

1. **Chapter Two** reviews literature. As it is believed that an analysis of the comprehensive collection of experiences with solar home systems to date would bring the ultimate goal of real large-scale implementation one step closer, a greater part of this chapter will be dedicated to reviewing these experiences.

Part two of this Chapter will review lessons from 2.5Ampere pilot projects in Mafefe and Tambo villages. The analysis of the lessons should help give a clearer reflection of the rural householders' attitudes towards limited supplies of electrical energy, and

help understand other factors at play in the acquisition and use of energy sources and appliances.

2. **Chapter Three** presents the methods used in gathering data and describes the research findings of the fieldwork conducted in Eastern Cape.

3. The use of energy, particularly among the rural poor, is influenced by a number of factors which are often difficult to separate. The first part of **Chapter Four** will be an analytical presentation of the socio-economic and technical factors (such as income and level of electric supply) that influence the use of fuels. However, as the use of fuels cannot be divorced from appliance use (each influences the other), the Chapter will also try to show the importance of energy appliances in fulfilling certain end-uses, and how this influences fuel use.

People's use and perceptions they have about fuels and appliances are also, to a large degree, guided by their social connections. And rural areas are characterised by strong social networks, much of which are related to meeting energy needs. It is important to study these relationships, and the extent to which they impact on people's use of energy. The second part of this Chapter will put the use of fuels and appliances into this social context, and examines how social dynamics have affected the widespread use of SHS in the rural areas.

4. **Chapter Five** will be an analytical presentation of people's perception and experiences with SHS. The Chapter will focus on the main constraints and benefits of the solar technology – as perceived by householders.

5. **Chapter Six** will conclude the discussion by summarising key research issues and findings, spelling out emerging lessons applicable to future project design and evaluation, and making recommendations.

CHAPTER TWO – REVIEW OF SOUTH AFRICAN EXPERIENCE IN NON-GRID ELECTRIFICATION, AND CURRENT-LIMITED SUPPLIES OF ENERGY.

2.1 Introduction

For a number of years, extensive efforts have been made in the research and implementation of solar energy technology in South Africa, and it was widely anticipated that the actual numbers of installations would have assumed very high figures by now. However, this has not been the case. Only small pilot projects have been implemented so far – the largest to date being the Eskom-Shell joint venture (with 6 000 SHSs installed). Reality shows that many problems still exist and these inhibit both the rapid increase in numbers of solar energy systems for households and the success of projects which have already been implemented. For this reason, it is felt that an analysis of the comprehensive collection of experiences to date would bring the ultimate goal of real large-scale implementation one step closer.

An attempt has also been made to implement current-limited supplies of grid electrical energy – as low as 2.5 Ampere. Although the arguments for the implementation of this level of supply are important from Eskom's perspective, it has been noted that there are some difficulties in determining whether the supplies would be affordable, appropriate and accepted by rural people.

The first part of this Chapter reviews experiences in the provision of solar energy to South African rural households, focusing on the pilot projects at Maphephethe, KwaBhaza, Free State Province, Folovhodwe and Eastern Cape. It should be highlighted however, that the review gives some projects a fairer amount of detail than others, and this is mainly because of the amount of reference material and information available. Part two of the Chapter provides a review of the lessons from the 2.5A pilot projects at Tambo and Mafefe – examining, in particular, whether the level of supply provides for the electricity service needs of rural households.

2.2 A review of the SHS pilot projects in Maphephethe, KwaBhaza, Free State Province, Folovhodwe and Eastern Cape.

2.2.1 Maphephethe

Maphephethe, a village situated in the 'Valley of a Thousand Hills', some 80km west of Durban, is one of the areas that will probably not be linked to the national grid in the near future because of its remoteness, sparsely populated settlement pattern, mountainous relief and low per capita energy requirements (Green & Erskine 1998). In fact, both Eskom and Durban Electricity, which are responsible for electrification of Maphephethe, indicated in 1996 that they have no plans for electrification in the region for the next five-year period (Geerdts 1996). To date, there are still no plans to provide the area with grid electricity.

Maphephethe is one of the first pilot project sites set up to develop and test a formula for the provision of basic electricity to rural communities by use of SHS. The project was initiated by the Solar Electric Light Fund (SELF) – a US non-profit organisation which promoted the use of solar technology for rural electrification (Geerdts 1996). SELF specialised in establishing country SHS programmes to bring basic electricity needs to rural communities using SHS. Solar Engineering Services (SES) was awarded a contract by SELF to develop and test a formula applicable to South African conditions (RAPS 2000). After consultation with various grid electricity distributors and rural communities, Maphephethe was selected. A standard SHS, which operates high efficiency fluorescent lights, a television and small electrical appliances such as radios and sewing machines, was decided upon.

The typical system comprised (RAPS 2000):

- 50 to 55Wp photovoltaic module;
- 105Ah battery;
- 3x9W compact fluorescent lights;
- 10A charge controller regulator;
- 5A socket and plug for a television or radio;

- 3 wall-mounted switches, strips of aluminium for the roof mounting and associated wiring.

Customers were expected to pay the full capital and maintenance costs. The finance terms were as follows (RAPS 2000):

- Loans were available for a 3 or 4-year term at an interest rate of 18.5 per cent, with a minimum deposit of 10 per cent.
- For a 3 or 4-year loan, this involved a monthly instalment of R86 or R79 per month respectively.
- Ithala (a division of the KwaZulu Finance Corporation (KFC) added an additional amount of R62 as loan administration fee.

In August/September 1995, the first survey to establish the demand for SHS in South Africa was carried out at the rural community of Maphephethe, by Frank Hochmuth and Gabriele Seeling-Hochmuth. 144 households (out of a total of about 2200 households) were interviewed (Hochmuth 1996). An attempt to obtain people's attitude towards SHS reveals a very high demand for the system. For instance, the questionnaire used contained two questions about whether people like the SHS, and the questions were posed after the system had been explained to them – although the first question was asked before the financing options were explained and the second question was raised after the financing issues were introduced. The figures indicate a demand of about 75 per cent and 95 per cent respectively (Hochmuth 1996: 30).

There was also a section in the questionnaire, which raised questions about financing options, and system sizes preferred. The section was introduced with the information that a typical SHS including three lights would cost about R2 000 (Hochmuth 1996). The respondents were first asked how much would they be able to pay for a deposit – the choices being: R200, R300 and R400. The report by Hochmuth (1996) indicates that the majority of respondents (about 56.5%) went for the cheapest option (R200); but there were many respondents (about 15.7%) who mentioned inability to afford this cheapest option (see Figure 2.1).

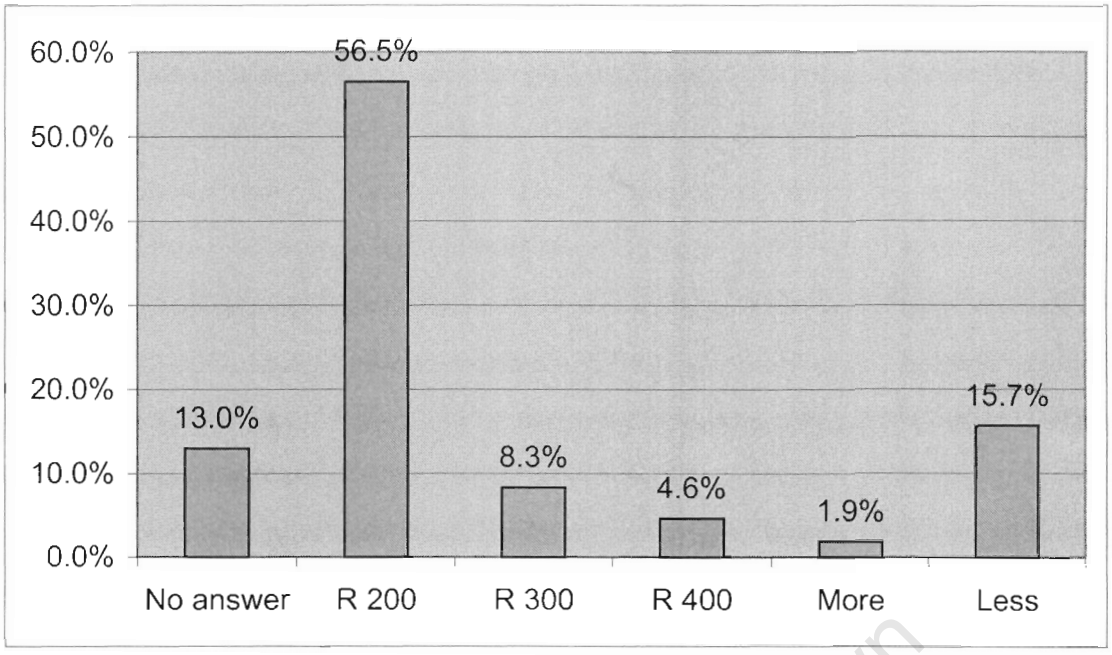

Figure 2.1: Percentage of households indicating ability to pay certain deposits. Source: Hochmuth (1996).

The second question asked how much would they be able to contribute to monthly instalments – options being: R30, R40 and R50 (Hochmuth 1996). Again, the report indicates that most respondents (44.4%) chose the cheapest option (R30). However, about 40 per cent indicated the ability to pay more than that: 26.9 per cent indicated the ability to pay R40, and 10.2 per cent indicated ability to afford R50, and 0,9 per cent indicated ability to afford R300 (see Figure 2.2).

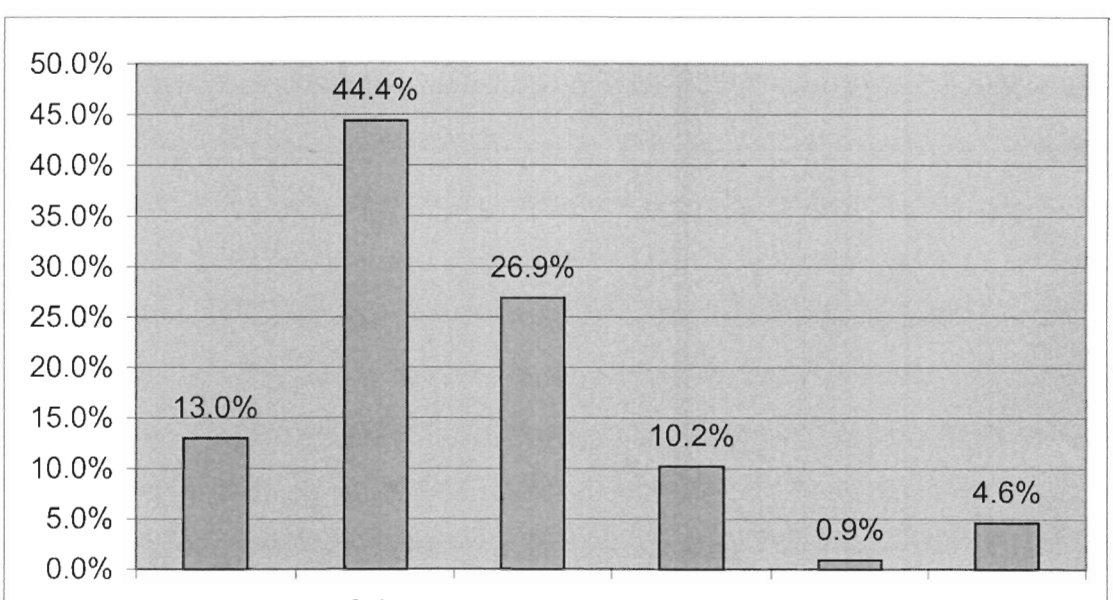

Figure 2.2: Percentage of households indicating ability to pay certain monthly repayments. Source: Hochmuth (1996).

Installations in Maphephethe started in late 1995, with the installation of six systems (Cowan et al 1996). In April 1996, a survey to obtain information about the impacts of the SHS on the socio-economic and energy expenditure patterns was conducted with those six households that had a SHS installed at that point of time (Cowan et al 1996). It was found that all of them were satisfied with their SHS, and that they were saving money by using the SHS (Hochmuth 1996). It is stated that the main reason for these savings was that these householders had spent large amounts on car batteries before the SHS was installed (Hochmuth 1996). In addition, their expenditure on candles and paraffin for lighting was reduced as well (Hochmuth 1996).

Although this statement is in a way confirmed by the findings of the survey conducted by Green and Erskine (1998) two years later, there seems to be a contradiction at the same time. Green and Erskine's study, involving a sample of 200 households and institutions investigated current energy usage and expenditure patterns and future requirements (Green & Erskine 1998). They selected Maphephethe because about 40 domestic solar energy units had been installed there, and the community was expected to have some understanding of alternative energy (Green & Erskine 1998). The study

confirms that the majority (about 86.3%) of the SHS users indicated that they had saved through the usage of a SHS (Green & Erskine 1998). However, from the energy audit obtained from the households who own a SHS, it was established that there were no significant decreases in candle, car battery or dry battery usage, and that there was no significant difference between SHS users and non-users in the expenditure on such resources (Green & Erskine 1998). According to Green and Erskine (1998), this meant that SHS does not replace present energy sources; instead, the quantity of energy used increases.

But whatever the case may be, the fact is that, to date the sales figures of SHS are very low in Maphephethe. By October 1997, about two years after the project had started; only 38 households had acquired SHSs (RAPS 2000). As of October 1999, a total of 50 systems had been installed, and 8 systems had been repossessed due to poor payment records (RAPS 2000).

It is believed that these low figures of sales are to some extent due to lack of funds and the finance terms (RAPS 2000). According to Green and Erskine (1998) however, the survey findings had indicated that income levels were slightly above national (rural) norms in Maphephethe, although they displayed a wide variability. Also, the current general uncertainty regarding grid electrification, and the uncertainty regarding allocation of a subsidy for SHS, were believed to have significantly dampened demand (Banks 1998). Hochmuth (1996) points out that people are often reluctant to allocate financial resources to a SHS. And he seems certain that in this regard, subsidies would contribute to increase the demand for SHS (Hochmuth 1996). According to Banks (1998), at subsidised rates, market penetration will increase, although unlikely to reach the poorest 30 to 50 per cent, unless the subsidies are sufficient to bring prices for both acquisition and operation and maintenance on a par with the current monthly amounts being paid by poor people for electricity.

2.2.2 Folovhodwe

The village of Folovhodwe, which consists of approximately 670 households, is located in the Limpopo Province (Geerdts 1996). The village was identified as being

potentially suitable for a SHS project for the following reasons (Cowan et al 1996): (a) it is far from the existing electric grid; (b) relative to other villages in the region, it is large and appears to be relatively affluent (this means that it was seen as likely to be able to sustain an unsubsidised SHS project); (c) there is a relatively high awareness of the technology and what it is able to do (the community had been exposed to solar technology not only through the installation of a system at the Folovhodwe clinic, but also by an installer who has marketed domestic solar systems in the village); (d) the systems which had been installed had performed well, and there was a relatively high level of confidence and satisfaction within the community with the technology; (e) it was recommended by very important players in the field of electricity provision - Eskom, Independent Development Trust (IDT) and Venda Electricity Committee (VEC) to be a strong candidate village for a SHS pilot project.

In August 1995, the community was approached to find out about interest in entering a pilot project (Cowan et al 1996). A number of meetings were held with the residents, and as a result of these meetings, a list of 31 names of people expressing interest in purchasing SHSs was collected, and a project committee was established (Geerdts 1996). However, following this fairly positive direction, the community had discussions with Eskom. It seems that Eskom gave the community a great deal of confidence that it would be electrified within the next few years – as the community decided not to opt for the SHS project but for the grid thereafter (Cowan et al 1996). This position was taken despite the fact that Eskom could not indicate when exactly the electrification of the village was likely to take place. Anyway, the envisaged SHS pilot project could not proceed. And it is argued that the seemingly very promising conditions for the use of SHS technology in Folovhodwe were destroyed through these expectations for the electric grid (Geerdts 1996).

In 1997 however, another initiative to exploit the promising conditions for the use of SHS technology in this village was taken. The Bavarian government approached the DME with a proposal for the establishment of a Solar Village to serve as a demonstration and test site for solar electrification (Thom et al 2000). The Bavarian government would provide grant funding for the project in the form of hardware products, such as photovoltaic modules, charge controllers, DC-DC converters, and

DC energy efficient lamps; and the DME would provide the cost of the balance of system equipment and the cost of SHSs installation (RAPS 2000). The village of Folovhodwe was proposed, as it was one of a few communities for which information was available, and because, as it came out, it was unlikely to receive grid electricity in the short to medium term (RAPS 2000).

During 1997 and 1998, several national government officials, from both countries, local government officials, manufacturer representatives and other role players visited the village, and meetings were held with the community's representatives (civic, headmen, Project Steering Committee). It is argued that unrealistic presentations and promises were made to the community in these meetings, due mainly to over eagerness to get the project established (RAPS 2000). These presentations and promises did not centre on such things as the necessity of paying a service fee. And when the community was later informed of the actual fees they would be expected to pay, they revolted (Thom et al 2000).

However, despite the unhappiness in the community and the fact that no monies were coming in, the installation process was completed in February 1999, and the official opening of the project took place in mid March 1999 (RAPS 2000). No connection fee was received from any household before installation, and no service fees were collected until November 1999, and this happened only when a second project got underway to sort out the problems experienced by the initial project (RAPS 2000).

A connection fee of R100 had been initially intended, but installation took place before collection was made (RAPS 2000). The idea of the collection of a connection fee has subsequently been dropped. Also, although a monthly service fee of R35 per month was requested to make the project sustainable, the community decided to pay only R20 per month (RAPS 2000). And although, according to RAPS (2000), the majority of householders in Folovhodwe could afford a R35 per month service fee, only about 3 per cent of householders paid R35 towards the requested R100 connection fee in January/February 1999. And although the community confirmed, at a community meeting held on 5 December 1999, their decision to contribute R20 per month towards the service, it was not until April 2000 that some service payment was

received (RAPS 2000). During the same month (April), about 9 SHSs had their solar modules removed due to non-payment (RAPS 2000).

2.2.3 KwaBhaza

This joint venture project between Eskom and Total at KwaBhaza in the KwaZulu-Natal Province was aimed at testing the concept of energisation[1]. This is a form of integrated energy delivery project, where PV systems and Liquified Petroleum Gas (LPG) were combined in a package and offered to rural households in an attempt to meet all their energy needs (Annecke 2000). The village was chosen as a pilot project area because it is very remote, far from any grid infrastructure, and it was felt that the provision of grid-based electricity to this community would not be an economically viable decision (Hochmuth et al 1999).

The KwaBhaza project gathered 80 signatures of intent to purchase SHS and gas supplies at their 'Energy Day', and delivery of systems started in October 1998 (Hochmuth et al 1999). By January 1999, some 40 systems had been put in place (Hochmuth et al 1999). The energisation package consists of 49Wp solar home system and an LPG hardware set comprising a two-plate stove and two cylinders weighing 4.5 kg each (Hochmuth et al 1999). The package and its installation cost about R3 300; a deposit of R140 is payable by the end-user before the installation, and users pay monthly instalments of R55 over 36 months to cover gas refill, capital and maintenance costs (Hochmuth et al 1999). Finance is provided from Eskom's funding, and Ithala Bank, which was supposed to finance the systems initially, is now providing loans to users who want to upgrade their systems (Hochmuth et al 1999). Previously, the DME agreed in principle to provide a subsidy of R1 500 (through REFSA[2]) for each system, but that was not effected (Hochmuth et al 1999).

[1] See Kloot (1999) for more information on energisation.
[2] Renewable energy for South Africa (REFSA) was established on 1 October 1995 – and has provided impetus to initiatives to arrange suitable forms of financing for renewable energy projects, with a specific focus on SHS dissemination. See Davis (1996) for more information on REFSA.

According to Annecke (2000), the uptake has been incremental but slow, and she quotes Kloot (1999) to the effect that, the greatest barrier to acceptance was the expectation of grid electricity.

2.2.4 The Free State farm-worker programme

Since 1990, three of the four District Councils in the Free State Province have been implementing a service provision programme to supply water and electricity to farm-worker households (RAPS 2000). The initiative involved extensive subsidisation by the District Councils - at a rate of R2000 to R2500 (Thom et al 2000). According to Annecke (2000), the programme has been successful in delivering nearly 1800 solar home systems to farm-worker households (at no cost to them) on nearly 280 farms in the Free State Province, which had been determined to be too costly for grid electrification.

Various sizes of SHS formed part of the programme. The most common size system consists of a 20Wp solar module and a 50Ah battery driving 2 fluorescent lights (RAPS 2000). According to RAPS (2000), the small size systems are largely designed to match the subsidy, and larger systems are supplied only where the farmer is willing to pay the additional cost associated with a SHS catering for more than two lights.

It has been established that there has been a significant drop in SHS installations since 1995, due partly to the high levels of grid electrification of farm-worker households (RAPS 2000). Also important is the fact that only about 60 per cent of the systems were operating reasonably well at the time of the survey (RAPS 2000). According to Annecke (2000), this is partly attributed to the fact that, the ownership of solar systems is not clearly understood – and this fact has a negative effect on the sense of responsibility and involvement by farmers and farm-workers in looking after the systems. It is also worth noting that, an evaluation conducted in 1998 showed that 41 per cent of the SHS users were dissatisfied with the systems (Hochmuth & Morris 1998) – despite the fact that they were not expected to contribute anything towards the payment.

2.2.5 Eskom-Shell Joint Venture

In 1999 a joint venture between Eskom and Shell was initiated in the village of Bipha, in the Eastern Cape. By June 2000, the joint venture had installed about 6000 SHSs in the O.R. Tambo district - northern Transkei. The intention was to supply more than fifty thousand households with 50Wp photovoltaic systems capable of powering small black and white television sets, radios and three to four lights, during the next two-and –a-half years (Banks et al 2000). The joint venture was planned to operate on commercial principles, and is mainly characterised by a 'fee-for-service' contract.

According to the 1999 figures, the hardware and installation of one system cost R5 100 (Hochmuth et al 1999). The consumers do not own the systems (systems remain the property of the service provider), but pay R150 for installation and a monthly fee-for-service of R52 per month (Banks & Karottki 2000). The utility type 'fee-for-service' structure includes full maintenance and replacements of parts such as the battery of the SHS at no additional cost. And it is believed that this R52 monthly fee-for-service is reasonable when compared to existing expenditure on candles, paraffin and batteries for lighting, radio and television, which is replaceable in full or in part by the use of SHS (RAPS 2000).

The service is managed via a prepayment meter, which is activated when the end-user inserts a magnetic card with a specific number of days user credit. The system is pre-programmed in such a way that at the end of a 30-day period, for instance, it automatically switches off, unless a new card has been inserted (Qase 2000). The system shows the number of days that are remaining before the load is automatically disconnected, thereby allowing customers time to purchase a new card (Qase 2000).

The SHS package consists of: 50Wp solar module, module pole mounting structure, 4 compact fluorescent lights of 9W, system controller with integrated charge controller and DC-DC converter to supply current for a Monochrome DC TV connection and radio, 105Ah battery and system controller enclosure (RAPS 2000). The system is capable of powering 4 hours of lights, 4 hours of television and 6 hours of radio daily

(Qase 2000). The system can be used in different output configurations, as long as the total power consumed is 200Wh or less a day (Ruffini 1999). Those who require more power (to power more lights, for instance) must invest in an additional system.

Qase (2000) notes that communities have mixed reactions towards SHS. In some villages, communities are happy with the system, while in others they have rejected it altogether. She states that those communities who reject it argue that, they want "proper" electricity, which they can use to cook and power their vacuum cleaners and washing machines (Qase 2000).

The Eskom-Shell JV project in the Eastern Cape forms part of the DME's non-grid concessions programme, even though it has been implemented in advance. This means that the Eskom-Shell joint venture will be participating in the South African non-grid programme as a concessionaire. This is a delivery model currently selected by government, with the aim of providing non-grid energy services to the section of the rural population that will not receive grid electricity in the foreseeable future. It grants non-grid concessions to public-private partnerships in particular geographic areas (ECON 1999). By October 1999, six consortia (including Eskom-Shell JV) had been selected as potential concessionaires, from twenty-eight parties interested in the programme (ECON 1999).

According to Banks et al (2000), this non-grid concessions programme, which is characterised by a 'fee-for-service' approach, has been developed to try and resolve some problems and difficulties associated with solar home system dissemination. The 'Electrification Strategy Document' (a document which contains some principles to guide the national electrification programme) of the National Electrification Co-ordinating Committee (cited by Thom et al 2000: 17) states the following on the reasons for the selected approach to non-grid service delivery selected for the South African programme:

> The South African government has investigated the pure commercial route of SHS dissemination through the REFSA programme. However, out of this experience and in view of

the successful grid extension programme alluded to above, it was decided to follow a utility route also in the case of SHS dissemination.

The utility route can readily address the delivery issues and the affordability question. The utility will install, maintain and own systems and sell the service at an appropriate monthly tariff.

The six consortia that will be participating in this programme are expected to adopt an energisation delivery model, which promotes fuels like gas and paraffin in addition to SHS. This energisation model has been motivated by the realisation that electrification often does not meet all the energy needs of households who, after electrification, tend to continue to rely on multiple fuel sources (ECON 1999).

A thorough and systematic investigation into the constraints pertaining to the widespread use of SHS is of vital importance for this programme, particularly given that the provision of non-grid electricity via the concessionaire delivery mode, with emphasis on SHS technology, is a relatively new concept internationally. That is one of the reasons why the fieldwork in Eastern Cape is so vital.

2.3 Post-electrification study of the Tambo and Mafefe pilot projects

2.3.1 Introduction

Electrification of rural areas present a significant challenge due to the high cost of electrification, distribution losses and low consumption rates in these areas. Faced with the difficult task of devising electrification policies in these areas, where costs are high and consumption remains low, Eskom proposed – as part of a broad initiative to reduce the costs of electrification, to develop and implement current-limited supplies in rural areas, particularly those which are far from the electricity grid and have low settlement densities (James 1997). In 1995, Eskom requested the Energy and Development Research Centre (EDRC) to undertake a pre-electrification[3] study at Tambo (July) and Mafefe (October) villages prior to commencement of the

[3] See James (1996) and Thom (1996) for a detailed report on the pre-electrification research, including the history of the villages.

installation of the infrastructure. A post-electrification research was then conducted in 1996. The Tambo and Mafefe electrification project case studies form part of the EDRC project: "The role of electricity in the integrated provision of energy to rural areas".

The information presented below has mainly been obtained from studies conducted for the purpose of assessing the pre-electrification process in the Tambo (James 1996) and Mafefe (Thom 1996) village pilot projects; a study of rural household's response to the 2.5Ampere electricity supply option in the Tambo village pilot project (James & Ntutela 1997); a post-electrification study of the Mafefe electrification project (Wentzel et al 1997); and a study on current-limited supplies of electricity in the context of South African rural areas (James 1997).

2.3.2 Background on the villages

Tambo village

Tambo village is located in RA60, some thirty kilometres from Queenstown and nine kilometres from Whittlesea[4]. After consulting the Cape Provincial Administration (CPA) about a suitable village for the pilot project, and after visiting a number of sites, Eskom decided that any of the villages in RA60 would be an appropriate site for the pilot project. Although not situated in a deep rural area – which is far away from the existing electricity grid, it was felt that the villages in RA60 were suitable because the settlement patterns were not dense and electricity consumption rates were likely to be low. The villages were easily accessible and also considered to be large enough, with a degree of permanent occupancy, to justify the implementation of the project.

The Tambo village was selected as a site where Eskom piloted the current-limited supply of electricity, mainly because of the existence of 'strong' community leadership, which Eskom considered important in that it could rely on to ensure that the project was accepted and that tasks within the village would be undertaken.

Mafefe village

Mafefe village, on the other hand, is an area of approximately 250 square kilometres in the Limpopo Province. It is situated roughly 75 kilometres from Polokwane in a south-easterly direction on the Burgersport road, in a triangle between the Strydpoortberg, the north-eastern Drakensberg and the Olifants river . Most of the area is mountainous and uninhabitable, but has relatively high rainfall, with fertile land in the valleys of the surrounding mountains. Villages are situated mainly along the foot of the mountains above the arable land (Thom 1996).

The Mafefe electrification project has a long and interesting history. After a long drawn-out debate on the electrification of the area, Mafefe was ultimately selected as yet another site for Eskom to pilot the current-limited supply of electricity. The decision to expand Mafefe as a pilot project was made partly because of the good relationship which had been established with the Mafefe Electricity Committee (MEC[5]) – seen as a dynamic organisation in the area.

2.3.3 Supply packages

In each village, current-limited supply was introduced together with other supply capacity, with each supply capacity having a different tariff and connection fee. In Tambo, households had to pay a R10 connection fee and a monthly flat-rate tariff of R15 for a 2.5A supply. Households failing to pay the monthly flat-rate tariff were immediately disconnected and could only be reconnected after paying a reconnection fee of R15. For a 20A supply, the connection fee was R200 and the standard homelight tariff of 26.84c/kWh with pre-payment meter was charged in 1995.

In Mafefe, customers were provided with two supply options: the 2.5A supply with a monthly flat-rate tariff of R8.50 and R10 connection fee; conventional meters with both the 20A and 60A supply and the connection fee of R300 and R450, respectively.

[4] See James and Ntutela (1997) for the location map of Tambo village.
[5] The Mafefe Electricity Committee (MEC) was established in December 1991 with the purpose of bringing electricity to Mafefe. See Thom (1996) for more information on the MEC.

A fixed monthly charge of R37.03 and an energy charge of 20c/kWh was charged for both 20A and 60A supplies. The R8.50 monthly flat-rate was charged for the first six months and then R15 was charged for the next two months. Due to the unpopularity of this price hike, the flat-rate tariff was dropped to R8.50 again after only two months at R15 per month. (James 1997).

With a 2.5A supply of electricity, it is possible to use any appliance which does not require more than 560W to operate. This means that thermal applications are not possible, and although certain appliances, such as irons and kettles, had been adapted to operate with a 2.5A supply, these were not freely available on the market (James & Ntutela 1997).

2.3.4 Problems experienced by communities

Level of supply and expenditure considerations

About a year after the process of implementing the 2.5A supply had started, a post-electrification research was conducted in both villages. The research revealed that most households who opted for the 20A and 60A supplies, did so because they wanted to be able to use them for a range of electricity services not available with a 2.5A supply. A significant establishment around this issue was that not all these households fell into the high income category. Another important reason for households selecting the 20A and 60A supplies was so that they could control their monthly expenditure on electricity. The pre-payment meter allowed for flexibility and control over expenditure. It is reported that not one person interviewed was happy to pay a flat-rate tariff, and everyone mentioned their preference for a pre-payment meter. (James & Ntutela 1997; and Wentzel et al 1997).

The interviews also revealed that many people with the 2.5A supply at Tambo and Mafefe felt that the connection fee for the 20A and 60A militated against them being able to think about saving for or purchasing thermal appliances. Although they were aware of the fact that it was possible to upgrade, they felt that the poor were being penalised in these villages if one compared the connection fees with other villages and

urban areas. They also wanted pre-payment meters so that they would be able to control their expenditure, spend less on electricity and avoid paying a reconnection fee. The desire to have pre-payment meter was overwhelming even to a number of people who had expressed happiness with the 2.5A level of supply.

It was also found that energy expenditure had increased in every household since electrification. In households where fuels for lighting, and batteries for radios and TV sets were not displaced by electricity, energy expenditure had significantly increased. Also, the greater the number of appliances which could not be used with electricity (radio and TV) and the more rooms which required wiring, the greater the increase in the household's energy expenditure.

Electricity disconnections and poor customer service

A total of 497 households had been electrified in Tambo since the beginning of the project in 1995, with 131 opting for a 20A supply, while 366 were connected to a 2.5A supply of electricity (James & Ntutela 1997). Nearly 72 per cent of households with a 2.5A supply had been cut off due to non-payment by the beginning of October 1996 – only seven months after the first group of houses had been 'switched on'. As 20A households had pre-payment meters, disconnections only affected the 2.5A supply households which had to pay a flat-rate tariff. With few reconnection payments being made, only 78 households were still connected to their electricity supply by the beginning of October, and a further 54 households were to be disconnected. By the end of November, fewer than thirty households were connected.

With R8.50 monthly tariff charged in Mafefe, very few households were disconnected. However, when the tariff was raised to R15, there were more disconnections. It is stated that, at the time of the fieldwork for the post-electrification research, the flat-rate tariff had been raised from R8.50 to R15. After one month of paying the increased tariff, more than 50 of the 790 households with a 2.5A supply had been cut off as a result of non-payment.

It has been argued that in both villages, one of the reasons for the high rate of non-payment lies with the circumstances and expenditure priorities in individual households, which had resulted in their being unable to pay the flat-rate. And it was found that the flat-rate was particularly burdensome on pensioners, as the pension is often the sole source of income for a household. People felt that paying R15 for lighting only was too much.

Another reason lies with the revenue collection system and the disconnection process. The following are some of the problems experienced in this regards:

- Households were disconnected despite having made their monthly payments.
- Households which had settled their accounts did not appear on the reconnection list.
- The cut-off date for payment was not flexible, especially with regard to pensioners who were not paid at the same time each month and were often paid later than the Eskom cut off date.
- Poor communication between Eskom and the community (for example, a question of who to report to when there is a problem).

2.3.5 Livelihood strategies

It was found that state welfare grants, in the form of pensions and disability grants, were the predominant source of income in both areas. Labour migrancy was still an important income-generating strategy for households, although remittances from migrant workers were unreliable, unstable and infrequent. Another commonality between the two localities was the reliance on part-time project work for income. Projects funded by the state or outside donors, such as Mvula Trust and Operation Hunger, provided important short-term, albeit unsustainable, income opportunities.

In Mafefe, subsistence agriculture was an important livelihood strategy, although there were distinct disparities and inequalities of access to the fertile land (see Thom 1997). In Tambo on the other hand, there was little reliance on agricultural activities for survival. It was also established that, despite its relative advantage of having easy

access to major roads and urban centres. Tambo was much like other rural areas in South Africa – characterised by high levels of poverty, lack of income opportunities and basic resources.

2.3.6 Effect of electricity on rural energy use

Multiple fuel use was found to be common in all households in the researched areas, and it was established that electricity did not displace other fuels. The key findings with regard to multiple fuel use include (James 1997):

- Candles and paraffin were still being used for lighting as not all rooms had been wired. It is said that this was a result of the cost of materials, as well as the cost and availability of labour. These fuels were also used when power failed.
- Electricity was not used to operate radios and televisions. Radios did not have internal mechanisms to use electricity and there were no conversion mechanisms available. Thus, dry cell batteries continued to be used. Some of the television sets were found to trip the electricity supply, and these households continued to use car batteries to power the televisions.
- Fridges were not extensively owned or desired by the households interviewed. It was found that only households wishing to use refrigeration for income generation purposes wanted to obtain them.
- Besides the irons and kettles given away by Eskom, none of the households had prioritised expenditure on kettles and irons.
- Hotplates were prioritised above irons and kettles. But, although some households owned hotplates, there was not a displacement of other fuels by electricity. A variety of appliances and fuel combinations were used for cooking. Only food which cooked quickly was cooked with electricity.

2.3.7 A new approach

This approach was abandoned because of the negative response in these communities. It is argued that the communities of Tambo and Mafefe did not object to the 2.5A supply *per se* , but to the flat-rate tariff and the fact that other supply options were not provided at affordable connection fee (Thom et al 2000).

Since the beginning of 2000, Eskom has been providing the 2.5A supply, with a pre-payment meter, to households in pilot areas who cannot afford to pay the connection fee for the standard 20A supply option (R150 at present) (Thom et al 2000). The tariff paid by 2.5A users is the same as the 20A tariff, comprising a simple unit energy charge with no fixed monthly charges (Thom et al 2000). Users can upgrade to a higher level of supply by paying the required connection fee.

This seems to be an appropriate strategy to ensure that electrified households – also the poorest who are unable to pay the connection fee, are able to use electricity. It is an important strategy to ensure that there is greater equity in access to electricity within rural areas.

2.3.8 Conclusion

The results of the research serve to provide insights into the appropriateness and acceptability of the current-limited supplies, especially as low as 2.5A. The flat-rate tariff seemed to loom large in people's perceptions of the 2.5A supply and overshadowed the positive aspects of this supply option in Tambo and Mafefe. The flat–rate was not appropriate because it was inflexible, requiring consistent payments at the same time each month. According to James (1997), such a tariff does not take account of the shifting circumstances and priorities in rural households, where the ability of households to absorb crisis or unusual demands on their financial resources are limited.

CHAPTER THREE – MATERIALS AND METHODS

3.1 Introduction

Much of literature review reveals that the dominant constraints on the widespread use of solar home systems are economic and technical. The emphasis here has been on affordability and the limited nature of the system. It is argued that the initial purchase cost of the system, particularly, is too high for the rural households to be able to afford this technology; and that the system delivers a far more restricted level of service to households. Unfortunately, to correct this situation, there has been a tendency to ignore or pay very little attention to other factors which have an enormous impact on the daily use of energy.

Concerned about this situation, the researcher proposed to embark on a study that would investigate key barriers to the widespread use of the system, establish households' conceptions of and experience with SHS, and ascertain how acceptable the system is to the rural households. Although the study has focussed on investigating socio-cultural factors, the method used to collect data (face-to-face individual interviews) has left enough room for other factors to surface (see questionnaire in Appendix). It is believed that the analysis of the face-to-face interviews and observations will bring out relevant points in terms of understanding the impact of socio-cultural factors on the daily use of energy by rural households.

3.2 The research area

The fieldwork was conducted in July 2002 in the O.R. Tambo district (DC 15) in northern Transkei – Eastern Cape. Eastern Cape was selected mainly because the project there is the largest in South Africa to date - with about 6000 SHSs installed by Eskom-Shell joint venture in the first phase (Thom et al 2000). The process of defining institutional and legal frameworks within which the service providers can operate has been the main cause of delay in getting the second phase started (Banks 2003). There are about eight areas which have been supplied with SHSs in the O.R.

Tambo district, and the Mbizana Local Municipality (EC 151) selected for the study, is one of these areas.

The local municipality of EC 151 consists of 21 wards and has 42 councillors. The area of the municipality is 2 411 square kilometres, and there are about 81 areas that make up the municipality. The areas include Mfundisweni and Ntlenzi (made up of two villages – Ndakeni and Rockville) which were selected for the study (see Figure 3.1.). It should be noted that the three villages used to fall under the former Flagstaff district, and it was only after the new demarcation that they are now part of Mbizana. The main shopping town of the villagers however, is still Flagstaff.

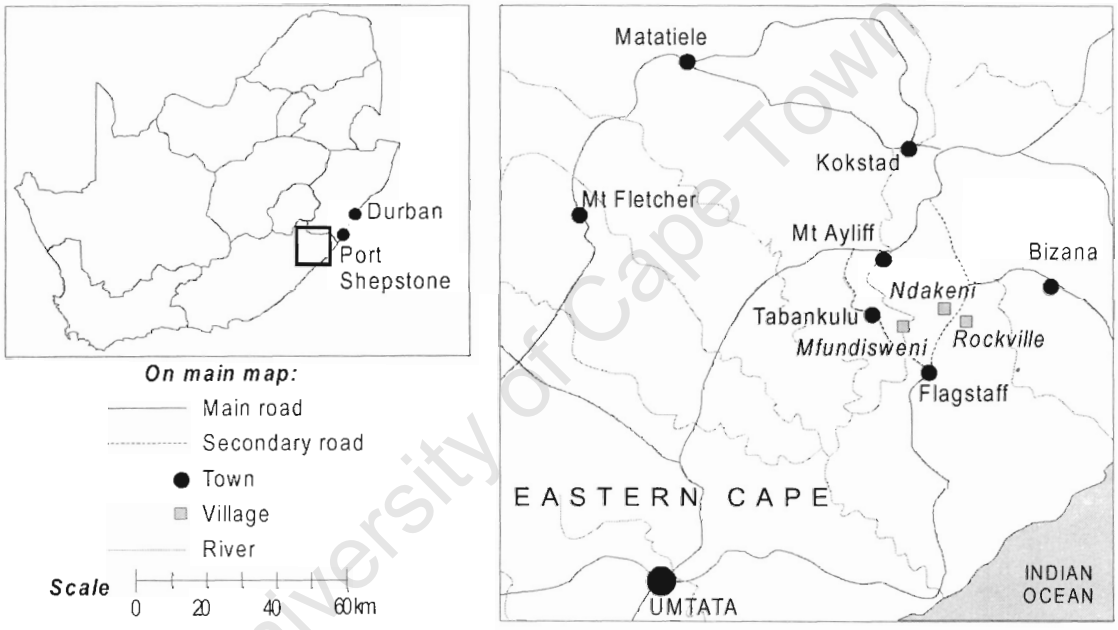

Figure 3.1: Location map of Mbizana

The main road which runs through Ntlenzi divides Ntlenzi into two villages, namely, Ndakeni and Rockville. The demographics for Mfundisweni and Ntlenzi – including the number of households, estimated household income, population, gender and age breakdown are provided in Table 3.1.

	Mfundisweni	Ntlenzi
General		
No. of households	1 987	5 128
Estimated income of all hhs	5890200	10804800
Population		
African	4 388	11697
Coloured	4	12
Indian	0	3
White	0	0
Other	12	33
Gender		
Male	1987	5 128
Female	2 413	6 608
Age breakdown		
0-4	650	1 895
5-19	1 869	5 359
20-29	682	1 277
30-49	627	1 612
50-64	307	760
Over 65	244	804
Age unknown	23	31

Table 3.1: Demographics for Mfundisweni and Ntlenzi. Source: www.demarcation.org.za.

3.3 Getting settled

The author chose to reside in one of the villages during the fieldwork to participate as fully as possible in the social life of the community. This was not an easy decision to make, in the light of hostile reactions that the author, as a Xhosa, could expect from these communities. The Mbizana Local Municipality and many other local

municipalities in the O.R. Tambo district are made up of areas referred to as "emaMpondweni" (the place of Mpondo), and about 90 per cent of people residing in Mbizana are "amaMpondo" (the Mpondo people). The two groups – "amaMpondo" and "amaXhosa" speak the same language – that is Xhosa, although "amaMpondo speak the language with a dialect. The author however, had no problem with the slang – having worked in the mines for years with "amaMpondo", and the language therefore was not the basis for fear of hostile reactions.

The hostility between the two groups actually originates mainly from 'ethnic' squabbles about "amaMpondo" not going to the initiation school, and therefore looked down on and referred to as "amakhwenkwe" (boys) by "amaXhosa" (there is a dramatic change to this situation now as more and more young "amaMpondo" are going to the school). This hostility could be more intense if you were coming from the former Ciskei (like the author), as this tendency to call others 'boys' is known to be widespread and still practised in these areas. But, a researcher has to take his or her chances in worse situations.

After a few long phone calls, a SHS inspector at Mfundisweni offered to host the author. On arrival, however (which was late in the afternoon), the host was not at home and he was coming home only late in the evening. Given the pressure that the author was under – in terms of time constraints, every minute of the time had to be used effectively. And so the author decided to make use of this time, by visiting a spaza shop (about 500 metres away) which had been pointed out by the kids at the host's residence. This spaza shop also operated as a shebeen - selling different kinds of liquor and beer, including "umqombothi" (traditional beer), and the children had informed the author that the host's father was there – drinking "umqombothi" with other men. This was the author's opportunity to test the ground (these men could be the 'real' gatekeepers) – by going there and introduce himself, come what may come.

To the author's great relief, he received a very warm welcome after a brief introduction which included mentioning who his host was (there were about twelve men sitting outside the spaza shop drinking, and three women inside the shop). The introduction was quickly followed by a conversation, which involved disclosing

personal life, hobbies, interests and background. And this, coupled with the use of a bit of persuasion, and the ability of the author to quickly determine the kind of person an individual would feel most comfortable with and then to adapt as much as possible without being necessarily insincere, convince the group to accept the author. Another advantage was that most of the men here had worked in the mining industries, and that experience was gone over once more. It soon became clear that the author had been accepted as a non-threatening person who just needed information – information which could be vital in addressing some of their problems in the long run.

When we got 'home' that evening (with the inspector's father), the host was still not around, but there was nothing to worry about now. The ice had been broken. He only arrived around nine o'clock at night, and between the three of us, we agreed that I get one of the rondavels to sleep in. The author was now in a good position to freely observe daily life.

3.4 Sampling process

The Mbizana area was randomly selected from eight areas which have SHSs in the region. And due mainly to time and financial constraints, only three villages could be selected for the study. The three villages were also randomly selected.

In the selection of households for the sample, non-probability type of sampling, in the form of quota sampling had to be employed – again due mainly to time and financial constraints. Another reason for using quota sampling is that it is easier, cheaper, and quicker than, for instance, probability sampling. It is also useful in that the researcher can ensure that some population differences are in the sample (this makes it an ideal type of sampling for this study).

The selection of households for the sample was based on the relative state of poverty of households. Also, three generations (between the ages 18 and 34; 35-59; 60 and above) were interviewed to ensure that a wide range of households and respondents, including the very poor and young were included. The households were selected as follows:

- Ensuring that households covered all three categories of relative poverty and wealth (the sample was biased towards the poor). Solving the problem and difficulty of trying to define the extent to which households are poor was made easier by the help of the 'inspector' (maintenance and outlet agent of the SHS token cards) who resides at Mfundisweni, and is responsible for Mfundisweni and other villages (excluding Ndakeni and Rockville). Even though this person is no longer responsible for Ndakeni and Rockville, he used to work there and he knows the people in these villages quite well (particularly those with SHS). He was therefore able to help identify (from a list of SHS users which the researcher had managed to get hold of) which households were poor.

  This was done by suggesting a combination of one or more of the following factors as indicators of poverty: (a) lack of a stable source of income as well as dependence on pension as means of income and survival (b) a large number of children in the household (c) the absence of a male in the household (d) type of houses in the homestead. The researcher also played a role in influencing this definition; and in the end, the perception was used to group the households.
- Ensuring that there was equal representation of age groups in different households, as one of the components of the study has been to establish the influence of age on energy and appliance use and acquisition.
- Ensuring that both men and women were included (but biased towards women).
- Inclusion of SHS non-users (biased towards SHS users).
- Willingness to participate in the research.

In the end, 40 respondents – 34 SHS users and 6 SHS non-users were interviewed. These included 27 women and 13 men (see Figure 3.2).

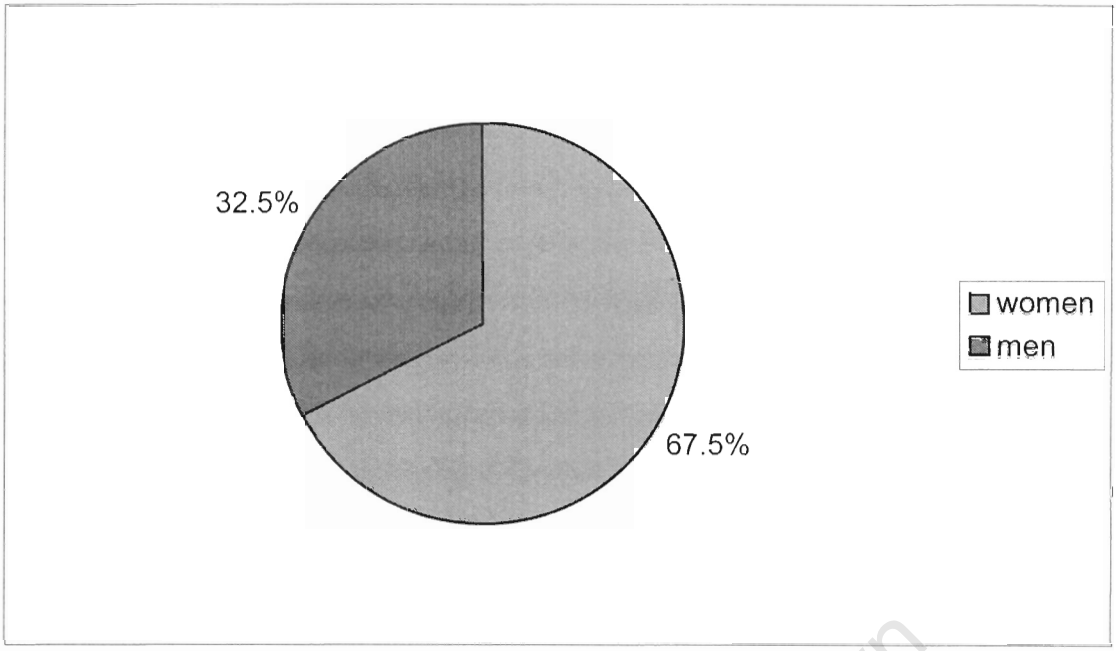

Figure 3.2: Gender bias in sampled household respondents

It can be seen from Figure 3.2 that female respondents dominated. This bias is attributed mainly to the fact that females are mostly the direct end-users of energy in African homes, and as they are likely to be passionate about energy issues, they are also likely to respond to questions about energy use in a passionate manner.

The interviewees included 2,5 per cent respondents under the age of 18; 37.5 per cent between the ages 18 and 34; 37.5 per cent between 35 and 59 years; and 22.5 per cent from 60 years and above (see Figure 3.3).

Figure 3.3 shows that over 97 per cent of the respondents were above 18 years, which is an indication of maturity of the responses. Furthermore, about 70 per cent of the respondents can be said to be in their 'active' age (i.e. between 18 and 59 years), and this indicates the likelihood that most of the respondents knew what they were responding to. About 22.5 per cent of the respondents were above 59 years.

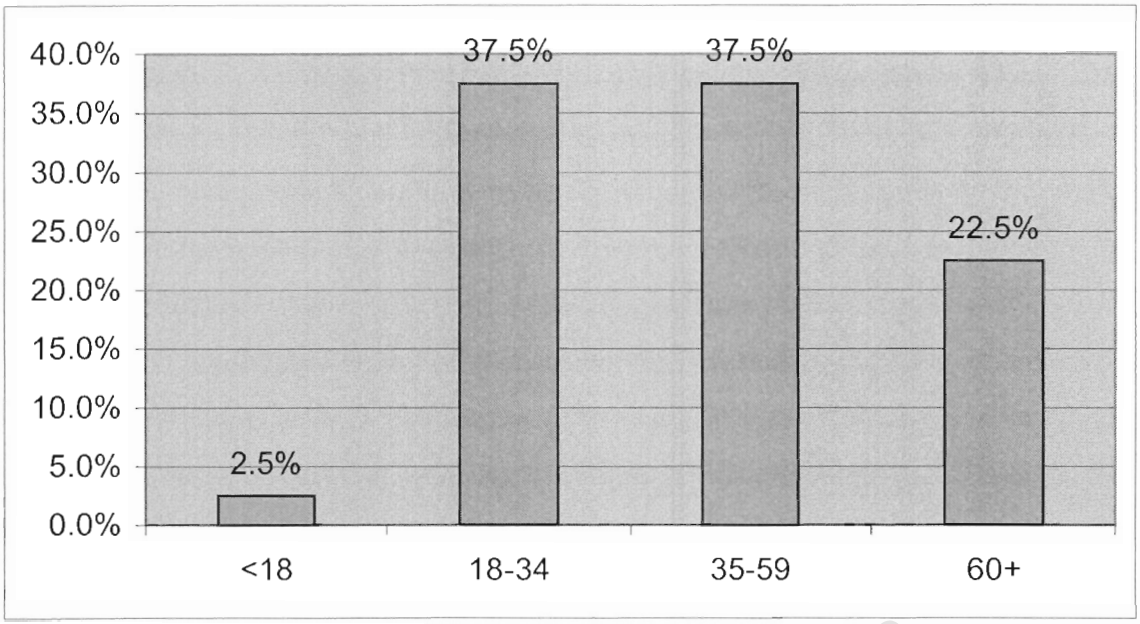

Figure 3.3: Age group of respondents

3.5 Participant observation and individual face-to-face interviews

It should be noted at this stage that the warm welcome the author received did not end in the shebeen. In the course of the fieldwork, a similar strategy as that used in the first introduction continued to be employed (without exaggeration) to build trust and gain access. And the author was thrilled by the intense interest the households interviewed and the people overall expressed and how cooperative they were. In a number of cases, some members of the households who had initially shown reluctance to participate in the interviews and had referred the interviewer (author) to others to interview, had later developed some interest in the interviews and came back to listen and take part.

The author went to the field aware that in a multilingual society like South Africa, it is important that respondents are interviewed and answer questions in a language they feel comfortable with. This implies that questionnaires need to be translated. The questionnaire used in this research -- to look at various aspects of energy utilisation and probe opinions and experiences about the SHS, was originally in English (see Appendix). Weeks before departing for the field, the author had gone into an exercise of translating the questionnaire from the original language into Xhosa, and conducted

some mock interviews. This exercise proved useful, in that during the actual interviews, the translation went smoothly. The interviews were conducted in Xhosa, but the responses were written in the original language (English). After the interviews, the back-translated version was then checked against the original version.

There was no need to have someone helping with the translations as Xhosa is the author's home language. However, in the light of suspicions that may be raised or uneasiness at which people might find themselves when a total stranger comes knocking at one's door, it was necessary to have someone known in the villages to accompany the author. This person would help not only with pointing out the targeted households, but with making the initial introduction (such as introducing himself first and then the author). With the help of the inspector, the author was able to get a person who knows the three villages quite well and whose clan name was well-known. Having this person helped to put the approached household members at ease and to get the respondents relaxed.

As mentioned earlier, residing in one of the villages put the author in a position to freely observe daily life. Participant observation, both within the homestead and the greater community provided valuable aspect to the research. The insight gained established an intuitive understanding of the information collected through more formal techniques.

Interviews and observations focused mainly around the following issues: household income, appliances, household budgeting and decision-making on expenditure; social relationships; perceptions and experiences with SHS. And it should be noted that, well-informed responses were received from women, who appeared to be most aware of the energy use and needs of the family.

When the interviews were complete, the open-ended responses were coded (with the author often having to interpret the meaning of the responses) before analysis. They were then analysed (using a multi-disciplinary approach) answering the research questions that had led to the study in the first place.

CHAPTER FOUR - RESEARCH RESULTS

Before we get to the actual establishments, it is important that a brief comment be made on the "household" as a unit of analysis.

4.1 Understanding the 'household' as a unit of analysis: Household dynamics

It will be noticed from this study that the investigation and analysis of findings has been located within the context of the 'household'. It is important, therefore, to briefly comment on the general understanding of the 'household' before the research findings are presented. The household is seen as central to domestic energy use, and is an important unit of analysis used by developers and planners. The definition of the term "household" however, has often been a contested issue. In rural energy studies, households are assumed to be homogeneous units. According to James and Ntutela (1997: 2), this assumption stems largely from neo-classical economic notions of the household which can be simply summarised as follows:

- Households behave as if they were a single entity, with internal harmony of interests.
- Decision-making on the allocation of resources is based on altruistic principles where decisions are made to maximise joint welfare (cited in Kabeer 1994; Kabeer & Joekes 1991).

This model has been critiqued by anthropologists and their insights have been supported by a growing body of literature which points to inequalities within households. These anthropologists argue that the notion of the household should be seen and located within particular socio-cultural and politico-economical contexts. According to Ross (1993b – cited in Mehlwana and Qase 1999: 20), 'it is inappropriate in certain contexts to view the household as co-residential ('living together'), commensal ('eating from the same pot') and co-productive ('pooling resources for all in the household) units at the same time'. It has been shown that an individual's allegiance shifts between these units – they may be commensal in one unit, resident in another and co-produce for the benefit of various units (Mehlwana & Qase 1999).

The anthropologists' argument seems to agree with what is visibly apparent in Mbizana. And for the purpose of this study, a similar model has been used to define the 'household'. It was observed, for example, that dwellings tend to be built in clusters in which an extended family resides. These clusters are referred to as 'homesteads' and consist of a number of 'households'. There are also people who live in the same homestead and share a number of things (for example, the cost of candles and paraffin), but do not eat from the same pot. These would be considered separate households by the 'neo-classical economic' definition. In fact, all in all the definition is much more complex than envisaged.

4.2 Density of villages

Three factors are usually considered in planning the extension of the electric grid. These are: the remoteness of the villages from the existing grid; population density; topographic relief. It was observed that the villages do not depict any of these features. For instance, the main road from Flagstaff which joins the road to Kokstad and Bizana runs between Ndakeni and Rockville – these areas are no more than 200 metres from the road and no more than 10 kilometres from the nearest grid. And Mfundisweni, which is a bit further, is no more than 5 kilometres from the road and no more than 15 kilometres from the grid (see Figure3.1). This suggests that the expectations of the communities to obtain the grid are likely to be high in these villages. Indeed, if these factors are powerful enough in determining whether a certain area should be grid electrified or provided with SHS, these villages are likely to be provided with grid electricity in the near future.

4.3 Local variation

There is very little variation between the villages, except the following:

- Approximately 90 per cent of households in Mfundisweni use wood for cooking compared to about 70 per cent of those in Rockville and Ndakeni. This is mainly because Mfundisweni is closer to the forest.
- The transport costs for all resources are less in Rockville and Ndakeni than in Mfundisweni. This is because these two villages are closer to the main road and formal shops, and the household members do not have to change transport to get to the nearest town. Also their closer proximity to the main road means that they can always get someone going to town to buy them the goods they need at a lower price. Moreover, formal shops tend to be cheaper than spazas, which are prevalent in Mfundisweni.
- Recharging or replacing car batteries costs less in Rockville and Ndakeni compared to Mfundisweni – again because of easy access to main road and charging facilities.

4.4 Type of houses

It was observed that in all three villages, basically two different types of house construction are predominant. The most common one is round traditional construction (rondavel) with a tin or thatch roof, or a combination of tin and thatch. The walls are made of soil, supported by a wooden substructure. The round houses are large, with an average circumference of about 17 meters and an average area of 21.3 square meters. They always consist of one room only, and they are 10-30 meters distant from each other. There are up to four in one homestead, and each of these houses is used for different purposes – for instance, as a sleeping room for young boys, a kitchen or a room for an older daughter.

The homesteads are not well-suited for illumination with SHS because each house needs only one light for general lighting and the other houses of the homestead have to be connected to the system by long cables.

The next common housing type is of rectangular shape with several rooms for different purposes. Some houses of this type have the same material and building technique employed for the round houses, and others are 'modern' constructions – characterised by concrete brick walls. There are many newly built houses of this type (others are in the process of being built) that are electrified with SHS, and most of them have three rooms each – although there are those with four to six rooms. The three-roomed houses are perfectly suited for providing all rooms with lighting with a standard-size SHS.

4.5 The position of respondents in the household

Respondents' position in the household is shown in Table 4.1 below.

Position in the household	Household head (Male)	Household head (Female)	Daughters of the hhh	Sons	Wives	Total
Number of respondents	8	7	17	6	2	40

Table 4.1: The position of respondents in the household

The Table shows that: 15 respondents are heads of the household (hhhs), of whom 7 are women and 8 are men (the majority of these male respondents are in fact, the sons who claim the household head position after the death of the father, even though the mother is still alive); 17 are daughters of the household head (including 4 daughters-in law and 3 granddaughters; 6 are sons (including 2 grandsons); and 2 are the wives of the household head.

4.6 Household income

The size of the household income is seen as one of the important factors in determining whether households can afford to own and use certain appliances and energy sources. Households in the study sample have various sources of income, but

the most important ones are old age pensions, salaries and remittances from family members working in urban areas. An attempt to work out an estimation of average household income proved a futile exercise however, as some of the respondents were reluctant to reveal the income of household members. Also, incomes from informal sources, remittances and livestock sales and their frequencies were poorly recalled by respondents – which makes it difficult to quantify the income.

Nevertheless, the interviews did reveal the number and percentage of households receiving income and remittances, as well as the average size of the sampled households (see Table 4.2 below).

Income source	Number of hhs receiving income	Percentage (%) of hhs receiving income	Average household size
Pension and remittances	16	40.0	8.1
Pension and salary	4	10.0	7.8
Salary and remittances	2	5.0	8.5
Pension only	7	17.5	6.1
Remittances only	1	2.5	6.0
Salary only	7	17.5	6.1
Pension and other sources	1	2.5	6.0
Salary and other sources	2	5.0	5.0
Total	40	100	7

Table 4.2: Number and percentage of households receiving income and remittances, as well as the average size of the sampled households

Table 4.2 shows that from the sample of 40 households, 16 (40.0%) households depend on both pensions and remittances; 2 (5.0%) are dependent on both salaries and remittances; and 1 (2,5%) household is dependant on remittances only. The average size of these households is 8.1; 8.5 and 6.0 respectively.

While some households receive regular remittances (12 households) others (households number 9, 12, 18, 19, 21, 22 and 30) get irregular remittances. The amount remitted varies and/or there are some months when no remittances are received. Regular remittances are mostly from sons, fathers or husbands and daughters who work mainly in Tekwini (Durban) and have children at home. Households 17, 28, 29 and 33 are supported by remittances from both daughters and sons; household 14 receives remittances only from a daughter; and seven other households (households 3, 6, 7, 11, 25, 27, and 32) are supported by fathers or sons or husbands. The remittances can be as large as R3 000 per month (household 11). And in most cases, these remittances are received by the household head or a member of the household who is responsible for managing the household.

Whilst 4 (10%) households in the sample are dependent on both pensions and salaries (households 2, 13, 15 and 34), 7 (17.5%) are completely dependent on pension (which is about R620 per month) as a household income (households 1, 5, 8, 20, 31, 37 and 38). The average size of these households is 7.8 and 6.1 respectively. Most pensions are old age pensions, but households 5 and 37 have members receiving disability pension. Another important aspect regarding the households receiving pensions is that in 9 households (households 8, 11, 12, 15, 16, 22, 32, 37 and 38) there are two members receiving pension in each household. In addition to the two pensions, household 16 supplements this income with income from raising and selling pigs. The size of this household is 6.0.

Table 4.2 also shows that there are 7 (17.5%) households in the sample that depend solely on salaries. This source of income is mainly from lady teachers working locally (households 10, 14, 23 and 36). The average size of these households is 6.1. In addition to the salary (net pay of which is about R5 166 per month), the household head in household 39 – a lady teacher, raises chickens for sale and also sells

vegetables from her garden. When we got to her place she was in overalls, very busy digging out the remains of cabbage she had planted herself and preparing the soil for the next planting. She said that her small projects are quite profitable, although she would not say exactly how much she makes from the sales. The person who gets a salary in household 35 is a SHS inspector, and this salary is in the form of a commission. The household supplements this income with money received from charging cell phones (costs R3 to charge a cell phone) and running a barber shop (hair cut costs R5). The average size of households 39 and 35 is 5.0.

Other income of the sampled households is derived from the sale of livestock and crops. In addition to the house plot, more than 50 per cent of the households own farming land and also own livestock. The income derived from all these sources is used for various purposes, including fuel and appliance purchase.

4.7 Appliance ownership and use

The main purpose of this section has been to establish the extent to which SHS is appropriate for the households – given the appliances they own and/or wish to use. It is often argued that poor households are happy with limited supplies of energy, as they are not likely to ever prioritise expenditure on appliances (see James & Ntutela 1997). The provision of electricity for lights and media only, is thus perceived to be entirely appropriate.

It is widely accepted that appliance use cannot be separated from fuels. As Mehlwana and Qase (1996) state, access to fuels influences the type of appliances people use, and access to appliances dictates use of certain fuels. Moreover, sometimes the cost of either a fuel or appliance might influence the effective utilisation of the other. Household appliances can be divided into four main categories, namely: appliances that are owned by the household and used; appliances that are owned but not used or used only occasionally; appliances that are not owned but used (borrowed) and appliances that the household plans to buy.

The interviews and observations reveal that the households own various appliances and various sources of energy are utilised to power these appliances. The number and percentage of appliances owned, and the energy sources utilised to power them is provided in Table 4.3. The Table however, shows only those appliances which are commonly owned by the sampled households – excluding paraffin and wood appliances. The exclusion of wood and paraffin is partly due to the fact that the study is concerned with the more environmentally and health-friendly fuels (and not in traditional and dirty carbon-based fuels), and to the fact that, over the years, there has been quite an extensive research on the use of these fuels and appliances and the constraints and opportunities regarding their usages have been well established (see, for instance, Hofmanner 1999). This does not suggest, however, that the debate is exhausted. Gas has been included because gas is regarded as a 'modern' source of energy in energy studies.

Appliance name	No. of hhs owning the appliance	Percentage (%) of hhs owning the appliance	Main energy source utilised
Hi-fi/radio	36	90.0	SHS
Black & White TV set	38	95.0	SHS
Colour TV set	17	42.5	*
Fridge	17	42.5	Gas
Stove	17	42.5	Gas
Cell phone	11	27.5	SHS

*appliance which is not used or used only occasionally on generator

Table 4.3: Number and percentage of appliances owned and the energy sources utilised to power them.

Table 4.3 shows that the majority of the interviewed households (36) own hi-fis/radios; 17 (42.5%) own colour television sets, fridges and stoves; and 11 (27.5%) own cell phones. About 80 per cent of the hi-fis/radios were gifts from employers, friends and relatives or they were remittances from family members working in the

cities, and they were mainly second hand. Others (20%) were bought new, mainly for cash and through hire purchase.

Out of the 17 households that own colour television sets, 7 (about 41%) households depend mainly on pensions and remittances as source of income; 6 (about 35%) households depend on salaries; 2 (11%) depend on pensions and salaries; 1 (5%) household relies on two pensions, and the other one relies on salary and remittances.

The sets were mainly bought new, through hire purchase (60%). And one pensioner reported having difficulty in getting her TV set until her uncle (Spaza shop owner) intervened. Two other pensioners, however, did not have any problems getting their TVs on hire purchase. About 38% of these TV sets were remitted by family members working in the cities. They were mainly second hand, and were sent home on the assumption that the SHS could power them. The other 2 per cent were gifts from employers.

About 47 per cent (8 out of 17 households) of those who own refrigerators depend mainly on the income from pensions and remittances. The households received these refrigerators as gifts (5 households) from family members living and/or working elsewhere – particularly in Tekwini, and they were second hand. Of the 3 households who claim to have bought their refrigerators, 2 bought them on hire purchase in Tekwini and the other one was bought on lay-bye in Flagstaff. About 17.5 per cent (3 households) depends on salaries and remittances. The 3 households had their second hand refrigerators sent to them by their family members working in the cities. Another 17.5 per cent (3 households) which depends on salaries, bought their fridges new. One of the fridges was bought in Johannesburg, and the other two were bought in Tekwini. There are also 2 households (11%) out of the 17 that own refrigerators, which are dependent on pensions only. One of the refrigerators was a gift and the other one was bought on lay-bye. And the 1 household (5%) that is dependent on two pensions and some informal income bought its second hand refrigerator for cash in Flagstaff.

As shown in Table 4.3, there are also 17 households from the sample that own stoves. About 47 per cent of these households (8 households) rely on remittances and

pension, and their stoves were bought or received (as gifts) second hand. It is worth-noting that in two of the households, there are savings club members and the stoves were bought by the money saved in the club. Out of the 23.5 per cent (4 households) that rely on salaries, 2 households bought their stoves new on hire purchase, and the other 2 bought theirs for cash on second hand shops. And the 2 households that rely on pensions only, reported having received their stoves (second hand) as gifts from family members. There are also 2 households in the sample that rely on salary and pension and own second hand stoves. One of the stoves was bought from second hand shops on lay-bye, and the other was received as a gift. The 1 household that depend on two pensions and some informal income bought the stove (cash) from a second hand shop.

All the cell phones were bought or received new. And out of the 11 households that own cell phones, 7 (63%) rely mainly on salaries; 2 (18%) on remittances and pension; and 1 (9%) on remittances and salary.

It should be pointed out though, that the households, in fact, own more appliances and utilise more energy sources than shown in Table 4.3. Most of these appliances are not used or are used only occasionally. They range from electric refrigerators (households 8, 24 and 28); electric stoves (households 8, 16, 18, 19 and 28); electric irons (households 7, 16, 18, 19 and 24); electric kettles (households 16 and 19); to CD players (households 4, 9, 24 and 36) and sewing machines (households 23, 28 and 39).

The energy source often used to power some of the appliances which are used only occasionally is a generator. The households that own and use a generator are: household 25 which uses a generator to power a colour TV; household 16 uses a generator to power a fridge; household 36 and 9 use it for colour TV and CD player.

It should be noted that the households that own and use generators are not necessarily better off – in fact their sources of income vary. For instance, household 9 is dependent on one pension and irregular remittances from a daughter (the daughter is the one buying most of the appliances, including the generator). Household 16 supplements two pensions with income from raising and selling pigs; household 25

depends on remittances from husband; and household 36 is dependent on salary from a lady teacher.

Some of the appliances that are not used remain with or 'had to be taken back' to some members of the household or relatives working and/or residing in urban areas – Tekwini in particular (households 2, 8, 10, 24, 28, 33, 39). Others are at home and are mainly used to decorate the house – for instance, electric fridge and stove in households 33 and 8; gas fridge in household 30; electric stove, microwave, kettle and toaster in household 19; colour TV and stove in household 18; colour TV and CD player in household 4; and colour TV in household 36.

The black and white TV used in household 8 was borrowed from a relative, and the TV in household 31 was lent to a neighbour after the solar system in this household was repossessed. They now go watch TV at their neighbour's house.

Among the households planning to buy more appliances is household 11, which is planning to buy a colour TV and refrigerator. Household 3 is lay-buying a refrigerator (gas), and while household 12 is planning to buy a refrigerator, the daughter of household 9 has promised to buy her mother a refrigerator in December 2002.

4.8 Household budgeting and decision-making

This section aims at exploring different levels of decision-making – the issue of household budgeting and the social dynamics of decision-making within households. It sought to understand the main factors that determine individual rights to participate or influence decision-making within households.

According to Kabeer and Joekes (1991: 2), household decision-making is a 'bargaining process between parties whose bargaining power depends on their position as individuals within the larger economy … where there is a conflict of interests, decision-making outcomes will reflect the differential bargaining power of household members'. Household budgeting on the other hand, is mainly about how money is allocated to various functions such as food and fuel within households. It

includes the manner in which householders prioritise their spending depending on available financial resources (Mehlwana & Qase 1998).

The interviews and observations reveal that the function of household budgeting and managing the use of energy and appliances, and using energy within the household is mainly women's responsibility. In 31 households (77.5%) only women were found to be taking this responsibility. In about 22.5% (9 households) of the households, this responsibility is shared between wife and husband (households 10, 16, 26, 35, 37 and 40), and between daughter and father (households 5, 28 and 29). The majority of women also control decisions around the overall household expenditure. The responses to the question which inquired who decides how is the money spent (own money and remittances) indicate that in 20 (50%) households, the decision is taken by women; 11 (27.5%) by men; and in 9 (22.5%) households the decision is taken jointly.

It was found that men are mainly responsible for managing the stock and ploughing fields, and that their expenditure priorities are in this area. Although some men take it as one of their responsibilities to cut wood for their families and put together a span of oxen to transport the wood loads to the household (households 22, 26, 27, 31, 37 and 38), others cut wood only for profit (cut wood and sell to anyone willing to pay). Men, particularly those working in urban areas, also buy furniture and energy appliances and send them to their rural homes. Nosipho[1], for instance (household11), says: 'my husband buys me lots of things – hi-fi, TV, fridge. Things are cheaper in Johannesburg'.

Children have also played an important role in facilitating appliance purchases. Zwayi, a 52-year old grandfather says that he had to buy a television set because he did not like seeing his grand-children watching TV at neighbours' house and coming back late at night. 'Children are not safe anymore these days. Kudlwengulwa nditsho nabafana aba bancane' (Even young boys get raped). Fiks (59 years old) of household 28 says:

> They [children] always want things they see at neighbours. For example, one of my daughters had to buy that inverter so they can charge cell phones. Why don't they go charge where

[1] People referred to in this study have been given pseudonyms so that their privacy is respected.

everyone else is charging? They also want colour TV – saying they are tired of watching "abakhwetha" [term used to refer to black and white TV]. In fact there is nothing they do not want.

In household 27, the mother was against the idea of buying a TV, but the children put pressure on the father until the TV was bought. Xila (household 38) also had to buy a television set even though they were not ready for that. He says '…they are trouble if you listen too much to all the things they say'.

It is significant that not all the households who own these appliances fall into the high income group. Although there are quite a few households which seem to have a comfortable standard of living, there is also a significant number of poor households owning the appliances. For instance, household 19 is relatively poor – yet the 16-year old boy said that the following appliances are owned by the household: colour TV; black and white TV; electric stove; microwave; electric kettle; electric iron; hotplate; toaster and egg-beater. These were bought new by his deceased mother who used to work as a domestic worker in Cape Town.

4.9 Perceptions and experiences with SHS

A range of issues (positive and negative) from all respondents both SHS users and non-users came up when asked the question: "Can you please account from your experience what is it that you like and/or dislike about the solar system". Most of the issues that came up are technical in nature. Only a few examples will be quoted at this stage however. The issues will be discussed in detail in Chapter 5.

Constraints

- **Maintenance problems and poor customer service**. Customers complain that the maintenance agents take time to come check if there are any problems with the system. Even when the problem has been reported, households have to wait, sometimes for weeks for the maintenance agent to come and fix the faulty part – for instance, clean the panel. And when they do come to fix that

part, it happens that yet another problem has developed, for example a fault with the battery or fuse or light fitting.

Xi, a 38 year-old household head (household 26) says:

> When there is a problem, inspectors come after a long time to fix it. They also come after some time to check if the system is still ok. When they do come, they point to one problem, only to find out that when they come back again, it is another problem. We don't blame them very much. We know that they stay far and perhaps have many systems to inspect. But it's frustrating to have to simply stare at this thing, not knowing where to begin to fix the problem. They said we should not try to fix it.

Transporting a faulty battery to town (to the office) is yet another problem, as these inspectors have to physically transport it to the nearest main road first (hundreds of metres away) to get a lift to town. It takes time for the customer to get the battery back, or replace it – and 'the inspectors say that there is a shortage of batteries in the office'. These inspectors are not provided with means of transport, yet they are very stretched. They have to develop means themselves because they "must get our commission at the end of the day". The researcher once watched, for a moment, one of the inspectors trying to put together an old bicycle. The inspectors do not complain, they just do their job as much as they can, so as to get the commission. What they do complain about, however, is the fact that there is no fixed date for payment of their commission from the supplier.

Another issue that the customers are complaining about (more than 80 per cent of the respondents) is that the system provided does not fully satisfy their households' lighting needs, and they need 'larger' systems to power more lights. As mentioned earlier, most households in Mbizana consist of several separate dwelling units (mainly rondavels and rectangular shape types), and as a result, the SHS has not totally replaced candles and paraffin lamps. Paraffin and candles are still in use in dwellings that are not connected to the SHS.

They also expressed discontent with the fact that one can hardly have them both – lights and TV. The lights have to be switched off when one is watching TV. Fiks, for instance (59 year-old man from household 28), complains:

> This thing is very problematic, and it is killing my already troubled eyes. It switches on and off all the time. One moment it's on, the next it's off. It's okay with radio, but if you play TV, it's bad. You need to have a person next to it all the time – to switch it on again. I can't take it anymore. If it were not for the kids, I would have had it taken away a long time ago… It also does not light the whole homestead, and does not light far enough – yet I want to see thieves a distance away. But my children, who work in Tekwini like it, although they often complain that it does not power refrigerator and does not cook. They have the appliances in Tekwini and they want them at home. They want their home to look nice. As you can see, they are building another modern type of house.

- **Repossession of systems.** People say that the system is repossessed even when you are one month in arrears, and you have a valid reason to be in arrears. They believe that this is unfair and selfish, particularly given that the households are expected to pay the full amount even though the system was out of operation for weeks. The agents who come to take away the system get commission, and they won't allow any room for negotiations. A 47-year old Pakamile (household 31)says:

> …I had one [solar system] but it was repossessed just a couple of months ago. I failed to buy the token card for two months because of delays in getting my UIF (unemployment insurance fund). But these people would not listen. They said they did not come here to argue. And they seemed to be enjoying what they were doing. It was a sad day for the family because we were already used to having solar for lighting and powering television. But there was nothing we could do – we had no money at the time.

- **Problem with the magnetic card used and time of purchase**. It is stated that the system switches off before the 30-day period. And although theoretically, there is a way to rectify the situation, practically, it is quite complicated and often, one never gets back the days one has lost.

  There is also a lack of flexibility in allowing customers to purchase a new card. If, for instance, you buy your card on the 25th, you must stick to that date

– you cannot buy before or after that date. The card you buy before or after your original date becomes useless.

- **Limited Energy supply.** Customers complain that they cannot use solar for cooking, ironing, refrigeration and to power a colour TV. Although they admit that they were aware of the limits of the system (50watt p) when they applied for it, they argue that the people who came around, explaining about the system, promised that the system would be improved to cater for other needs. Almost all the households interviewed say that they need larger systems – to power more appliances, including lights. And from the interviews, it became very clear that the idea of SHS with, for instance, LPG in a package, is very appealing and could make solar very attractive. More than 90 per cent of the respondents believe that the idea could make a difference.

- **Other issues that came up.** More than half of the SHS non-users have, in fact applied for the solar. As one of the inspectors explained, applications were made a long time ago. Some were made in the year 2000 and the instalment fee of R150 was paid, but the systems have still not been installed. In Mfundisweni alone, for example, about 16 households applied in the year 2000.

Other SHS non-users, as well as a few SHS users fear that the solar system would make their households vulnerable for lightning. The strike of lightning is experienced every now and then in these areas, particularly in summer, and in many homesteads lightning conductors are installed.

Benefits/Opportunities

The positive side of the issues is that about 90 per cent of the households interviewed (SHS users and non-users) say that they like solar despite the technical problems. The lights – that make the homestead look like "eyomlungu"(European), as well as relief from the heavy burden of transporting the battery to charging facilities located far away, seem to be the most important reasons why the householders like the solar.

Nokulunga, a 35 year-old "makoti"(daughter-in-law) from household 6 – which has no solar system says:

> …They [SHS users] no longer have to go through all the trouble of having to charge the car battery for TV all the time. And you pay only once a month. The lights are also bright. It's like other electricity as far as I can judge – but my husband insists that grid electricity is coming, and we should not try to chase after everything that is being introduced in the village. We should be careful. But he is not here most of the time, and does not know how it feels like walking in the dark. Yet he knows I'm scared of darkness.

Zet, of household 1, who has just been retrenched from the mines, has this to say:

> At first, I didn't like solar. I saw it from my neighbour – the lights are not bright and it does not light the whole homestead. I used to go along with people who say that 'these people' [SHS users] are lighting torches. I didn't realise that it's saving money. Ever since I had it, there's no more stress of battery charging. And my kids are now watching TV at home all the time, although we have a problem in that you have to switch off the lights when watching TV - otherwise the power cuts off all the time…

Another householder and respondent (household 39), comments:

> People were saying all sorts of negative things saying "sithatha ofinyafuthi" [we are taking the old fashioned traditional paraffin wick-lamps]. I could hear them passing by my house, saying all these things – particularly during the early days of the arrival of solar. But I used to confront them and tell them that I am lighting my house, not theirs. So they must back off. But now they want solar as well.
> If you sit down and calculate, it is quite cheaper.

There are two houses in household 39 – a two-roomed modern rectangular shaped type and a round modern one-roomed house. This perhaps makes it easier for the householder to calculate the benefits as the household's lighting needs seem to be satisfied.

A rather uncommon and interesting establishment was made regarding the inside lights. Nonzuzo, a "makoti" in household 3, who spent a better part of her life in Cape Town (and not used to the rural environment), revealed that the houses in her

homestead, particularly the kitchen, are infested with cockroaches. She said that it is difficult to fight these insects because most of the houses are thatched and the cockroaches simply hide in the roof beneath the grass, whenever you try to treat them. She had always been concerned that the insects always find their way onto the food, and more often they might be eating food with cockroaches. She said that it was difficult to notice if your food has got these insects because of poor lighting. 'When I raised my concern with the family – indeed I always did, they used to laugh at me and say that "iphela alinathambo" (the cockroach has no bones)' – implying that it was no big deal. She said, 'I am very grateful to the introduction of solar. The improved quality of light means that I will never have to worry about eating cockroaches again – with or without bones. "SingabeLungu ngoku nalapha ezilalini" (we are now Europeans even here in the villages).'

CHAPTER FIVE – A PLETHORA OF INTERLOCKED AND MUTUALLY INCLUSIVE FACTORS CONSTRAIN THE WIDESPREAD USE OF SHS IN SOUTH AFRICA.

5.1 Introduction

The use of energy, particularly among the rural poor, is influenced by a number of factors which are often difficult to separate. The research has shown that the broader environmental context within which households operate is an important factor which determines what fuels are used and how these fuels are used. The first part of this chapter is an analytical presentation of the socio-economic and technical factors that influence the use of fuels such as electricity, gas, paraffin, candles, batteries and wood. The emphasis will be put on SHS though. The next section puts the use of fuels and appliances into its social context, and discusses how social dynamics have affected the use of energy in rural areas of South Africa.

5.2 Affordability of SHSs

Many people have argued that the largest single obstacle to the wide dissemination of PV SHSs is the cost of the system – particularly the initial purchase cost, which 'constitutes a threshold too high for the rural household to be able to afford this technology' (Banks 1998). It is believed that, at subsidised rates, market penetration will increase (see, for instance, Banks (1998) and Hochmuth et al (1996)).

In most energy studies, affordability is often linked with household income – suggesting that the major factor which determines energy use is the size of the household income (James 1997). The research conducted, however, shows that an analysis of energy use and acquisition based on such a view is inadequate and is likely to mislead energy planners and have negative repercussions on energy policy planning, formulation and implementation. The following discussion attempts to demonstrate that income is not necessarily useful in determining whether households will be able to own a SHS – that together with the size of household income, other factors influence the purchase of SHSs.

Take the case of Maphephethe, where the general attitude towards the SHS was shown to be favourable. It was established that income levels in Maphephethe were above national (rural) norms (Green & Erskine 1998) – which suggests that many people could be expected to afford the purchase of a SHS, even with the existing finance terms. 'Some 64.5 per cent of the households reported receiving a regular income (excluding remittances and casual labour involvement)' (Green & Erskine 1998: 225) – suggesting that they could easily be granted loans. Yet, about two years after the project had started, only 38 households had acquired SHSs (RAPS 2000).

People are said to have expressed an inability to afford the monthly payments or to commit themselves financially for several years given the insecurity of their financial situation. Furthermore, the pre-condition for obtaining a loan is to have a permanent income (Hochmuth et al 1996). Whatever might have dampened demand, Banks (1998: 13) points out that the 'market penetration rate of less than 2 per cent by a well-run programme does not bode well for the prospects of an unsubsidised programme'.

The study conducted by Green and Erskine (1998) indicates that there was no relationship between household income and ownership of a SHS. Some SHS owners received an income of less than R300 per month and others received more than R1900 per month (Green & Erskine 1998). The study also revealed that Maphephethe is fairly close to Durban where, according to Green and Erskine (1998), about 35 per cent of the adults are employed during the week. The community is therefore not solely dependent on the land for its livelihood – and although some families do utilise their land, it is seldom the main source of income (Green & Erskine 1998).

Folovhodwe is another example, which shows that an analysis based on the perception that the major determinant of energy use is the size of household income, is flawed. The village of Folovhodwe is relatively affluent – and one of the reasons why it was selected for a SHS project was that it was seen as able to sustain even an unsubsidised SHS project (Cowan et al 1996). However, the households refused to pay a monthly service fee of R35 per month towards the service, although it had been established

that the majority could afford this amount. Even when the amount was dropped to R20 per month, about 9 SHSs had their solar modules removed during the same month that the R20 fee was agreed upon, due to non-payment. Also, a large number of accounts remained in arrears (RAPS 2000).

In the Free State Province, extensive subsidies were granted to address the affordability problem (farm workers in South Africa are characterised by very low incomes – thus affordability of the solar system is perceived to constitute a big problem in these parts). The programme succeeded in providing about 1 800 farm-worker households with various sizes of SHS – at no cost to them. A study conducted by Hochmuth and Morris (1998) notes that, 41 per cent of the SHS users expressed dissatisfaction with the systems – despite the fact that they were not contributing any money towards the services.

Although the Free State Province case is, in a way, different from the two cases above – in that the issue of affordability of the system could be pointed out as a constrain to the purchase of the solar technology in the two cases, and not in this one – they point to the same direction. The size of household income may not always necessarily determine the use of energy – in this case, the SHS.

The Tambo case study also provides an insight into this affordability issue (see James 1997). For example, a household (household 9) which had relatively more livelihood strategies (pension, informal work, credit, livestock and a vegetable garden) had been unable to pay the flat rate tariff of R15 per month and had had its electricity supply cut off. On the other hand, household 7, which relied solely on pension for survival, and household 8, which received approximately R100 per month more than a pensioner and had a large number of children to support, had managed to pay for electricity each month (James 1997).

Also important in the Tambo case study, is the revelation that not all the households which opted for a 20A supply of electricity (installation R200 compared to R10 for a 2.5A supply) fell into the high income category (James 1997). Household 1, for instance, did not necessarily have a high income – even though the householder

owned a spaza shop. The income was, in fact, variable and unreliable (James 1997). And household 2 (with 8 members) survived on one pension and unreliable remittances. But these households managed to pay the R200 connection fee for the 20A supply of electricity. Household 9, on the other hand, opted for a 2.5A supply even though the household had relatively more livelihood strategies and more income.

This discussion has been trying to highlight that while income is indeed a significant factor in the ownership of SHSs, other factors play an equally significant role. The rest of this chapter explores some of these factors.

5.3 Grid expectations

Much of literature review reveals that, next to the affordability issue, perhaps the biggest constraint to the widespread use of SHS is the uncertainty regarding future grid electrification plans. It has been found that not only the planning itself, but also the expectations of rural communities regarding the planning are by far the highest constraints for the dissemination of SHS in South Africa (Hochmuth et al 1996). As mentioned earlier, several attempts to initiate pilot projects in different areas of South Africa have been made. And according to Hochmuth et al (1996), in all cases, approached communities have expressed high expectations of obtaining grid electricity in the near future.

These expectations have led to either a very small demand, or to completely abandon the effort. Take the case of Maphephethe and Uitkyk. Maphephethe is located at the border of the Inanda dam. Communities located on the opposite shore of the dam have been electrified (Hochmuth et al 1996). This has led to widespread expectations of obtaining the grid electricity, hence the very low figures of SHS sales. In Uitkyk (Limpopo Province), it is reported that the expectations led to the completely abandon the effort (see Hochmuth et al 1996). The systems were perceived to be incompatible with grid electricity and would therefore not worth investing in. It will be remembered that a common concern regarding SHS electrification is that it will only power lights and black and white television sets, and unlike grid electrification, it will not meet

energy needs for cooking. Grid electrification is perceived to provide higher levels of service at a more affordable cost to the user.

Other case studies also confirm this grid expectation argument. In Folovhodwe, for instance, a preliminary demand assessment showed that a substantial number of households had indicated sincere and strong interest in the SHS option before the grid prospect came into play. According to Hochmuth et al (1996), this was destroyed through the expectations for the electric grid.

Also in KwaBhaza, the greatest barrier to the acceptance of the system is said to be the expectation of grid electricity (see Kloot 1999). This is despite the fact that energisation is presented as an alternative to grid electrification. According to Annecke (1998), in a land where grid electrification is greatly desired by rural inhabitants, not least because of the relief from the burden of wood collection that it brings to rural women, energisation is an exciting prospect.

The KwaBhaza case study raises some questions about people's desire to obtain the electric grid. One question would be, what do households need grid for? And if the answer to this is that they need grid electricity to meet their thermal applications, the question would be, why then would they continue to want grid when their thermal requirements could be addressed through 'energisation'? Literature is very quiet about a possibility that energisation and other PV projects may be seen as inferior to grid electricity as an energy supply source. For many people, electricity is only known as 'cable electricity' or 'card electricity'.

This grid expectation argument therefore, needs to be treated with caution – particularly when the argument goes as far as to suggest that the communities' expectations to obtain the grid is the highest constraint for the dissemination of SHS (see Hochmuth et al 1996). And very much linked to this argument, is the suggestion that grid expectations play a major role when SHSs are very expensive compared to the cross-subsidised grid, but less important when SHSs are also subsidised to a high extent (Hochmuth et al 1996).

In the Free State Province, the high levels of grid electrification of farm-worker households is said to have led to dissatisfaction with the solar systems, and to a significant drop in SHS installations. This is despite the fact that the SHSs were subsidised to a very high degree, and the farm worker households were not expected to contribute any fees towards the service. This suggests that other constraints must be at play here – not necessarily affordability nor grid-related.

It is also worth noting that the study conducted by the author at Mbizana reveals that very high grid expectations do not prevail in the area. Except for two individuals – that is, Nokulunga's husband (household 6), who insists – against his wife's judgement that, 'grid electricity is coming, we should not try to chase after everything that is being introduced in the village'; and the man who burst out in a social gathering and shouted, 'we do not want solar here, we want grid', no one in the villages expressed the desire for electric grid (at least not in those exact words). The research established that many people like the solar despite the problems encountered. Take for instance, the number of households (16 at Mfundisweni alone) who have been patiently waiting (for more than two years now) for the systems to be installed in their homes. Moreover, the SHS users did not express any desire for grid electricity despite their complaints about the limitations of the solar (perhaps because no question was asked as to their preference of grid electricity to SHSs). Instead, they expressed a desire to have their systems improved to cater for more appliances – as 'promised'. This is also despite the fact that, according to the observations made, the area is likely to receive grid electricity in future – given its close proximity to the national road and a number of town centres. The town centres and the villages closest to them are grid electrified.

Faced with such a scenario, it is quite tempting to agree with Hochmuth et al (1996) in their argument that, in the long term, it is expected that 'expectations will decrease substantially, depending on clarification and information campaigns…' The low grid expectations in Mbizana is perhaps a confirmation of this. The people in these communities seem to have accepted the SHS. Take the case of Zet (household 1), who says:

> ... Many people want solar now. I understand that they believe now that grid electricity is not coming in our village. They have had it in other villages for some time now. But not here. So what can you do! Even rich people use it.

Nevertheless, as discussed below, there seem to be more constraints on the widespread use of SHS in the rural areas of South Africa.

5.4 Putting the use of energy into its social context: appliance acquisition, use and social relationships.

5.4.1 Introduction

Ownership and use of appliances by households is often explained according to the income levels of households. And rural households are generally impoverished. Poverty includes inadequate access to basic services such as water, health, education and energy. In addition, limited job opportunities also impact adversely on rural livelihoods. Subsistence agriculture is no longer sufficient as a means of surviving or generating income.

The school of thought that explains ownership and use of appliances by households according to the income levels, assumes that as household incomes increase or decrease, so does their investment in, or accumulation of appliances (Mehlwana & Qase 1999). For instance, in electrified households with low disposable incomes, the argument goes, 'people do not invest in electrical appliances and, therefore, resort to cheap and readily available appliances, such as wood and paraffin appliances' (Mehlwana & Qase 1999).

This section will try to show that even though it is true that rural households are characterised by poverty, an analysis based on the assumption that they therefore, cannot afford sophisticated electric appliances or they do not prioritise expenditure on appliances such as electric or gas stoves and fridges – and that current-limited supplies of electricity are therefore appropriate for them, is inadequate and might mislead.

5.4.2 Slowly changing gear: The social ethos of rural life

Nowadays, rural life resembles that of township in many ways. For instance, like the township life, the social ethos of the rural life put more emphasis on acquisition of material things. As Mehlwana and Qase (1999) correctly point out, indeed, a household's worth is judged by the number and sophistication of appliances, 'modern' buildings and furniture. Household members tend to spend large sums of money in upgrading the structures of their dwellings and fitting in 'modern' furniture and appliances.

In the three villages visited, for instance, the common dwelling type is a mixture of traditional and 'modern' houses – and the continued existence of traditional houses (particularly rondavels) suggests that the area is relatively 'backward'. In many rural areas of South Africa – particularly in the former Ciskei, it is very rare to see a traditional house. Of the interviewed households, 62.5 per cent have as a type of dwelling, a mixture of traditional huts and modern buildings; 27.5 per cent have a modern structure; and 10 per cent are traditional. This suggests a community in a transitional stage – from traditional type of dwelling to 'modern' type. It was also observed that there are many 'modern' houses still in the building process.

The number of households that own sophisticated appliances such as gas fridges (42.5%), gas stoves (42.5%) and colour TVs (42.5%) is an indication of the value that rural people are now placing on 'modern' appliances. Even poorer households which are reliant on pension only as source of income (for example, household 8 owns an electric fridge and stove; and households 16 and 19 own electric stoves) have prioritised 'modern' appliances. 'Modern' appliances are important not only because they function well, but also because of how they make the dwellings look dignified and beautiful. Fiks (household 28) says that his children bought the appliances (fridge, stove and colour TV) because they want their 'home to look nice'. A dwelling with many 'modern' appliances draws both envy and admiration from neighbours, friends, relatives and visitors (Mehlwana & Qase 1999). Sometimes, 'modern' appliances serve to hide the real true status of impoverished households and make them look presentable – so that friends and visitors could not guess how poor the households are.

Poor households even go to such extremes as to keep appliances that no longer work, and use these to decorate their houses.

5.4.3 Kin networks, city life influence and appliance acquisition

Literature has acknowledged that among the poor sectors of communities, family ties serve a variety of needs (see Ross 1993). Family ties are used by rural households, for instance, to acquire 'modern' appliances. The research has established that many rural households have family members living elsewhere – particularly in cities. These people – often referred to as "amagoduka" (migrants), keep their rural contacts and homes even though they may own urban dwellings. Influenced by city life and familiarity with 'modern' appliances, and aspiring to middle class status, these migrants – particularly the youngsters, tend to invest in 'modern' appliances. As Mehlwana and Qase (1999) point out, irrespective of income, the common denominator is the pursuit of 'modern' appliances, whether by buying them for cash, hire purchase or as gifts from benevolent employers. In many instances, these appliances are sent to the rural homes (see Mehlwana & Qase 1999).

Many households (about 43%) in Mbizana, which own electric or gas fridges, stoves and colour TVs say that these were remitted by their daughters, sons or husbands working in the cities. Fiks (household 28) says that his children who work in Tekwini like the solar, although they complain that it does not power refrigerator and stove. 'They have these things in Tekwini, and they want them home. They want their home to look nice. As you can see, they are building another 'modern' type house'. Nolupho, the "makoti" in household 11 – bragging about 'things' her husband buys her (e.g. hi-fi, TV, fridge) points out: 'things are cheaper in Johannesburg'.

Limited access to electricity however, constrains the use of these appliances. A significant number of households in the three villages, for instance, have kept their electric appliances (those that cannot be powered by SHS) in the hope that they will be able to use them in future; others have sent them to their families living in grid electrified areas (mainly back to the cities where they were acquired). The interviews revealed that many of these appliances had been bought and/or sent home because the

households were made to believe that SHS would be improved to cater for these appliances as well.

The Tambo and Mafefe case studies also, to some extent, help show the complexity of trying to explain the ownership and use of appliances according to the level of household income. It has been reported that in Tambo and Mafefe, people expressed unhappiness towards the high installation fee for the 20A and 60A supplies – stating that the connection fee militated against them being able to think about saving for or purchasing thermal appliances. A closer observation though, suggests that there was a feeling that the current-limited 2.5A supply also militated against them doing this. It would be remembered that many of those who opted for the 20A and 60A supplies, stated that they wanted this level of supply to be able to use it for a range of electrical services not available with a 2.5A (see James 1997). Yet, like other rural areas in South Africa, poverty is prevalent, and labour migrancy and remittances were found to be still an important income-generating strategy for households.

If we are really dedicated to helping develop the rural communities, the pride and effort that many migrants have taken and continue to take in maintaining their rural homes, needs to be exploited instead of judging the rural poor in this manner (that they are poor, unlikely to afford certain services or appliances, happy with just lighting and entertainment, and therefore, current-limited supplies of electricity are appropriate for them). For instance, a strategy aimed at having family members living and working in the cities and towns take the responsibility of paying for the services provided for their rural homes could be worked out. If researched well, planned and implemented successfully, this strategy might go as far as render obsolete Eskom's often quoted analogy: "Rolls Royce systems are supplied to customers requiring bicycles" (see James 1997). The strategy might also help address the issue of under-utilisation of electricity by rural people.

5.4.4 Sharing of fuels and appliances and the credit system

Sharing of fuels

The sharing of fuels and appliances is deeply embedded in poor people's social relations (see Banks et al 1996). The economically marginal populations rely on their social relationship for survival (Mehlwana & Qase 1999). These social relationships are based not only on kinship, but on neighbourliness or friendship as well. Studies have shown that the very poor cannot rely on a single resource base for survival. According to Mehlwana and Qase (1999), sharing of resources is an adaptive strategy under the conditions of poverty and instability.

About 50 per cent of the interviewed households in the three villages indicated sharing various items with their neighbours, relatives or friends. Things shared range from cooking utensils, groceries, paraffin, candles, and TVs, to ploughs and cattle. As Niki (household 17) points out: 'we share everything – even ploughs and cattle'. The energy-related items that are shared most, however, are paraffin, candles and television sets. Respondents have summed up this borrowing/lending or sharing business in these generalised words:

> You simply send a child to go borrow a little something from your neighbour – for instance, a piece of candle, or ask your neighbour to "Kha uncede wethu undinyelele apha" (could you please just wet the wick of my lamp). You do not bother to return this, and the neighbour does the same. If you borrow, say a bottle of paraffin, you only return it when the conditions allow. It might take months before you return it. The same thing with groceries – particularly, tea and sugar. As far as TVs are concerned, children just come and watch. It is no big deal really – except with difficult people. We are not just neighbours here, we are relatives as well. And sharing is our culture.

It seems that the ownership of SHS has not changed this culture – perhaps because the majority of SHS users continue to use paraffin and candles for lighting. In fact, in some households the ownership of SHS has helped cement this relationship. Take the case of Nolupho (household 11) who states:

> we are back on good terms now with my neighbours. We used to be at each other's throats because of children. The children next door would refuse to help carry the battery to the bus stop, yet they wanted to watch television every night. I used to chase them away. But now, there is no more battery charging and no more fighting, and they can watch for the whole night.

The credit system

The relationships between local shops and/or spazas and households in circulating fuels is also quite important. This relationship is based on a socially defined credit system. Respondents have stated that credit is seldom if ever extended to households not known to the shop owner.

Because these shops are within a short walking distance from households and often have no strict trading hours, most households rely on them for their appliances and fuels purchases. A candle or bottle of paraffin may be bought even late in the evening. Furthermore, local shops are more popular because they allow credit. Indeed, many respondents (about 55%) in the three villages admitted getting their fuels and appliances from the local shops on credit. Most of those who get easy access to credit are pensioners. As Zet (household 1) puts it: 'pensioners have no problem getting credit because they are reliable'. This reliability of pensioners is partly attributed to the fact that, these local shops are often used as paying sites for pensioners. The first thing that these pensioners do when they get their money is to get inside and negotiate with the shop owner. They may pay and take more items on that same instance if they so wish. Also, pensioners are unlikely to run away with the money owed, and hide in the cities (unlike youngsters). Wives with husbands working in the cities also have no difficulty accessing credit in these local shops. Nolupho (household 11) had this to say: 'Pensioners get no more than R400 credit from the local shops, but I get up to

R600 or more. They know that my husband "akaloxelegu" (is not a crook). He will send money at the end of the month – he always does'.

Paraffin is the fuel mostly purchased from these local shops – perhaps because it is usually sold in affordable quantities. It is not just paraffin that is mostly bought though, some paraffin appliances such as lamps and stoves, are also bought here – particularly on the pension pay-out day. Some households (households 3 and 8) have reported getting help with their LPG bottles from the shop owner. They would drop their gas bottles at the shop, and the shop owner takes them for a refill, 'when he goes to buy stock from Kokstad[1]. As recognised and reliable customers, they are not expected to pay for the transport.

The granting of credit is one of the strategies that the local shops and spazas use to have a stable and relatively permanent client base. Although this system has advantages for a particular household, however, it obliges the household to continue buying at a particular shop, thus tending to establish and perpetuate a patronage relationship (Mehlwana & Qase 1996). Moreover, even though the shops may be expensive, many poor people continue to rely on them for energy-related needs – such as paraffin for cooking and lighting and candles for lighting. The uncertain financial conditions faced by most of the rural households, make their relationship with local shops crucial for their survival. And as Mehlwana and Qase (1996) correctly point out, any policy initiative that undermines this relationship could be counter-productive and have a negative impact on many households. Sharing and credit system are calculated decisions by poor people in their quest for survival.

5.4.5 The role of gender and age in influencing energy usage

<u>Gender</u>

As mentioned earlier, energy is needed for a variety of household uses. The main use of inanimate energy in rural areas is for cooking and heating, and biomass is the

[1] Kokstad is a larger and nearer town and most shop and spaza owners in the area usually buy their stock there. See Figure 3.1 for the location of Kokstad.

primary fuel used. The major source of energy in these areas is human labour, used for both survival activities and production. Much of this energy use and production is by women.

Many previous energy studies found that some women did not have control over resource allocation decisions when it came to major expenditure on energy, such as the purchasing of appliances (see, for instance, Kabeer 1994). However, the interviews at the three villages in Mbizana reveal that this is not true for all households, and it is important not to generalise this assumption across women and across households. It was found that in about 78 per cent of the interviewed households, major decisions on energy expenditure are taken by women alone. Respondents argue that women are mainly responsible for allocating resources to energy use because they are the 'best managers' when it comes to this domestic chore. The arguments made by women respondents can, in general, be summed up as follows:

> We are always at home and know better. Men take the responsibility of looking after the stock and ploughing fields – that is when they are not drinking beer. Men do not cook, we do. In fact, all that men care about is food on their tables at the end of the day. How you prepared or organised the cooking of that food is your business. We therefore tend to be vigilant when it comes to organising things around the kitchen, because you are likely to be sworn at even by your children if there is no food ready.

> Sometimes men would not give money to buy these things (fuels and appliances). It is fine if you are financially independent, because you can always allocate money as you wish. But, if you are financially dependent, you must be strategic – going as far as lying to squeeze some money out of them. A good strategy, approach and tactics are, in most cases, what keeps our kitchens beautiful and always burning. Even though men may be stubborn, traditional or conservative, they are also weak. You just need to play your cards right and you are in control. Their weakness is attributed to the fact that they know at the back of their minds that we do these things (managing the household) better.

According to Nolupho, a 34 year-old "makoti" in household 11, 'I have full control over resource allocation decisions when it comes to my husband's money. I manage this home while he is in Johannesburg, and he trusts me to make good investments'.

And Simo (household 38) says: 'My wife is the boss on energy related issues. Of course, I provide financial resources, but I do not tell her what to do with the money. She knows better and I respect her budgeting skills. But when it comes to the general household decisions, everyone knows that I am the boss in this house'.

A lady teacher in household 34 asserts: 'It is my money and I do as I please with it. My first priority though, is to see to it that my kitchen looks presentable'. Indeed, her kitchen does look sophisticated. But she points out that her money helps in various other chores – including servicing the livestock and ploughing the fields. She does not regard this investment as men's responsibility. Her husband works in Kokstad as a bus driver, and he comes home every day. Although he tends to control decisions on some issues, he does listen and consider her opinions as well.

It is evident from these cases that the power relations are not oppressive or unequal. While men may expect to have control over decision-making processes in the household, their wives are able to challenge them and assert their opinions and needs.

The gender relations in household 6 however, are different. The unequal gender relations in this household result in Nokulunga having no control over the decision to apply for a SHS. She points out that both her father in-law and her husband are 'traditional'. For instance, when her husband sends money, it is received by her father in-law, not her. The only money that is secretely sent to her is money for personal use (for example, to buy some under-wears). The two men take most of the decisions in the household.

Moreover, in this household, men do not take responsibility for energy related issues. Their responsibilities revolve around the kraal and fields. Yet, they see it justifiable to dismiss Nokulunga's idea of obtaining a solar system – even when she continuously expresses her fear of darkness, and also mentions other positive aspects of having a SHS (for example, relief from the burden of transporting the battery, which she claims she herself transports). She says that money is no problem to her husband – he earns about R4000 per month. 'The installation cost of a SHS would be nothing to him. The problem is that "ligqolo kakhulu umfo lo" (the guy is very stingy). But "makoti" is

'resolute to put my foot down on this one' – that is, insisting on obtaining a SHS. "Thula wena" (just wait and see).

Interviews with other people in the sample revealed that decisions about fuel and appliance acquisition were made jointly. Thus, a simple cause and effect analysis on gender relations and decision-making over resource allocation are not necessarily true for all households.

Age

The above discussion provides some insight into the important role gender plays in household management and decision-making. As demonstrated, women do most of the domestic work. Children, however also contribute to the household's labour resources and decision-making, and play an important role in facilitating appliance purchases.

In performing their tasks, women rely heavily on children, and teenage girls, in particular, tend to be very supportive of their mothers and grandmothers. Responding to the question: "Who is responsible for budgeting for and providing energy, managing the use of energy and appliances and using energy within the household", most of the interviewed mothers and grandmothers said: 'me and my daughter'. Senior women feel that it is their duty to teach younger women – particularly their daughters, how best to manage a household: how to be a proper "makoti". The interviews revealed that girls were very much active in child caring, fetching of water, collecting wood, buying groceries (including paraffin and candles), as well as helping in cooking and cleaning – that is, when they are not at school. A 19 year old teenager in household 25 says that fetching water, collecting wood and cooking 'is what all girls do in the village', and her household is no exception. In fact, in cases where the girls live alone with their grandmothers or fathers, they tend to take over the roles often played by their mothers. A 19 year old girl in household 19, for instance, is said to take all the responsibility for managing the household. Her 62 year old grandmother complains that she is too old and weak now to bear the stress of managing everything - 'the girls are strong and wise. "Ndabaqeqesha kakuhle" (I brought them up well)'.

Boys are only marginally involved in domestic work. They seldom do any kind of housework or child-care. Their main responsibility is ploughing fields and looking after the stock. A 16 year old boy in household 19, however, says that he helps his grandmother with everything. 'There is no women or girls' job in the household', he says. And his grandmother knows and trusts him to be able to perform all the domestic chores.

Because households are made up of individuals with certain rights, responsibilities and obligations, adults often feel obliged to accommodate their children's needs (Mehlwana & Qase 1999). For instance, in household 14 a CD player was bought specifically to keep the children entertained and happy. Nosimo (household 39) bought a cell phone for her teenage daughter who is studying at a technikon in Durban. The girl was working with her mother in the garden when we arrived for the interview. And the mother states that she is very helpful when she is around. "Andisokoli" (she lessens the burden). A television set was bought in household 20 – the poor household with two orphans. One of the granddaughters in this household – a 22 year old, comments that the TV keeps them at home. Where income permits, households that have children or are occupied by young adults, tend to have a variety of appliances.

The research revealed that hi-fi/radios and TVs are the most frequently bought household appliances (see Chapter 4). Entertainment appliances form a central part of people's lives. Although they are mainly bought to please children, a closer observation reveals that their purchase is so important that householders, irrespective of gender, economic status, ideology and generation, or commitment, perceive these appliances as necessities.

CHAPTER SIX – PERCEPTIONS AND EXPERIENCES WITH SHS: CONSTRAINTS, BENEFITS AND OPPORTUNITIES.

6.1 Introduction

This Chapter discusses people's perceptions and experiences with SHS – drawing on the perceptions of both SHS users and non-users. The Chapter seeks to establish the extent to which SHSs are appropriate and accepted, or whether the level of supply does provide for the electricity service needs of those in Mbizana.

The research revealed that the general attitude towards solar home systems is favourable in the area. The community is aware that most of the areas will be inaccessible for grid extension for the next twenty years. Thus, SHS seems to be a welcome option for a substantial number of the population. For example, about 90 per cent of the interviewees' first response to the question: "what is it that you like or dislike about the solar system", was: 'I like solar'. However, householders expressed discontent and unhappiness, especially with regard to ensuring that technical problems were resolved promptly; inflexible date of paying for services; and the fact that the SHS is incapable of powering other appliances. These issues seem to loom large in people's perceptions of and experiences with SHS and overshadow the positive aspects of this technology in Mbizana.

6.2 Problems experienced by householders

6.2.1 Maintenance

Perhaps the greatest weakness of PV programmes to date has been the serious underestimate of the need for adequate repair and maintenance systems. Although maintenance requirements for PV solar systems are typically low, the arrangements for secure maintenance are critical (according to local and international experience), or the PV unit will inevitably go out of service. In South Africa, problems have been found among privately installed systems as well as those in institutions such as health clinics and schools.

The research in Mbizana revealed that the maintenance of the SHSs has been inadequate. And in the light of the fact that the 'fee-for-service' approach was developed to try and resolve some problems and difficulties of this nature, this calls for much concern. More than 90 per cent of the interviewed SHS users reported maintenance problems as critical in the area. And one woman noted that it is these maintenance problems that lead to a poor image of SHS in the area. The problems reported include basic maintenance tasks, such as checking and topping up the battery water level and cleaning the PV module from time to time. Many householders, however, could not say why their systems had not been working anymore, because they did not bother asking the technician who had come to fix the problem, and so they did not know. Moreover, they were told 'not to touch the system under any circumstances'. And even if they were allowed to perform these maintenance tasks, they would have needed some training or at least some information to perform them fairly well. They did not know, for instance, that PV modules need cleaning from time to time (especially in the dry season when dust can accumulate on the surface of the module), or that the battery water level needs to be checked regularly.

The problems also include repair and replacement of parts. Repair and replacement of parts consist of replacing batteries, lights, light fittings and fuses. Replacing of batteries is particularly more problematic. The inspectors who are responsible for this job are not provided with transport to take these batteries from the villages to town. They have to physically transport them to the main road, which in some cases may be more than a kilometre away. Concerned about this situation, one lady (household 39) even offered to help carry the battery to the nearest taxi rank, using her wheelbarrow. Twelve households reported their batteries having been replaced at least once. And they said that they had to wait for weeks before the batteries could be returned. Besides the transport problem, and the fact that these inspectors are very stretched, the inspectors had told the customers that 'there is a shortage of batteries in the office' (reason why it takes so long to replace the batteries). The customers, of course, blame the Joint Venture for these problems and they tend to sympathise with the inspectors.

As mentioned in Chapter 2, the Eskom-Shell JV is responsible for full maintenance and replacement of parts such as the battery of the SHS. And since Eskom has been involved in a number of SHS pilot projects implemented in South Africa, as well as the schools and clinics non-grid programme, it would be expected that the JV would be the perfect choice for the job. The utility has obviously developed some expertise in non-grid delivery and technology. However, there has been some criticism of the target-driven approach they have followed, which has resulted in underestimating the requirements for successful after-installation support and user involvement and education.

Maintenance of SHSs is critical to keep the systems operating now and for many years to come, and to keep the customers happy. Customers expect value for their money. Only if maintenance tasks are being performed regularly and adequately the system will work over extended periods of time. This makes it necessary to arrange training courses for local technicians and employing them for routine maintenance and user advice services. This should help, *inter alia*, reduce travel costs and response times. But, simply providing training courses for technicians will not meet this need. Unless the technicians are employed and appropriately compensated for their work, they will not consolidate their skills, and the training will be wasted. Major emphasis in programme planning should therefore be given to establishing sustainable repair and maintenance services. This should include training householders in the basic operating and maintenance of the systems. The potential for success of this training and its necessity can be traced from the statement made by Xi, a 38 year-old man in household 26, who said: "It is frustrating to have to simply stare at this thing, not knowing where to begin fixing the problem". Worth-noting is the fact that there were no reported, observed or confessed incidences of SHS abuse through self fixing in all the households visited. Household members seem to have very little knowledge about the technology to try anything of this nature.

Although this is in a way a positive sign, it is critical that these customers be given an opportunity to learn how SHS work and how to undertake basic diagnostics and repairs, if they are to get satisfaction from their purchase. They must not be isolated from the system that they use on a daily basis. This would result, among other things,

in higher levels of utilisation with the benefits of convenience, lower energy costs and higher returns on the capital subsidy.

6.2.2 Inflexible payment schedule

It was mentioned in Chapter 2 that the Eskom-Shell JV solar electrification project is being undertaken using commercial principles, and is mainly characterised by a fee-for-service contract. The customers pay R150 up front for installation and a monthly service charge of R52. The monthly fee is used to cover maintenance and other costs. To facilitate monitoring and control of payments, the project uses pre-payment card technology. Customers are required to buy a swipe card every month, and the system is pre-programmed such that at the end of a 30-day period it automatically switches off, unless a new card has been inserted. The use of the system is 'like renting a house – even if you go on holiday for a month, you still have to pay your monthly rent' (Qase 2000: 2).

Research has shown that poor households have a difficulty paying a fixed monthly rate. Take the case of the Tambo pilot project in the Eastern Cape, which investigated the possibility of a flat-rate tariff for current-limited supplies of electricity. This study showed that the flat-rate tariffs were inappropriate (see James 1997). This system of payment is not appropriate because it is inflexible, requiring consistent payments at the same time each month. And as noted earlier, many rural households are dependent on infrequent and unreliable incomes. The villages in Mbizana are no different. The unreliable manner in which incomes are received makes it difficult for households to make payments on time. In Tambo and Mafefe, this approach was abandoned, mainly because of the negative response to the flat-rate tariff.

In Mbizana, the customers expressed a great deal of anger and frustration with the system of payment. But they objected not to the fixed monthly payment *per se*, but to the inflexible nature of the date for card purchasing. The token cards are purchased on the same date each month (not before and not after), otherwise they become useless. And as mentioned earlier, about 47 per cent of the interviewed households are dependent on remittances derived from activities by members of the household in

urban areas (mainly Durban and Johannesburg). The infrequency and unreliable manner of these remittances means that these households may not be able to meet their monthly payments, even if they intended to do so, before they are entered onto the disconnection list. And this means that they are penalised for non-payment as a result of circumstances which are beyond their control.

Even if the issue of unreliable remittances were to be brushed aside in favour of the argument that these households also do receive pension grants – which is stable and reliable, the fixed date of card purchasing would still be problematic in a number of ways. For example, the date of card purchase may fall in a week or two before or after pensions have been paid out; or the date of purchase may co-inside with an emergency; and so on. Given these unforeseen circumstances, one is tempted to argue that the people at Tambo were justified to want a pre-payment meter which allows for flexibility and control over their expenditure. The type of payment currently in use in Mbizana does not seem to take account of the shifting circumstances and priorities in rural households, where the ability of households to absorb crises or unusual demands on their financial resources is limited (James 1997). The customers also noted that what adds insult to injury is the fact that 'you sacrifice everything to buy the card on the due date, only to find out that the system switches off before the 30-day period. And it takes months for the supply authorities to rectify that – if it is rectified at all'.

It is important that the Eskom-Shell JV is flexible and facilitates the payment for electricity in a way which is suitable for these households. Financial arrangements for regular monthly payments need to be re-established by both parties (customer and service provider) to allow for flexibility.

6.2.3 Repossession of systems

Repossession is one of the greatest source of discontent and unhappiness with the SHS project in Mbizana. This has been expressed by about 70 per cent of SHS users who have not necessarily been affected, but seemed frightened by the procedure. People say that more than anything else, the action is embarrassing. These householders indicated that they have had some difficulties making their payments in

time, 'just like everyone else'. But, as the 60 year-old lady (household 32) states, 'what has provided me with incentive to retain a good payment record is anxiousness to retain a reputation of integrity. "umyeni wam wayengeloxelegu" (my husband was a fine man of integrity).' Another lady (57 year-old Nogqwashu in household 17), who also feels very unhappy about the 'ill-treatment' they get from the JV said: 'I would have had this thing removed from my homestead a long time ago. "Ndinentloni nje zabantu" (it is just the fear of embarrassing myself).'

Although the customers understand that the JV retains the right to repossess systems from defaulting customers, about 50 per cent feel that something could be worked out to avoid this humiliation. Apparently, this feeling is based more on the perception that the JV itself is failing the people (referring to many incidents of system failure and delays to fix the problems), and so cannot rush into penalising them when they fail or miss their payments. It is believed that the JV 'acts without considering its customers'shaky financial position'. The situation with Pakamile (household 31) seems to confirm this point of view. A sad Pakamile (who had his system repossessed) claims that he failed to pay because of delays in his UIF money.

Establishing a mechanism whereby customers ensure that they report their financial difficulties and negotiate an alternative way of payment with the supply authorities would surely make a difference. The main aim of this funding mechanism would be to provide for flexible payment options. This has a potential to improve the supplier-customer relationship. There is no doubt that customers accustomed to the benefits and convenience of electricity (like Pakamile) would resume payments when their financial position improves. Surely, no supply authority wants to deal with a high number of frustrated customers (who can easily be turned into enemies) from whom no income is received.

Simply sending some strange men (who will not listen to reason because they are doing their job – and the more systems they remove the more money they get) to people's homesteads to remove the systems does not really solve the problem of regular payments. Instead, it angers the community and sets people against each other.

One of the customers, for instance, swore that if he ever fails to pay because of circumstances beyond his control, they

> 'will get the system over my dead body. "Bakubekaph'imali yam kuqala" (they will give back my money first – referring to the instalment fee). How can they be so selfish after giving us such tough time with their poor service! Look at Telkom. The Telkom people always come to check if the system is still in good working condition. They don't, and yet they expect us to be perfect in our dealing with them. "Hayi mna ndidiniwe yilonto" (I myself am fed up with this nonsense).'

Even though repossession of systems is an issue of much concern and frustration in the area, and has been found to be a direct result of inflexible date of purchasing the token card, it does not seem to have affected a large number of households. Anyway, householders do not have to be directly affected to feel the pain and express their feelings about the matter. They are quite aware of the old saying: "Le min'iyeza nakuwe" (what goes around comes around). The inspector could recall twelve households in the three villages which have had their systems removed (about 80 systems were reportedly installed in these three villages).

An attempt to find (from the solar office in Flagstaff) an exact figure of the households which have been repossessed was unsuccessful. It was also difficult to find out exactly how long it takes before a customer is disconnected. Pakamile said that he was two months in arrears when repossession took place. Other respondents claim that one's system is removed even if one is one month behind. And the inspector himself could not say how long it takes. Apparently it is anything from one month to a year or so. For example, the inspector related a story of his uncle whom he said was five months in arrears. The advice he had given him (given the situation) was that he gives up the current system and applies afresh. Although it makes sense to do so from the perspective of a customer who is five months in arrears (in that he will now be expected to pay the installation fee of R150 instead of R52x 5 months, which equals R260), the inspector's interest is in keeping a reasonable number of customers. The amount of money he receives as a commission depends on the number of customers he serves or has served that month. But when the author left the village, the system was still there.

With more than 40 per cent of the systems reportedly in arrears, clearly there is inconsistency in repossession of the systems in the area, and this is perhaps caused by a lack of clear policy, not just on repossession, but generally on how to improve the services provided. Whatever the case may be, the lack of system maintenance and consequent system failure is very likely to lead to customers suspending payments, and to negative perceptions amongst potential users. In view of the uneven income flows of many rural households and as regards repossession of systems, it is crucial that the payment of services be flexible to prevent the necessity of repossession of the solar home systems.

6.2.4 Limited energy supply

Energy is one of the services required by households for survival and for comfort and convenience. It is used by people to fulfil a number of different needs or to provide services, such as cooking, water heating, refrigeration and powering appliances such as radios and television sets. Energy also provides opportunities for income-generating productive uses. According to Eberhard and Van Horen (1995), energy has a social use, but also an important economic value; it is both a consumptive and a productive good. In rural areas, the consumptive and productive uses of energy are more intertwined, with most households also requiring energy for water supply, irrigation and food processing (Eberhard & Van Horen 1995).

The economic impact of SHSs is very important, because rural South Africa needs economic stimulators most. The potential economic impact of SHSs would be the initiation of small, medium and micro-enterprises. Future energy is determined by businesses that would be established, and tools and appliances people are currently able to use. From the interviews and observations, it would seem that the following could be future business options:

- **Setting up a TV room** – perhaps showing videos, sporting events and educational programmes. The large number of people who perceive a TV set as a priority appliance seems to indicate a potential need for this.

- **Running a barber shop**. The inspector at Mfundisweni is already running one, using solar energy to power his machines. And as a result, he is never short of money to buy a loaf of bread for his poor family.
- **Opening a station to charge cell phones**. About 8 (20%) households, including the inspector at Mfundisweni, are already engaged in this business. And it was observed that, sometimes up to ten cell phones are charged per day.
- **Hatching and rearing of chicks** – for which solar may be applicable. Either solar power for heating and lighting or solar-heated water circulating to provide warmth for day-old chicks could be investigated. The lady in household 39 did mention rearing of chicks as one of her agriculture-based businesses, but the author failed to establish as to whether solar power was used in this activity.
- **Starting a sewing business**. A SHS would be ideal for starting a sewing business, easily meeting the initial energy demands of a light (to extend the number of working hours in the day) and an electric sewing machine (90W).

Although a SHS is ideal for all this businesses, more powerful energy sources are necessary to really stimulate the economy of the area – energy for irrigation and food processing, for instance.

Many people in Mbizana complained that they 'cannot use solar for cooking, ironing, refrigeration and to power a colour TV set' – asserting that they were 'promised that the system would be improved to cater for [these] needs'. More than 90 per cent of the respondents also complained that the system provided does not fully satisfy their households' lighting needs, and they need 'larger' systems to power more lights. The research revealed that the community of Mbizana is currently meeting these energy requirements through the exploitation of a number of different energy sources. These include the use of mostly wood for cooking, heating and ironing (fuelwood was found to be the main source of energy for cooking and heating in all the villages – even though Ndakeni and Rockville are far from the forest); paraffin is also commonly used, mainly for cooking, but also for heating, ironing and lighting; candles are used for lighting; generators are used (by a very few households) for colour TV sets; and LPG is used for refrigeration and to a lesser extent for cooking. This suggests that,

although household PV systems have many advantages that make them an attractive choice for rural areas, they only provide a portion of a household's energy needs.

The number of households that own electric appliances such as stoves, fridges and colour TV sets in the sample (see Chapter 4) indicates that the desire to have electric power which is capable of powering these cannot be swept under the carpet. Many respondents expressed much disappointment, particularly with the fact that the systems are designed to provide power for a black-and-white television. Included in those disappointed is a large number of householders who presently use black-and-white TVs – having been forced to give up their colour TVs because the solar system could not power them. Many of these colour televisions are now with friends or relatives residing in grid electrified areas, and the owners resent having to 'give up our sets, yet we claim to have electricity at home'. Given that it is not impossible, according to Kloot (1999), to run a colour TV (a small colour TV set requires 50 watts) even from the standard system provided (50Wp), from the interviews and observations, it would seem that providing a larger system to those that require it would be a solution – not only to the colour TV-related problem, but to addressing the problem of limited lights as well.

As mentioned earlier, most households in Mbizana consist of several separate dwelling units (mainly rondavels and rectangular shape types), and as a result, the SHS has not totally replaced candles and paraffin lamps. The rondavels are not well-suited for illumination with SHS because the room basically needs only one light for general lighting. The other houses for lights are some 10-30 meters away in additional dwellings which have to be connected to the system by long cables. The three-roomed rectangular shape type of houses however, are perfectly suited for providing all rooms with lighting with a standard size SHS. Paraffin and candles are still in use in dwellings that are not connected to the SHS. The system is designed such that the lighting requirements of these homesteads can only be satisfied if the households purchase more than one system (the PV SHS were installed with four compact fluorescent lights – three inside the house and one outside). The downside of this approach is the significant burden on the household. In any event, the people have already expressed unwillingness to invest on an 'additional system just for lights'.

They believe that a larger system would take care of all their requirements. And not a single respondent wanted a smaller system.

It is imperative that the technical design of electrification projects makes allowance for the need to upgrade. As James (1997) notes, the circumstances and needs of households are not static, it is essential therefore that, where current-limited supplies are implemented, there is the potential to upgrade. It is critical to acknowledge that rural areas, no matter how remote we imagine them to be, are stratified, and there is a need to develop an electrification strategy which accommodates different needs. Improvements to people's lives can be realised by allowing people to exercise choice.

The complaint that thermal applications, especially cooking, are not possible with the PV solar home systems is widespread in non-grid electrified areas. Also in Tambo and Mafefe, many women expressed dissatisfaction with the fact that thermal applications were not possible with the current-limited 2.5A supply of electricity. It makes sense to argue that current-limited supplies of electricity militate against people being able to think about saving for or purchasing thermal appliances – particularly, cooking appliances. The concern that SHS electrification will only power lights and TVs, and will not meet energy needs for cooking, has been found to be one of the reasons why rural communities tend to want grid electricity which does not limit their use of appliances. Cooking is one of the most frequent daily functions to perform and for which to secure energy. And although it is difficult to quantify the demand for cooking with electricity, there are a range of households in the sample (about 15%) which already have electric stoves (households 8, 16, 18, 19, 28 and 33).

The information available on electricity use and cooking is complicated. Although cooking cannot be replaced totally by solar technology (an additional solar cooker would be necessary to address this), much of the literature seems to suggest that even when energy supplies which are capable of replacing traditional cooking fuels are introduced into an area, people do not always change to the new technology. According to Davis and Ward (1995) however, one third of electrified rural households use electricity for cooking, often in conjunction with other fuels. Whatever the case may be, it is imperative that an alternative energy source that is able to meet

the high energy demands of cooking be introduced in non-grid electrified areas, if women especially are to benefit, both in terms of their physical health and time saved. As many women in rural areas are primarily responsible for both domestic and productive work in households, it is important that strategies are developed which reduce the burden on women.

The recent study on 'Gender sensitive impacts of various renewable energy technology in Maphephethe' has established that, since the introduction of biogas digesters in the area, the biogas households use less wood and paraffin for cooking, and the 'biogas household collects no wood at all' (Green 2003: 164). Women are likely to be the ones obtaining the wider benefits from this project. In fact, according to Green (2003: 166), the 'biogas seemed to make the greatest contribution in that it offers a permanent solution to women's cooking and fuel collection efforts'.

The questionnaire contained a question which aimed at establishing how the households felt about the idea of combining PV and LPG to the energy package (sometimes referred to as 'energisation'). It was found that the idea is quite appealing – more than 90 per cent of the respondents believed that it is a wonderful idea. This question about energisation was raised with the understanding that the South African government has embarked on a programme which promotes fuels like gas and paraffin in addition to SHS, to address thermal needs in the targeted rural areas (see Chapter 2). This was an agreement between the government and the concessionaires – including the Eskom-Shell JV, which is responsible for providing this service in the Eastern Cape.

According to Kloot (1999), energisation aims to replace traditional fuels and dirty carbon-based fuels with modern energy sources. And 'modern energy sources' may be defined as those that are clean, labour effective, affordable, safe and accessible (Kloot 1999). Thus, energisation excludes paraffin and wood as possible energy sources in favour of LPG. Interestingly, about 42.5 per cent of the interviewed households in Mbizana already own gas fridges and stoves, and 70.5 per cent utilise these appliances. Many respondents said that they invested in gas appliances because they had no hope of ever getting access to electricity. But it is the author's belief that the

prominent use of gas (in conjunction with other fuels) in this district is also attributed to its close proximity to the main towns (see Figure 3.1). Gas use is higher, for example, in Ndakeni and Rockville as compared to Mfundisweni which is further from the main road and town. If the service providers were to provide an even easier access to gas and make it affordable to the community (as agreed), that no doubt would be most welcome to members of the community – as the responses have indicated. According to the National Electricity Regulator (2002), the fuels are supposed to be sold in the energy stores of the service providers, located in the villages.

The convenience of using gas for cooking and refrigeration is appreciated even by those who do not own gas appliances. For instance, households 3, 9, 11 and 12 are planning to purchase gas refrigerators. Indeed, gas appliances are seen in the same light as electric appliances by many – both have a higher status than paraffin appliances. Like electric stoves, for example, cooking on gas is quicker than on paraffin stoves, and is more suitable to people's needs and lifestyles.

This positive response to energisation however, should not get us too excited. To the majority of those that need energisation, it seeks to bring with it energy upliftment to communities who would have to wait many years for any type of upliftment (Kloot 1999). To these ladies and gentlemen, the idea is of course appealing. But, as Kloot (1999) points out, the community is not a single homogeneous unit who are all desperate for access to energy, but a socially, economically and politically diverse group of people, whose different circumstances will result in different reactions to the energisation project. Other members of the community may not see energisation as equating with grid electrification, and may simply consider it to be an inferior form of energy delivery – like in KwaBhaza (see Kloot 1999).

The point that the author is trying to highlight here is that, combining PV and LPG seems like a good idea (as respondents also confirmed) in the quest to provide a simple and complete energy package, although it may have some unforeseen and complicated consequences. An important aspect of energisation though, is that it promotes access to energy, which is essentially a development activity. But more than

anything else, if the programme is implemented well, it is likely to make solar very attractive.

6.3 Benefits

As mentioned earlier, solar energy has many advantages that make it an attractive choice for rural areas. Solar systems are built from PV panels and are therefore able to provide relatively small amounts of energy very close to or at the point of demand. Solar power does not emit harmful pollution and is environmentally benign. The main benefits perceived by both SHS users and non-users however, have been the improvement in the quality of lighting, and the simplification of energy provision.

6.3.1 Quality of lighting

Not so long ago, small paraffin wick lamps were the most widely used form of domestic lighting among rural families. Some families in Mbizana, including the inspector's (where the author stayed during the fieldwork), still keep the lamps (although the lamps are seldom used). The lamp consists of a mall metal container or glass bottle with a fabric wick. It provides poor quality light; flickers and is easily blown out; has little if any capacity for adjustment; and usually produces smoke and smell. Now, people are using candles and the adjustable-wick paraffin lamps with a glass chimney that shields the flame from drafts. The research has revealed that these sources of energy do not provide good quality lighting.

The introduction of PV solar home systems has thus been most welcome in these communities. The system provides better quality illumination than candles and paraffin lamps, and all SHS users use it for lighting. The use of candles and paraffin is reduced. The candles and paraffin lamps still in use are either for system failures, or to provide light in houses or rooms not connected to the SHS. In those rooms or houses where at least one fluorescent light is located, no candles or paraffin lamps are used any more.

What people like most about solar lights is that they make the homestead 'look like "indlu yomlungu" (a European house)'. The outside light, particularly, is favoured and many said that they wish that it would be brighter. Household members, especially women and children, always move from one house to another in the homestead (sometimes preparing food in the kitchen, at the same time having to come watch TV in another house located twenty meters or so from the kitchen). Many of these members, such as Nokulunga (household 6) are very uncomfortable walking in darkness. The outside lamp is therefore quite valuable as far as these people are concerned (not only because it makes the house look like a European house).

It was also mentioned that the outside lamp helps chase away thieves. One lady related a story of her brother, who had his car broken in about three times (tape recorder and battery were among the items stolen from the car). The car itself was also once stolen. She said that theft stopped after the introduction of the PV solar power in the homestead. Other people have also expressed appreciation of the outside light, but stressed that they need a 'brighter' outside lamp because their cattle get stolen every now and then. During the fieldwork, the kraal of one household was broken in from behind, and eight cattle were whisked away. The cry for brighter outside light in this situation, is attributed more to the fact that the kraals are built away from the houses – about 20 meters or more away (this has something to do with culture – any woman married to the homestead may not get closer to about 10 meters of the kraal – this area is referred to as "enkundleni"[1]) and women who are in the homestead by marriage are banned from walking in the area however pressing or urgent the need may be.

This shows that electricity for improved light quality is highly valued amongst respondents, and is considered to improve their quality of life. Responses also indicate that having electricity for light is considerable more convenient than the fuels often used in the past.

[1] Loosely translated, "inkundla" is a court, where cases are heard. Traditional court hearings take place in this area. However, the reason why the area is so respected is because of a belief that during the night, the ancestors also gather here to discuss family issues. And culturally, women who are in the homestead by marriage are required to show a great respect to the ancestors and their surroundings.

6.3.2 Physical relief and extended time of use

More than 60 per cent of the interviewed solar home system users utilised car batteries to power their TV sets and radios/hi-fis, and made use of battery charging before they obtained the SHS (others purchased their TVs only after the installation of the SHS – and they used dry cell batteries to power their radios/hi-fis). The batteries were mostly standard 12-volt car batteries with capacities in the range of 60 to 120 Ah. As could be expected (given financial constraints in the rural areas), many of these batteries were reported to have been second-hand and in poor condition. The batteries were charged every 5-30 days (depending mainly on how often they are used and on the appliance) at places which are only accessible by bus, taxi, or car. Some respondents recalled that it cost R7 to charge a battery in 2002. Batteries had to be carried from the household to the main road (100-500 meters). At Mfundisweni (which is far from the main road), the batteries had to be carried to the bus stop or taxi rank, and from there to the next bus stop on the main road. The PV SHS has thus been hailed for having brought relief from this heavy burden of transporting the battery to charging facilities located far away.

In addition, before the SHS was installed, the car battery was not available for the time of the transport to and from the charging station, and it had to remain at the charging station for at least one night (meantime missing on favourable programmes). The battery then had to be collected on the next day, for which another trip had to be made. In most cases, one had to look out for someone (a neighbour perhaps) going to town to bring back the battery – and if one was fortunate enough, the battery would be back at least by the following day. This meant that for at least one night, the appliances could not be used, as no other battery was available in the household. Four households however, reported using two batteries so that one is always available while the other is being recharged.

The use of PV system has filled these gaps to a great extent. There is now extended time of use as a result of more energy being available. Respondents acknowledged that whereas in the past you had to be selective of the programmes you watch to save the battery, now considerable more energy is available through the utilisation of the

PV system, which leads to the additional watching of TV programmes. This confirms that electricity for media is highly valued and is considerably more convenient than the car batteries.

Although energy expenditure was not investigated in this study, there is little evidence in the literature that SHSs replace energy-use patterns. In fact, experience with PV SHS pilot projects in South Africa and the current-limited supplies of electricity, suggest that energy expenditure had increased in every household since PV solar home electrification and the introduction of current-limited supplies of electricity, such as 2.5A supply (see, for instance, Green & Erskine 1998 and James & Ntutela 1997). In households where fuels for lighting, and batteries for radios and TV sets were not displaced by electricity, energy expenditure had significantly increased. Also, the greater the number of appliances which could not be used with electricity, and the more rooms which required wiring, the greater the increase in the household's energy expenditure.

According to Green and Erskine (1998), there does not appear to be any significant decrease in the expenditure on fuels used before the introduction of solar power by households that have SHSs when compared with the local averages of energy expenditure. In the paper that Professor Green presented at Cape Technikon in March/April 2003, she says that, although the SHS users in Maphephethe did report savings on candles and dry batteries, 'there was no difference in the total energy expenditure in households with or without energy technology. The SHS owners spent R120.80 per month on all non-capital energy requirements, while the group with technology spent R117.92 and the traditional energy group spent R114.90 monthly' (Green 2003: 164). From this, it can be concluded that energy usage and consumption are increasing in households with SHSs.

CHAPTER SEVEN – CONCLUSIONS AND RECOMMENDATIONS.

Renewable energy is becoming a key policy issue in the energy sector. Considering various energy options, renewable energies are seen to be ecologically sustainable and they contribute towards conservation of fossil fuels as well as the environment. Apart from the problem of 'global warming' caused by increases in the concentration of so-called 'greenhouse gases' in the atmosphere (the most significant single component of these greenhouse gas emissions being carbon dioxide), possibly the most serious environmental impact stemming from energy use patterns in South Africa occurs in the household sector, where unelectrified households rely mainly on wood, coal and paraffin. The exploitation and use of these fuels is one of the most widespread and difficult environmental and health issues to address in South Africa. The main problem is attributed to the lasting environmental degradation caused by unsustainable harvesting practices and the health effects of traditional cooking practices – especially impacting on women and children. However, despite the environmental benefits of renewable energies, their use is fairly limited, arguable due to technical and economic constraints.

Although the renewable energy sources of importance to South Africa are solar, wind and hydro-energy, and energy derived from biomass, the paper focused on domestic PV-based SHSs. This is mainly because, the principal technology being considered for household electrification in remote rural areas at present remains SHSs.

For a number of years, extensive efforts have been made in the research and implementation of solar energy technology in South Africa, and it was widely anticipated that the actual numbers of installations would have assumed very high figures by now. However, this has not been the case. Only small pilot projects have been implemented so far – the largest to date being the Eskom-Shell Joint Venture (with 6 000 SHSs installed). Reality shows that many problems still exist and these inhibit both the rapid increase in numbers of solar energy systems for households and the success of projects which have already been implemented. The largest obstacles to the wide dissemination of SHSs have been singled out, namely: the high capital

investment often required for installation (which makes it very difficult for the rural households to afford the systems); and the expectations for grid electricity.

In most energy studies, affordability is often linked with household income – suggesting that the major factor which determines energy use is the size of the household income. The discussion has tried to show that income alone is not necessarily useful in determining whether households will be able to have a SHS. Some studies have also shown that there was no relationship between household income and ownership of a SHS (see, for example, Green & Erskine 1998). Together with the size of household income, other factors influence the ownership of SHSs.

The argument about grid expectations revolves around people's perceptions about grid electricity – particularly, that it provides higher levels of service (for example, energy for cooking). And SHS electrification only powers lights and black-and-white TV sets. Therefore it makes sense to want grid electricity if it is available as an option. The research has shown, however, that high grid expectations do not prevail in Mbizana, and it is believed that one explanation for this is that, expectations for grid electricity might be decreasing – as noted by Hochmuth in 1996. People seem to be convinced that grid electricity is not coming in their areas, and they are thus beginning to settle for SHSs.

The paper has tried to demonstrate that although grid expectations and affordability, no doubt, constrain the wide dissemination of SHSs, other factors play an equally important role. It has been argued that a plethora of interlocked and mutually inclusive factors constrain the widespread use of SHS in South Africa. These include factors such as: negative perceptions amongst potential users – arising from lack of system maintenance and consequent system failure; socio-cultural dynamics in relation to SHSs. These had not been given much attention in the literature on SHS applications and programmes, yet they were found to have enormous impact on the daily use of energy.

The broad goal of this study has been to explore constraints that influence energy use at the rural household level and to extend insight into the factors that determine

household energy use. The main focus has been to establish householders' perceptions of and experiences with SHS, ascertain how acceptable the SHS is to those living in rural households of South Africa, and to investigate key barriers to the widespread and accelerated dissemination of the system, with special interest to socio-cultural factors pertaining to this widespread dissemination.

The general attitude towards the solar system is favourable in Mbizana. The community is aware that most of the areas will not get grid electricity. The SHS, therefore, seems to be a welcome option, and the households have benefited from it. However, householders expressed discontent and unhappiness with regard to issues such as:

- Ensuring that technical problems were resolved promptly;
- Inflexible date of paying for the services;
- Incapability of solar to power appliances, such as colour TVs, stoves and fridges.

Problems experienced and recommendations for addressing them

Maintenance problems

The research revealed that the need for adequate repair and maintenance systems is seriously underestimated, and that arrangements for regular maintenance are critical. The maintenance problems which call for the establishment of sustainable repair and maintenance services include: basic maintenance tasks, such as checking and topping up the battery water level and cleaning the PV module from time to time; repair and replacement of parts, such as batteries, lights, light fittings and fuses. It is recommended that:

- Local technicians be trained, employed and compensated appropriately for their work.
- Householders be trained and educated in the basic operating and maintenance of the system. It is critical that the customers be given a opportunity to learn how SHSs work and how to undertake basic diagnostics and repairs.

Inflexible payment schedule

Research has shown that poor rural households find it difficult to pay a fixed monthly rate. The system has been found to be inappropriate for these households because it is inflexible, requiring consistent payments at the same time each month – ignoring the fact that the unreliable manner in which incomes are received in most of these households makes it difficult for them to make payments on time. This type of payment does not seem to take account of the shifting circumstances and priorities in rural households where the ability of households to absorb crisis or unusual demands on their financial resources is limited.

It is important that the Eskom-Shell Joint Venture is flexible and facilitates the payment for electricity in a way which is suitable for these households. Flexible payment options need to be established as a matter of urgency.

Repossession of systems

Repossession of systems has been found to be one of the greatest sources of discontent and unhappiness with the SHS project in Mbizana. The respondents expressed the feeling that the procedure is very humiliating and is likely to scare off potential customers. There is a possibility that the lack of system maintenance and consequent system failure leads to some customers suspending payments, and thus to repossession of the systems. However, what seems to be a dominant factor regarding repossessions is the inability to meet the deadline. And in view of the uneven income flows of many rural households, it is crucial that the payment of services be flexible to prevent the repossession of the systems. It is also recommended that there be a delay in repossession where appropriate, within criteria specified – for example, up to three months.

Limited energy supply

Energy is one of the services required by households for survival and for comfort and convenience. It is used by people to fulfil a number of different needs or to provide

services, such as cooking, lighting, heating, refrigeration, and powering appliances such as radios and TV sets. It also provides opportunities for income-generating productive uses, and is required for water supply, irrigation and food processing.

Although PV systems have many advantages that make them an attractive choice for rural areas, they only provide a portion of a household's energy needs. Providing larger systems to those that need them would solve some of the problems. The SHS, for example, has not totally replaced candles and paraffin lamps. The provision of larger systems needs serious consideration, especially in the light of the fact that people are not willing to invest on an additional system. People should be allowed to choose between, for example, the current system and a larger one.

There is also a need to address the complaint that SHSs are not able to cater for thermal applications as well as refrigeration. It is imperative that an alternative energy source that is able to meet the high energy demands of cooking and refrigeration be introduced. And given that the idea of energisation is appealing to the community, this needs to be taken advantage of and exploited. All that is necessary is to involve the communities in the planning and implementation of the programme. And as mentioned in the discussion, the idea is likely to make the solar very attractive.

Benefits/Opportunities

The main benefits of SHS have been found to be:

- improvements in the quality of lighting
- physical relief and extended time of use of media appliances

Quality of lighting

Many studies (see for instance, Annecke, W. 1998; Crawford-Cousins,C. 1998; Foley, G. 1995) have noted that the sources of energy (like candles and paraffin) used for lighting in rural areas are not safe and do not provide good quality illumination. The introduction of PV SHS has thus been welcome and is much appreciated in these areas, as it provides better quality illumination. All SHS users were found to use it for

lighting, and candles and paraffin lamps were found to be used in houses or rooms not connected to the SHS, and for system failures. The research, however, revealed that the provision of brighter lights, especially the outside light needs to be considered. Electricity for improved light quality is highly valued amongst respondents, and is considered to improve their quality of life.

Physical relief and extended time of use

Many households made use of car batteries to power their radios/hi-fis and TV sets before they obtained the SHS. These batteries required frequent recharging at distant charging stations, and could remain at the charging stations for some time – mainly because of problems with transportation. The PV system has solved this problem to a great extent, and there is now more time to watch television.

Larger systems though, seem to be in demand. As they are capable of storing more energy, it is believed that they can help decrease expenditure on fuels such as candles, paraffin for lighting and batteries. In addition, energisation should be able to address refrigeration and thermal applications such as cooking.

It is also worth noting in these conclusions the important role played by social relations – particularly the credit system, in the use of energy. The granting of credit is one of the strategies that the local shops use to have a stable and relatively permanent client base. The uncertain economic conditions faced by most of the rural households make their relationship with local shops crucial for their survival. It is important to understand the credit system relationship and the type of resources that are frequently exchanged, and for policies to take cognisance of these relationships.

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