A GEOGRAPHICAL ANALYSIS OF THE ENERGY NEEDS, DEVELOPMENT AND THE SYSTEM OF PREPAYMENT ELECTRIFICATION IN TWO LOW-INCOME COMMUNITIES OF THE CAPE METROPOLE

by

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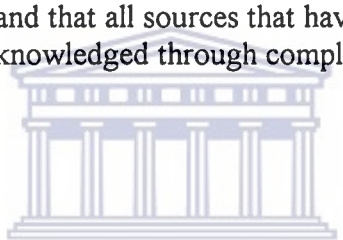
DECLARATION

"Herewith I, Michael Dyssel, declare that

A GEOGRAPHICAL ANALYSIS OF THE ENERGY NEEDS, DEVELOPMENT AND THE SYSTEM OF PREPAYMENT ELECTRIFICATION IN TWO LOW-INCOME COMMUNITIES OF THE CAPE METROPOLE

is my own work and that all sources that have been used and quoted were acknowledged through complete references"



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ABSTRACT

The aim of this study is to analyse the interrelationships among domestic energy needs, the system of prepayment electrification and development as manifested in two low-income communities of the Cape Metropole, namely Wallacedene and Delft. The study highlights the various dimensions of the following problem: Technological applications such as prepayment systems of electrification (whereby payment precedes the supply of electricity to users) can be rendered ineffective if it is not compatible with all the conditions that shape the livelihoods of its target groups.

Prepayment, unlike the conventional credit meter system (where electricity utilisation normally precedes payment), poses specific challenges to suppliers and users. Since the early nineties, most electricity supply agencies in South Africa (basically municipalities and local authorities), as well as its dominant electricity utility, Eskom, embarked on the large-scale implementation of systems of prepayment electrification. The aim of these systems is three-fold : to address the massive backlog in making electricity accessible to households with a low income; to solve administrative problems related to billing and the problem of non-payment for electricity services, and to enhance the efficient use of electricity.

Prepayment electricity is generally seen as the solution to the household energy needs in South Africa, as well as in other parts of the world and it has been applied in other developing countries such as Ghana, Zimbabwe, Fiji and Argentina. Limited application of prepayment electrification is also found in developed countries like New Zealand, Australia and England. Apart from the technological success of such systems, there is limited evidence of the impact of such forms of electrification on the livelihoods of low-income and materially deprived people. There is also a lack of information on the impact that livelihood circumstances have on these systems.

A further aim of this study is to fill a niche in geographical inquiry that has been created by the discipline's preoccupation with more global energy-need trends in demand sectors other than the household. The important role that the urban poor plays in

shaping the urban-ecological landscape, is also recognised in the study.

Surveys that were based on questionnaires, and to a lesser extent, on structured interviews and informal discussions as information gathering methods, have been undertaken. The results of the surveys were captured, manipulated and analysed by the use a computer programme namely the Statistical Package for Social Sciences (SPSS). Two theoretical frameworks, Political-Economy and Systems of Energy Flows are followed to give coherency to the analyses. The study analysed a variety of themes and criteria in an attempt to holistically assess the technology-consumer interrelationship. The criteria includes: domestic energy deficiencies, the geographical dimensions of energy needs and energy provision, the satisfaction of energy needs, the nature of the provision of electrification services, the different components of the system of prepayment electrification, the socio-economic dynamics of communities, the application of appropriate technology, and the influences of the physical environment.

The study concludes that proper attention should be given to factors, other than technical-product considerations, that impact on the efficiency of prepayment systems, as well as to circumstances created by the very implementation of such systems.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

"Energy" has different meanings to different people. Energy is for example "to the economists a synonym for fuel; to the scientist, one of the fundamental modes of existence, equivalent to and interconvertible with matter" (*New American Desk Encyclopaedia*, 1993: 413).

Despite all the different meanings, energy is in essence the ability and/or the potential ability to cause certain processes to take place. It is vital for the continuation of both the "natural" world (that is shaped mainly by biophysical processes) as well as the human-induced world (that is mainly shaped by social/economic/cultural processes). Energy, its input, exchange and transformation is therefore basic to all processes within nature as well as within the "life world" of people. It can therefore be considered as a basic need along with food, shelter and water.

One of the most important challenges that confronts development efforts globally is related to household energy sustenance. This challenge is of particular importance when household energy deficiencies (mainly in the developing realms) and problems associated with it are addressed.

The important relationship that existed since the beginning of time between people and different forms of fuel or energy, is important to consider if sustainable solutions to energy deficient households have to be developed (Fernie and Pikethly, 1985; Soussan, 1988). Initially this relationship had a high degree of dependency on the natural energy sources such as one's own physical power, wind, water and the sun. Societies based on hunter gathering as the dominant mode of production, were, for example, highly dependent on seasonal cycles for the "provision" of resources through which they could sustain themselves.

This relationship became more sophisticated with the passage of time and with technological improvement. The more effective harnessing of energy from natural sources is reflected by the different eras in the development of the ingenuity of people such as the era of animal traction, the sail and steam era, and the era of the combustion engine. Technological improvements were therefore major forces in the effective application of energy forms throughout the history of humankind (Pounds, 1981).

The most dramatic turning point in the use of household energy sources, came with the advent of electricity. The advantages of an electrified house, include more than just having access to a dependable and relatively safe energy source. It also has environmental, financial, educational and time management advantages for households. These advantages will be revisited and elaborated upon in subsequent Chapters of this study.

Compared to other household energy sources such as biomass and liquid fuels, electricity became "superior" due to its versatility, controllability and non-storage requirements (Leach and Mearns, 1988: 241).

The advantages of electricity are mainly enjoyed by the more privileged societies of the world (Soussan, 1988). More than two billion people worldwide have no access to "modern" energy sources and electricity in particular (Braunschweig Declaration, 1997: 1). The majority of these people reside in the developing world and are still very much dependent on woodfuel, other biomass forms and, to a lesser extent, commercial fuels such as bottled gas and paraffin/kerosene. There is a plethora of problems related to the use of such fuel sources, specifically in rural areas. Subsequently the electrification of rural areas throughout the developing world is considered to be the solution for household energy deficiencies in those realities (Foley, 1989).

Technological improvements in the field of electrification did not only revolutionise electrification industries but also the ways in which electricity is distributed and supplied to consumers. Different systems of electrification have different impacts on different people and their circumstances.

1.2 OBJECTIVES OF THE STUDY

It is against the background provided that this study sets out to examine (1) the interrelationship between household energy needs and the system of prepayment electrification; (2) its suitability or appropriateness for low-income households, (3) as

well as how it impacts on the development of communities. These relationships were examined and the subsequent results analysed for two low-income communities in the Cape Town Metropolitan Area.

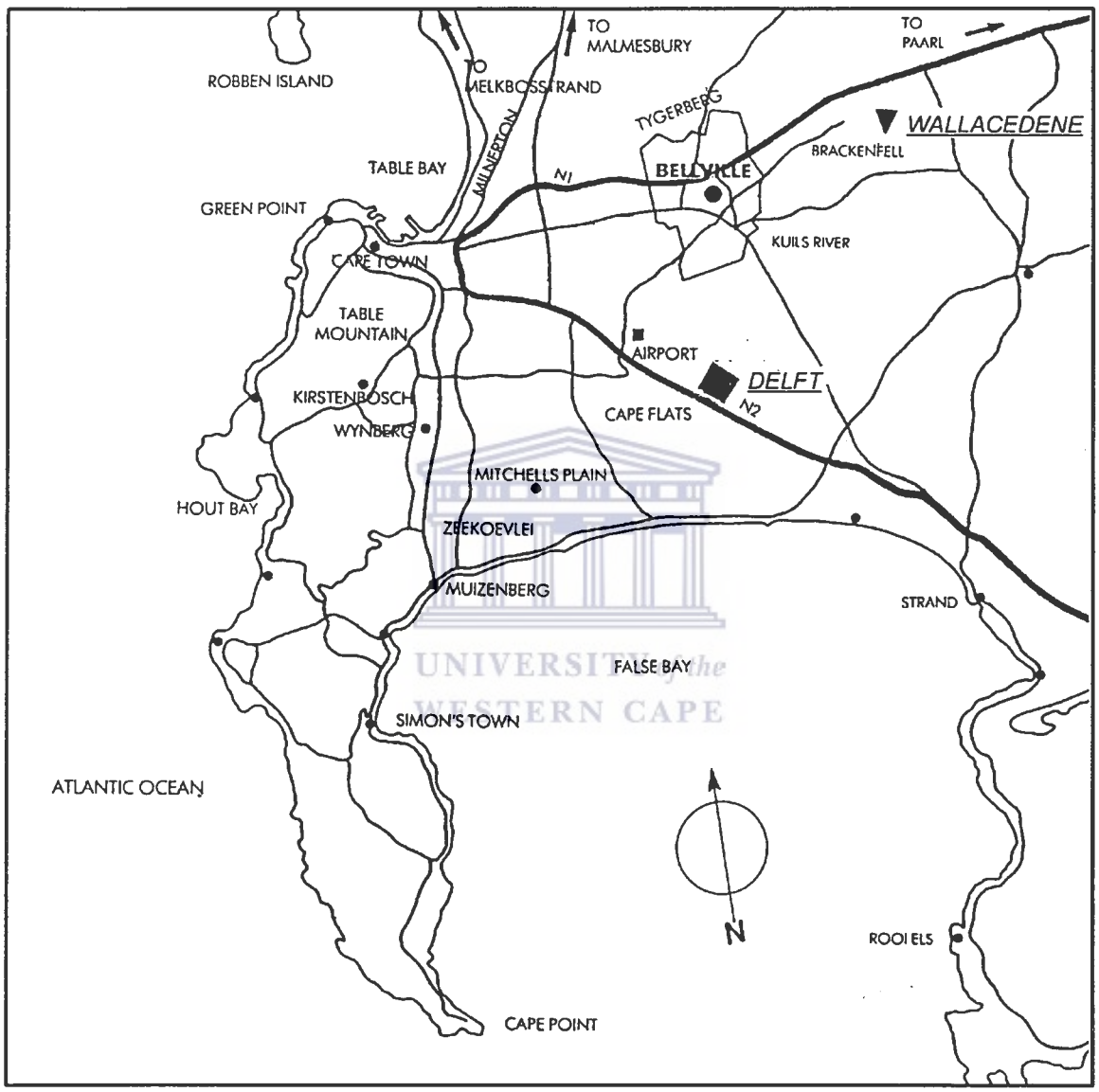
1.3 PROBLEM STATEMENT

Technological applications such as the system of prepayment electrification can be rendered inappropriate/ineffective if they are not compatible with the sum total of the conditions that shape the livelihoods of its target groups.

Prepayment electrification refers to the practice whereby the user pays in advance for the electricity that will be used. This practice is made possible by a vibrant electrification industry that provides the technology and devices to sustain such a practice. This study subsequently examined the application of prepayment electrification in two low-income communities in the Cape Metropole namely Wallacedene and Delft (see Fig. 1). Prepayment electrification can be influenced by a number of factors. Socio-economic, environmental and the quality of service delivery to the communities are some of the factors that the study analyse. Prepayment electrification suitability for those communities is assessed from these analyses.

The mass electrification drive undertaken by the South African government and the country's dominant electricity utility namely Eskom, achieved a lot in terms of the

FIGURE 1 : LOCATION OF WALLACEDENE AND DELFT



(Source : City of Tygerberg, 1996)

electrification of poor households over the last half a decade. At the end of 1995, 50,38% (National Electricity Regulator, 1996: 12) of houses in South Africa were electrified compared to the 33% in 1990 (Dingley, 1990: 3).

First time electrification of low income areas usually impacts internally (i.e. on the very household), as well as externally (i.e. on the immediate environment, other final uses, service delivery, etc.).

Information on this external impact is, however, limited. This study aims, therefore also to focus on those external dimensions.

1.4 LITERATURE REVIEW

1.4.1 THE GEOGRAPHY OF GLOBAL ENERGY ISSUES

Energy studies in Geography were traditionally related to more global-spatial interpretations of energy-use imbalances between the developing and the developed worlds (Foust and De Souza, 1979; Paterson, 1976; Waugh, 1996). The geopolitics of global energy demands and the subsequent supplies therefore became important foci in geographical studies (Fernie and Pikethly, 1985). Geographical research therefore display a strong "inventory" character in terms of energy related issues. Economic and sustainability concerns underpin many studies (Fernly and Pikethly, 1985; Waugh, 1996) related to regions of supply and demand, regions of producers and consumers, fuel- mixes, energy technology, etc. The imbalances in terms of the use of different

energy sources and the world's reliance on fossil fuels, specifically oil, as well as the West's "insatiable appetite" (Fernie and Pikethly, 1985: 30) became hallmarks in the global interpretation of energy issues.

The gap that exists between the demand for energy and energy use had and still has ramifications on a wide geographical scale. The geo-politics of oil and the pivotal role that the volatile Middle East Region has played up till now, reflect the repercussions of this energy "gap". The formation of OPEC (Organisation of Petroleum Exporting Countries), the strategic manoeuvring of oil companies to ensure a safe operational space for themselves, and the conflict between the West and some Middle East countries like Iraq, are also reflections of the wider impact that this energy "gap" has.

The industrialised world constitutes 23% of the world's population but consumes almost 70% of the planet's total energy stocks (Waugh, 1996: 489). The possibility that this ratio is likely to continue well into the next century, can have a detrimental impact on the world's economy, its ecology as well as its development.

Table 1 summarises the average per capita energy use (in gigajoules) and by implication also the imbalances, globally.

TABLE 1 : GLOBAL PER CAPITA ENERGY USE IMBALANCES

Region	*Per Capita Use (GJ)*[1]
Industrialised World	207
Developing World	33
World	72

(Source: Flavin and Lenssen, 1994)

The wide discrepancies reflected by these figures, therefore, provide some quantification of the widening gap between developed and developing countries pertaining to per capita energy use. (A more specific focus on per capita energy use in relation to income and the use of specific energy sources, is provided in Chapter Two.)

1.4.2 THE GEOGRAPHY OF DOMESTIC ENERGY NEEDS

The plight of energy deprived majorities in the developing world is, against the background of these more global energy concerns and crises, almost ignored in geographical literature. Soussan (1988: 54), referred to this situation as "the second or hidden energy crisis". The fact that it has been ignored for so long by governments and other significant role players poses specific challenges to all stakeholders in the energy industry. The energy challenges that are facing many poor households throughout the world need a proper understanding of the complexities of the problem before

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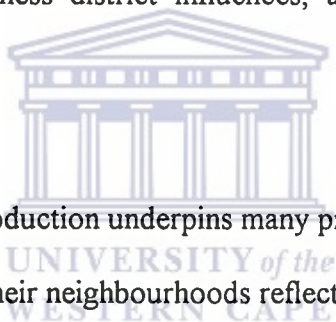
[1] [A GJ (Gigajoule) is equal to 1 million Joules. A Joule is a unit of energy that is needed to move a one kilogram weight one meter. Theoretically, based on standards in the western world a minimum of 8 372 000 Joules is required daily by an individual in order to function "optimally"]

(sustainable) solutions can be developed.

Such an understanding should be rooted in the evolution and foci of geographical research and analyses of processes in the urban environment. The fact that domestic energy needs and the struggles that the urban poor have in satisfying those needs necessitate a revisiting of the fundamentals of disciplines (such as Urban Geography) that examine urban processes. Urban Geography in South Africa in the period prior to the 1980s was, just as in the USA and the UK, dominated by apolitical and descriptive studies largely divorced from socio-economic processes within cities. The work of Davies and Beavon (1973), Hart (1973) and Schultz (1974) on issues such as urban morphology, central business district influences, application of models, etc. bear testimony of that tradition.



The prevailing mode of production underpins many problems experienced by societies. If the idea that cities and their neighbourhoods reflect a broader mode of production is acceptable, then different views should be taken to try and solve urban problems. Ethnocentric views of urban processes need then to be revisited (or changed) if attempts are being made to solve urban problems in a sustainable manner. Sawers (1984: 5), therefore, argues that an urban political-economy analysis should be underpinned by an understanding of the formation and perpetuation of different socio-economic classes in metropolitan areas through the interrelationships that exist between business, government and urban planners.

The capitalist city will therefore necessarily be a refection of the continuous growth in differences and imbalances among contrasting land uses, between neighbourhoods, and the nature and quality of services provided to regions and people in cities. Domestic energy crises in cities of the developing world are the results of the interplay of many factors. The South African household energy crisis shows trends that are similar to those prevailing in other parts of the developing world. Many financially needy people are staying in unelectrified dwellings (specifically in rural areas) throughout the country and satisfy their energy needs by using less dependable and less efficient fuels such as wood, paraffin/kerosene, bottled gas and batteries.

The scenario in South Africa's metropolitan and urban areas in which 72,9% (National Electricity Regulator, 1996: 12) of households are electrified, is relatively better than in the rural areas where only 31,3% of households are electrified. The household electrification rate (88,1%) in the urban areas of the Western Cape Province is the best compared to the urban areas of the eight other provinces. Based on the figures provided it can therefore be concluded that relatively little household energy problems will exist within the neighbourhoods and townships of the Cape Town Metropolitan Area. This very conclusion is, however, only partly true if the findings of this study are analysed.

1.5 SIGNIFICANCE OF THE STUDY

As discussed in the previous sections, urban processes need to be analysed in a critical and very holistic way if a better understanding of and subsequent solutions to urban problems are the objectives of an investigation. In an attempt to facilitate a more critical

and open approach to the analysis of urban geographical problems, McCarthy (1994: 141) advocates an "indigenisation" of urban geography. The specificity and peculiarity of the South African urban landscape, and in particular its black townships as sculptured by the application of apartheid laws, provide a framework for a more critical urban analysis. Beavon (1982: 16) also reflects on the South African urban uniqueness when he declared that:

> "... the geography of the Black township bears no resemblance to 'the geography' of the western city or to the patterns inherent in the classical models of Burgess and Hoyt. Nor indeed do the townships bear any resemblance to the geography of Third World cities in general and of Africa in particular, for they are simply dormitory areas ..."

Urban processes related to the delivery of municipal services to townships had, and are still reflecting the apartheid peculiarities referred to. The electrification of the South African township, as an example of service delivery, needs to be subjected to critical scrutiny. It is against this background that the study attempts to analyse the geographical underpinnings of the relationships among energy needs, the use of prepaid electricity and the development of communities.

1.6 THEORETICAL APPROACHES

Domestic energy needs and the satisfaction thereof cannot be separated from the broader spectrum of development problems that are prevalent in poor communities. The complexities of energy uses need therefore to be seen and interpreted within the socio-economic context that shape people's lives.

Moss and Morgan (1981: 190) referred to these complexities as the "web of interrelationships which links together not only all aspects of the energy use system, but all the related aspects of environment and of social and economic activity".

In an attempt to understand how these interactions are reflected in reality, a theoretical framework needs to be used from which different variables can be approached. A theoretical approach provides a framework for, and subsequent coherency to the analyses and syntheses emanating from research.

Two approaches are followed in this study namely: *Energy Flows System* and *Political Economy*. An Energy Flows System Approach emphasises the circularity of energy in- and outputs of biophysical and socio-cultural systems. (It is elaborated on in Chapter Two and utilised in subsequent chapters of the study.)

Political economy as theoretical framework, seems to facilitate a more coherent understanding of energy imbalances and needs at different geographical scales. It is particularly applicable if the impact of globalization of business, industry and

technological use is considered. Its applicability is also crucial for a critical appreciation of the history of electrification in South Africa. The history of the generation of electricity and the ties that it has had with the industrial development and stages as well as government structures since the turn of the century, reflect strong political-economic dynamics. The importance of the mining industry and the pivotal role it played in the spatial diffusion of industrial spatial diffusion of industrial development and the entrenchment of political power is of particular importance in this regard (Stadtler, 1987: 49).

A political-economy approach, refers basically to an analysis of the processes and outcomes of the interactions between politics and economics. Lane (1990) refers to the older traditions of political economy as substitute endeavours for what the discipline economics is actually all about. Political economy, as defined by various proponents such as Frey (1978) and Staniland (1985) reveals specific but also overlapping types and approaches to political economy. Based on how the relationship between economic and political processes is perceived by different analysts, Staniland summarises the following types: *deterministic* (as a causal relationship between two processes), *interactive* (as a relationship of reciprocity) or as *behavioural continuity*.

Identifiable approaches to political economy include Marxist, systems theory, institutionalist and public choice approaches.

Terreblanche and Nattrass (1990), in their attempt to periodise the South African political economy, warned that "theoretical space" needs to be provided for the rehabilitation and reorganisation of political-economy as an approach, outside the rubric

of political and economic interchange. The intricacies of the South African situation call, by implication, for a more pragmatic approach and more openness within it. Against the aforementioned, as well as the multiplicity of past and present processes within the South African political economy, all the types and/or approaches will to some extent or the other, be reflected in the identification, analysis, explanations and synthesis of issues related to this study.

Electricity generation and supply have been, just as the other spheres of the industrial economy in South Africa, highly influenced by the growing dominance of the mining industry since the late 1880s. Christie (1984) provided a comprehensive account of the interrelationships that started to take shape among mining houses, labour control, government bodies and the electricity industry. Stadtler (1987: 42) refers, for example, to the *symbiotic relationship* between the then Cape government and the mining companies that dominated the Kimberley diggings in the 1890s. The then government's approved programme of railway construction with the specific objective to link major mining centres, undertaken in the last decade of the nineteenth century, was a direct result of this symbiosis. The shaping of the South African space economy with its dominant core in the former PWV area and smaller clusters in and around the other major metropolitan centres, are therefore also reflections of this symbiosis.

The relationship of reciprocity between government structures, the mining industry and, by implication, also the electricity generation industry, provides an understanding of the geographical extent of the national electricity grid. If a political-economic characterization of the processes at that very early stage in South Africa's economic

development were done, the relationships would reveal a strong deterministic as well as interactive nature. It would be deterministic in so far as the absolute dominance of the mining industry was concerned and interactive in relation to the interrelationships that existed between the mining related industries and governmental structures.

Electricity was first publicly supplied in South Africa by small power stations and privately owned generators. Users at that stage included (primarily) urban households, municipalities (for street lighting), tramway systems in various urban centres, and the mining industry.

Christie (1984) maintains that although South Africa's electricity supply was relatively insignificant at the turn of the century, it became, along with the mining industry, a major economic driving force. The gold mines on the Witwatersrand, Kimberley's diamond fields and various coal producing areas, were therefore greatly advantaged in terms of longer working hours, higher production and the utilisation of labour extensive machinery. Electricity use was by implication and in collaboration with labour exploitation at that stage, partly responsible for the coerced and controlled labour practices that characterised the South African (industrial) economy until fairly recently.

The proximity of huge coal deposits to precious mineral mining areas such as Johannesburg and Kimberley, geographically facilitated the establishment of base line or coal fire power stations in the former Transvaal and Free State provinces. The spatial legacy of this affinity will stay, even if industries that are based on the mining and consumption of gold and diamonds come to a halt. Grid extension and/or off-grid

electricity supplies to (economically) remote areas and millions of unelectrified urban and rural homes, are therefore some of the challenges facing the electricity distribution industry in South Africa.

1.7 RESEARCH METHODOLOGY

Three methods were used for the collection of data for this study, namely *questionnaire surveys*, *structured interviews* and *informal discussions.* The questionnaire survey was based on *systematic sampling.* Systematic sampling or interval sampling is based on the selection of elements - in this case households - at equal intervals starting at a randomly selected point. A 5% sample (n=88) was drawn in Wallacedene and a 3% sample (n=94) for the areas surveyed in Delft namely, Roosendaal and Eindhoven.

A total number of 182 questionnaires was completed on this basis by respondents and subsequently analysed with the help of the computer programme, Statistical Package for Social Sciences (SPSS). To compensate for the bias that might have developed in restricting respondents to close-ended questions and answers, the informal discussions with available people who were not part of the sample, have been embarked upon. The interviews with the respondents who were not part of the questionnaire sample covered most of the issues included in the questionnaire as well as more "sensitive" aspects (such as vermin infestation of electricity meters and illegal electricity distribution to neighbours and friends). It was found that people could speak and voice their opinions more easily if their responses were not recorded. (In Wallacedene 12 people were

sampled in different sections of the township. A similar process was conducted in Delft where 15 people have been "interviewed".)

The structured interviews that were held with the different electricity officials covered the following aspects regarding prepayment electrification and its relationship with community development: macro-level influences (e.g. political, administrative, educational, perceptual); micro-level influences (e.g. manufacturing, marketing, service delivery); vending aspects (e.g. service hours, accessibility); meter and ready board (e.g. reliability, tampering, user-friendliness) and the transport mechanism/token (e.g. magnetic cards, encrypted codes).

For Wallacedene the systematic sampling based on a 5% sample for the 1712 serviced plots in 1994/5, worked out to 86 questionnaires. (Two extra questionnaires were added to cover a specific area in which intensive informal sub-letting/"subdivision" of plots took place.) A total of 88 questionnaires were therefore completed on Wallacedene. The area was divided up into 14 manageable blocks and every 20th household was surveyed. Field-workers worked in a clockwise fashion in those blocks whose demarcation was based on the street patterns of the settlement. (See maps in the Addendum.)

For Delft as a whole, with its 6836 households in 1994/5, a 3% sample was drawn that totalled 205 questionnaires. The surveys were conducted in two towns of the Delft development namely, Roosendaal and Eindhoven. Systematic sampling based on these figures allowed for each 33rd household to be surveyed.

In Roosendaal every 33rd household out of the registered 2264 plots was subsequently surveyed. That totalled 68 questionnaires. The area was divided into five sections separated by the almost hexagonal street pattern in the area. (See maps in the Addendum.) However, only 60 questionnaires were completed. The reason for this was that some houses that have been included in the sample were either evacuated or unoccupied. In other instances the unavailability of neighbours (that could have been included as substitutes for the evacuated or unoccupied houses in a systematic way), added to the problem. In Eindhoven every 33rd household out of the registered 1168 plots was surveyed. That resulted in 35 questionnaires. A total of 34 questionnaires was completed for Eindhoven. Therefore, out of the total number of 182 questionnaires 88 or 48,4% was completed for Wallacedene and 94 or 51,6% for Delft.

In interpreting results of this study cognisance should be taken of the following aspects:

- Some respondents and interviewees displayed suspicion and hesitancy when they were approached by the researcher and the field-workers. This behaviour could have been the result of the high levels of political consciousness in townships throughout South Africa in the 1994/5 period. Those attitudes could have impacted negatively on the reliability of the information that was given.
- Although permission for the survey was granted by the responsible representative structures of the two areas, some residents reported that they had not been informed accordingly by their leaders. In such instances they were not willing to co-operate in the completion of the questionnaires. However, field-workers, confronted by such situations, followed the instructions provided by

drawing in the immediate next-door neighbours to the left or right.

- In some instances language was a problem for both field-workers and respondents. Two field-workers in the team could, however, speak Afrikaans, English, Xhosa and at least one other (black). They could therefore help other field-workers as well as respondents who experienced language difficulties.

1.8 LIMITATIONS OF THE STUDY

The fact that it was beyond the scope of the study to evaluate the prepayment electrification system in a purely technical perspective way, i.e. assessing all the components or aspects thereof in relation to the quality of materials used, durability, manufacturing standards, etc. The fact that it is evaluated in a more functional way relative to energy needs and developmental issues, can make the study prone to technical critique.

Developmental issues and theoretical debates are limited and are largely related towards the setting of frameworks within which energy issues can be understood. As a result of this bias, not all theoretical/philosophical debates find expression in the study.

CHAPTER TWO

ENERGY AND DEVELOPMENT

2.1 INTRODUCTION

The Southern African Development Region (SADC/SADEC) is one of the best examples of the important relationship that exist between higher energy consumption levels of development. (The region is also characterised by countries that display relatively lower energy consumption and corresponding lower levels of development.) South Africa's dominant role in the region is also reflected in its energy consumption that is almost four times higher than the combined energy consumption of all the other SADC countries (O'Keefe and Kirkby in Cole, 1994: 59). This scenario is to a certain extent also applicable on smaller geographical scales such as the core-periphery divide and the urban-rural divide.

The important role that energy plays in the daily lives of people, in the natural environment as well as in the production processes of economies, is often not fully appreciated. It is perhaps even more so in circumstances where high standards of living prevail and in which energy provision is, to a certain extent, taken for granted. It is, for example, almost unimaginable to have a (western) city driven by an energy source other than electricity.

The problems facing people in developing countries regarding the satisfaction of their energy needs are very diverse and complex. A proper understanding is therefore needed to appreciate the extent to which energy forms one of the most important factors influencing people's lives. The way in which households sustain themselves in terms of their energy needs, shows great variation worldwide due to many factors that impact directly or indirectly on the process of energy needs satisfaction.

The aim of this Chapter is to analyse the interrelationships among household energy needs, the subsequent fuel uses or energy needs satisfaction, and how these influence the levels of development in low-income communities elsewhere and in South Africa specifically. Such an analysis can provide some context, understanding and rationale for the use of distributed electricity, and in particular prepaid electricity to disadvantaged communities.

2.2 DEVELOPMENT AND APPROPRIATE TECHNOLOGY

This section provides a brief overview of the complexities that underpin development and the extent to which caution should be taken regarding technological applications that often accompany development efforts.

2.2.1 DEVELOPMENT

The concept "development" is one of the most widely used terms in various academic disciplines as well as in other spheres of life. Despite the popularity of the term, it is one

of the most elusive concepts in terms of theory and practice. What development means will be an issue to contend with for as long as the envisaged results of the process do not satisfy all stakeholders involved. Development, in its most elementary and uncritical form can be seen as a process of change mediated or influenced by some form of human intervention.

The nature and impact of the "change" and the philosophy and practice of the "intervention" are some of the most contentious issues in development debates. An assessment of the extent to which a development project is successful or unsuccessful is, consequently influenced by how intervention and subsequent change are evaluated.

During the last couple of so-called development decades, different interpretations of how development should be seen and subsequently also "practised" were advocated. These interpretations found their manifestations in approaches that range from the philanthropist basic needs satisfaction approach on the one hand, to an unconditional indigenisation (i.e. time-space-condition specific orientation) of development efforts on the other hand.

Wolf (1996: 1) believes that development emerged from complex and confused struggles

> "... at international, national and local levels; the strivings of different centres of power and social forces had consequences which differed from what any of them had wanted or expected ... ."

It is important then that the motives and practices of specifically international development aid agencies and their activities in developing regions have to be scrutinised. If development simply means a replication of so-called First World setups in a developing realm, then critique against it will definitely intensify.

In an attack on the "development business" Eduardo Galeano in Carmen (1996: 2) captured his Uruguayan political activist feelings when he says that: " They train you to be paralysed, then they sell you crutches". These words summarise basically the situation in many developing countries in which decades of development aid did not bring the desired results.

Another example of the theoretical onslaught on the development business is expressed by Carmen (1996: 7) where he summarises Shiva's (1989) belief that considers developmentalism as a form of "new colonialism". Developmentalism's moral, educational and cultural motives are supposedly no less suspect than those of real colonialism.

In response to the critique and Eurocentric practices, development agencies adopted more fashionable terminology and approaches such as "people centred", "putting people first" and "participation". Carmen (1996:?) further argues that: "development is not and never can be neutral...it is a concept and an enterprise which is couched in human values". It is often the case that imbalances and conflict in human values lead to typical problems associated with development aid such as the collapse of a project if the donors and facilitators retreat or when malpractices and corruption occur among the "village

elite" created by a project.

Bias is an inevitable consequence of development so that it needs to be curtailed and handled with the necessary caution. If values need to be considered, then fair and sustainable compromises have to be built into projects and agreements. This principle should underpin technology dependent projects. Although the electrification of low-income households is not a development project *per se*, the use of new prepaid technology to facilitate such a process, can be evaluated against the guidelines of what constitutes appropriate technology.

2.2.2 APPROPRIATE TECHNOLOGY

Appropriate technology refers to a technological application that is appropriate or suitable for the situation in which it is to be used. High-tech applications will necessarily be more applicable in situations where people have higher levels of education, maintain higher living standards, and a more modern lifestyle. Cyberspace cafes, electronic financial transactions, computer-assisted working environments, etc. are examples of technological applications that would be inappropriate for communities who are facing bread-and-butter issues.

Technocratic theorists believe that with the ever-increasing expansion and sophistication of technology, most societal and resource related problems can be solved. Hoy (1984: 24) believes, however, that apart from the general critique against technical solutions, more emphasis is needed on the geographical and temporal misplacement of technology. Technological applications (specifically related to development projects)

seem, in many cases to be in the wrong place at the wrong time.

According to Intermediate Technology in Waugh (1996: 499) appropriateness can be "measured" in terms of the following:

- Is the technology culturally acceptable?
- Is it what people really want?
- Is it affordable?
- Is it cheaper or better than alternatives?
- Can it be manufactured and repaired with local material by local people?
- Does it create employment opportunities or does it safeguard existing ones?
- Is it environmentally sound?

These questions need qualification relative to existing circumstances and should be adapted to suite a particular situation. For example, the cultural acceptability of technology becomes problematic if there exists strong cultural diversity in the targeted community. The environmental soundness of an application also has a flipside - it becomes problematic if natural changes and variations impact negatively on the functioning of a technological device. Malfunctioning prepaid meters have, for example, been reported in the wake of surges caused by lightning in the Gauteng region prior to the improvement in surge suppression technology.

Some of these questions are used by Intermediate Technology, a British charity helping people in rural areas of the developing world to acquire the tools and techniques that the

latter need to further the development of their own communities. The charity's activities include projects in the rural areas of India, Nepal, Sudan, Malawi and other developing countries. Activities such as the local manufacturing of soil blocks for building purposes, the manufacturing and utilisation of improved stoves for more effective cooking, etc. are some of the activities embarked upon (Waugh, 1996: 499).

These criteria questions for appropriateness are to some extent also applicable when an assessment of the utilisation of prepaid electricity (by low-income customers) and the technology that facilitates that specific system of electrification, has to be made.

2.3 A CONCEPTUAL FRAMEWORK: SYSTEM OF ENERGY FLOWS

Every object has a component of energy in it. In using *fuels* like coal, wood, oil, etc., the physical substance is not used *per se*, but rather its *power* (i.e. the potential to do work). The power is derived from the *energy* released during the consumption of the fuel.

Although there is a fundamental shift in emphasis if the natural-scientific meanings of the terms fuel, energy and power are strictly applied (as explained above), these terms are often used interchangeably. Despite these definitional differences, the availability of, and access to energy sources, are crucial for all people and systems.

A system refers to anything that functions as a whole through the interaction of smaller, organised parts. Odum and Odum (1981: 3) believe that the future of all living beings

depends on the mutual interaction among the "three big E's" namely *energy, economics* and *environment.* These forces form part of a bigger system within which people and other living organisms operate. The dynamics amongst energy, economics and environment within this wider system need to be analysed in order to understand the whole. If balances or trade-offs cannot be reached amongst the three, they can lead to major energy crises (as was the case during the oil crises of the 1970s) and environmental catastrophes such as nuclear accidents.

The consequences of nuclear accidents at Chernobyl in the former USSR and Three Mile Island in the USA, as well as the deforestation of vast areas of tropical forests in Latin America and South East Asia, are manifestations of the extent to which the imbalances amongst the three forces can affect the global community. Ongoing concerns such as global warming, the widening of the development gap between the First World and the Third World, as well as widespread poverty throughout the developing world, also add to the growing list of global problems.

Following Odum and Odum's (1981) interpretation, it is also important, after the analysis of the parts, to put them together again in order to come to a better understanding of how the whole is functioning. Since energy is involved in all processes and events that shape the whole on which life on earth depends, energy flows can be simulated and quantified fairly accurately (Strahler and Strahler, 1997: 50). An energy balance and energy flow chart can be worked out for each component of any system (whether political, economical, ecological or cultural) in order to understand how the different parts interrelate with one another and how they combine to form wholes or

systems.

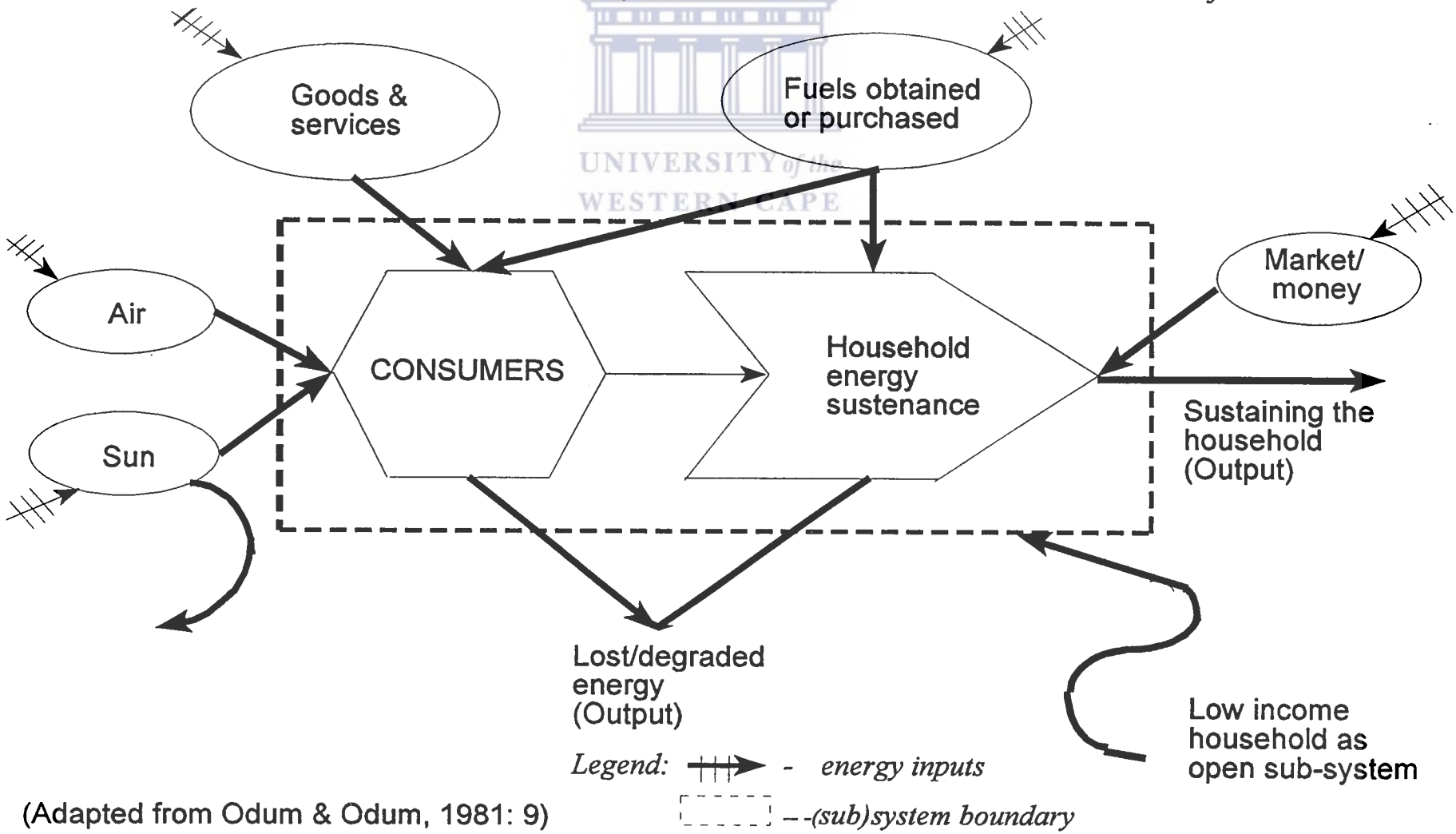
Flow chart quantification can also provide important inferences as to how systems outside the one(s) under scrutiny are functioning. The quantification of energy inputs and outputs may be problematic seeing that a standardised unit cannot simply be applied to every system or part thereof. For example, the kind of energy inputs and outputs that are needed to successfully run a large business enterprise are different from those needed to keep an ecosystem in a water pond healthy. Different indicators are required to try and measure the input and output of individual systems.

If a low-income household is considered as a system, then an energy flows system analysis can be applied to it. Energy needs, the ways in which they are satisfied, the energy flows created in the process as well as the implications thereof, can be used to gain an understanding of the impact of the use of energy sources (specifically electricity) on the overall well-being of low-income households. Figure 2 simplifies the complex web of energy flows among the physical environment, the household and the economy.

The fabric and continuation of all livelihood systems are intricately linked with energy flows through, and in them. Energy inputs can range from solar energy into natural ecosystems for the process of photosynthesis down to the use of a candle to light up a dark room in a remote village . The goals of sustainability can only be reached if proper attention is given to the various parts that constitute livelihood systems and of which energy is a vital component.

FIGURE 1 : SYSTEMS OF ENERGY FLOWS

Energy flows necessary for a low-income household to sustain itself



(Adapted from Odum & Odum, 1981: 9)

The rapid depletion of fuelwood reserves, specifically in poor countries, for example, is leading to a variety of environmental problems including topsoil loss, destruction of national habitats for other living species and animosity among villagers as access to wood becomes increasingly limited. On a more theoretical level Martinez-Alier (1993) has argued that the interplay among these forces (energy, environment and economy) is encompassed by many attempts to write critical ecological histories of places. These histories have, in most cases, had limited (global) application due the "uniqueness" of time-space specific circumstances. Various other views on the relationship between energy and the economy have been developed by ecological economists like Herman Daly (1985) and Albert Puntì (1988).

Daly (1985) argues, just as do Georgescu-Roegen (1986) and others, that the economy should not be seen as a circular flow of exchange value between producers and consumers, but rather as a one-way entropic throughput of energy and materials. Entropy refers to the extent to which the energy in a system is available for doing work, but in this context it refers to the distribution of the energy of a system between different modes (of production).

As seen in Figure 2 the very existence of systems is a result of the interplay among a variety of inputs from sources such as the sun, the air and the economy. These inputs in their turn are also influenced by other inputs from an even larger system. The intensity of insolation energy from the sun and on which human beings are also dependent can, for example, be influenced by a variety of factors. Seasonal changes, overcast conditions and polluted air, are some of the factors that can impact on that solar

intensity and subsequently also on how fuels are used (for heating and lighting purposes) at the household level .

2.4 ENERGY SUSTENANCE AND SUSTAINABILITY

Although various interpretations can be attached to the concept of sustainability, in essence it reflects the concerns and practices of humankind now for future generations (human and other species). The concept can therefore refer to "the amount of consumption that can be continued indefinitely without degrading capital stocks - including 'natural' capital stocks" (Costanza, 1991: 8). Fossil fuels and biomass constitute the natural capital stock reserves from which energy for household purposes is extracted.

The widespread use of woodfuel (specifically in the developing world) is a major concern in the sustainable energy-use debate (Eberhard, 1986; Henderson, 1992; Soussan, 1988; Waugh, 1996). The regenerative capacity of natural environments is seriously hampered by the extraction of fuelwood by poor people, particularly in the more arid areas on the globe. The impact of receding fuelwood source margins on the process of desertification in areas where people are dependant on wood, is also well documented (Soussan, 1988; Timberlake, 1987).

Results of research done by Henderson (1992) in South Africa's arid Richtersveld area also show the negative impact that fuelwood extraction and receding woodfuel margins have on the economies of poor households as well as the ways in which their time is

managed. It now takes women, who normally fulfil the role of wood collectors, much longer to collect the volume of wood required by the household.

The type of energy sources, their efficiencies for specific tasks and the way in which they are being used by people, commerce and industry, can impact on the sustainable use of other resources as well. The operations of and emissions caused by big coal-fired power stations can, for example, seriously impact on the aesthetic value of an area, the quality of air, the health of people and the value of land. The Vaal Triangle with its concentration of base-line power stations is a case in point (Makhudu et al, 1995). The interplay of factors that shape the energy situation, environment and economy of a certain area, needs therefore to be brought in relation to each other for the sake of sustainability.

Sustainable energy use can be enhanced through processes of *substitution* and/or *fuel mixes*. Substitution is normally a result of technological improvement (e.g. nuclear power replacing hydro-electric power). Shortages of specific fuels can also cause coerced fuel changes (e.g. bottled gas or paraffin replacing fuelwood). A need for a more efficient fuel can also lead to substitution (e.g. the use of electric light instead of a candle). Substitution can, therefore, be seen as an enforced or voluntary process related to specific time-space requirements.

The *energy balances* of different countries can also provide an indication of the sustainability of resource use. An energy balance is a table that shows, in a standard energy unit, the quantities of different fuels produced and used in different sectors of

an economy (Soussan, 1988: 45). In order to fully understand the different proportions of fuels used by specific sectors of an economy, consideration should be given to the important decision-making processes that underpin the preferences. Paterson (1976: 118) referred to the "power user's decision" that needs to be based on the "availability, suitability, cost and type of market" of and for different energy sources at a specific time and place. An example of the interplay among these decision criteria can be found in an examination of decisions as to what kind of traction be used for railway systems. Throughout the world variations and combinations that include coal-steam, diesel, diesel-electric, gas turbine and electric traction are the order of the day (Waugh, 1996: 492).

As explained earlier, substitutability can also be enhanced with the increasing sophistication of fuel technologies. The impact of these innovations can be experienced differently if there is diversity among users. Substitutional innovations can also prolong the lifespan of the energy resource base of a region. Fuels derived from biomass can for example supplement fossil fuels reserves and in doing so conserve fuel resources. Substitution should also be valued relative to its financial impact on an operation. If the task at hand requires the use of an efficient fuel, proper consideration should be given to prospective contenders (Paterson, 1976: 120).

The harnessing of energy from so-called inexhaustible fuels as a means of substitutability, also needs to consider these important decision-making criteria such as availability, efficiency or suitability for a task and cost involved. Against the background of these criteria, the tapping of renewable energy sources became fairly

"unpractical" due to the costs involved in such efforts as well as uncertainty of about the constant availability of sources such as wind, tidal power and insolation.

2.5 GLOBAL DOMESTIC ENERGY NEEDS AND FUEL USES

Global domestic energy concerns receive progressively more attention from many international organisations such as the United Nations, the International Energy Foundation and the International Energy Council. Efforts to narrow the energy-use gap between North and South as well as the alleviation of the impact of the "second energy crisis" reflect, among others, these global concerns.

As discussed earlier, global energy concerns that focussed more on the energy-use imbalances between the developed and developing realms have, to a certain extent, "marginalised" the very essence of household energy deficiencies and imbalances in poor societies. The deficiencies are, in most cases, addressed by the use of non-commodified/traditional/biomass fuels in these communities.

Fuels, such as wood, charcoal, crop and animal residues are not necessarily bought and sold through financial transactions and can very often be obtained "freely" from the environment. Due to the inconsistency in the availability of these fuels, they are closely associated with what Soussan (1988: 44) calls the "crisis of energy for survival".

Based on fuelwood use and the "relative ease of accessibility" to wood sources, the UN's Food and Agricultural Organisation (Soussan, 1988: 56) estimated that in 1980

roughly 1.3 billion or 40% of Third World dwellers were trying to make a living in fuelwood deficit areas. At that stage a considerable portion of the world's population thus experienced either chronic household energy deficiencies or they were without any means to satisfy their household energy needs. This scenario slots well into the typical spatial developmental imbalances between the North and South. Currently between 20% and 80% of energy demand in most countries is met by the use of fuelwood, and it is still increasing, specifically in developing countries (Regional Wood Energy Development Programme in Asia, 1999).

The data in Table 2 provides evidence for the situation that has been discussed in this section as well as a summary of the relationships between per capita energy use and income in different parts of the world. The figures in Table 2 show that there exists in general a positive relationship between per capita income and per capita commercial energy consumption worldwide. More reliable fuels can therefore be purchased if the income per household is higher. Lower per capita income also corresponds positively with higher proportional uses of fuelwood as is the case in countries like Nepal and Kenya. Proportional fuelwood consumption in countries or regions that are classified as industrialised such as the USA and the UK, is almost negligible. Fuelwood consumption is also relatively low in newly industrialised countries such as Malaysia and China. Although these figures provide substance to the existence of the so-called energy gap, they obscure the dramatic differences between rural and urban energy needs worldwide.

TABLE 2 : ENERGY AND ECONOMIC INDICATORS FOR SELECTED COUNTRIES

Country	*Per Capita GNP (US$) 1995*	*Per capita Commercial Energy Consumption (gigajoules) 1991*	*Fuelwood as % of total energy consumption 1991*
Nepal	200	1	79
Sri Lanka	700	4	64
Kenya	280	3	70
Mozambique	80	1	80
Nigeria	260	7	82
India	340	9	30
Thailand	2740	10	17
South Africa	3160	70	10
China	620	23	8
Malaysia	3890	45	8
UK	18700	157	-
USA	26980	320	-

(Sources: Bergman & Renwick 1999; Natarajan 1999; Regional Wood Energy Development Programme in Asia 1999)

The following section will focus more on the domestic energy needs of the urban poor in order to provide a background for this study that is based in an urban setting.

2.6 DOMESTIC ENERGY NEEDS OF THE URBAN POOR

Urbanisation and subsequent urban expansion are strong geographical forces that brought about the primate city status of many Third World cities. The dominance of big cities such as Mexico City (Mexico), Jakarta (Indonesia) and Cairo (Egypt) is perpetuated through these forces. They are therefore the industrial, commercial and service nodes of those countries. The influx of people to cities does not only cause major housing and employment problems for the governments of such countries, but also poses energy provision challenges to local authorities and poor people. The growth of urban populations therefore parallels the growth in urban energy needs.

There are important differences between the rural and urban poor regarding their energy needs and energy consumption. Soussan (1988: 76-78) identified the following energy consumption differences between rural and urban households that are not electrified:

- Multiple fuel uses or fuel mixes are more common and dynamic in urban areas. Although fuelwood is still widely used within cities of developing countries, the availability of other fuels add to these dynamics.
- Economic stratification among the poor, household size and geographical location within the urban environment, influence the structure of energy use for different types of households. Studies conducted in India and Kenya revealed

similar results. As a general "rule" the poorest of the poor would settle for the cheaper fuels such as wood and charcoal, while the "not so poor" would opt for fuels like bottled gas and paraffin/kerosene.

- Changes in fuel supplies, fuel prices and income of urban dwellers can add to rapid or slow energy transition processes. The transition is very often "upward", meaning from biomass fuels to commercial forms. It can also - due to fuel price increases - be "downward", meaning into biomass fuels. The latter situation manifested itself in Sri Lanka and Indonesia after the second oil shock of the early 1980s. Results of the present study have shown that in both Delft and Wallacedene, there is also smaller shifting of uses within the commercial fuel uses. Candles, for example, used for lighting if electricity, bottled gas or paraffin reserves are becoming depleted.
- Fuelwood is a commodity sold on a market for urban dwellers while it is "free" in most remote rural settings. Consequently, fuelwood competes in urban settings with higher order fuels such as kerosene and gas.

Energy problems and energy consumption patterns in urban areas are fundamentally different from the situation in rural settings. Plans and efforts to address and ultimately solve domestic energy problems need to take cognisance of these differences. However, these differences are not absolute, because in many instances the urban poor have their origins in rural areas. Rural practices can be adapted to fit urban life. In the wake of such urbanised rural energy uses, the urban-rural divide interpretation can become merely academic.

2.7 DOMESTIC ENERGY NEEDS AND FUEL USES IN SOUTH AFRICA

South Africa, like so many other developing countries, is also characterised by many poor and energy deficient households. Energy shortages and deficiencies are particularly prevalent in unelectrified, rural South Africa where it also goes hand in hand with shortages and/or the absence of basic services such as proper housing, potable water, sanitation and nutrition.

In such areas energy sustenance takes place primarily through the utilisation of fuels such as wood, paraffin, gas and coal. The use of these fuels has major consequences for the socio-economic well-being of people as well as the environments in which they are living. The findings of studies conducted by Eberhard (1986) and Henderson (1992) in different rural areas of South Africa, bear testimony of how detrimental an over-dependency on fuelwood can be on the effective running of households as well as for the conditions in which people are staying. Similar studies (Eckholm, Foley, Barnard and Timberlake, 1984) in other developing countries such as Peru, Ghana and Kenya have shown similar results.

Health hazards and indoor air pollution problems due to the burning of coal in stoves and in open fires, specifically in black townships, is another example of the impact that energy needs and the fulfilment thereof, has on the environments in which people are living.

Studies conducted by Makhudu (1995), Nell (1994), Sithole (1995) and Thamm (1995) on air quality and pollution caused by indoor coal and biomass burning in the Gauteng and Vaal Triangle townships documented the health risks related to the burning of coal in stoves and in open fires, very well. The emissions from thousands of small fires in townships are more difficult to control than those from a single power-generation plant.

Both gasses and particulate pollutants are released and emitted from such fires (in the open or in stoves) in often poorly ventilated dwellings where they build up during the cooking and/or heating processes. Positive correlations have been established between these emissions and the occurrence of respiratory problems, specifically with younger children. Nell (1994) estimated, for example, that children who are exposed daily to wood and/or coal smoke have, on average, an 80% higher risk of developing respiratory symptoms and illnesses than children who are not exposed to smoke. It is therefore imperative that in the absence of better and safer fuel alternatives, ways have to be found whereby biomass fuel uses can be made more health friendly.

Household fuel use, in particular coal and wood burning, also contribute to greenhouse gasses. Scholes (1994) estimated that the burning of wood and coal in South Africa's townships contributes significantly to the presence of carbon monoxide (7%), carbon dioxide (90%) and methane (92%) over such areas. The wider environmental-atmospheric impact of fuel uses in low-income communities can, therefore, not be underestimated.

Against the background of the disadvantages of "dirty fuels", electricity should be considered as the ultimate solution to the problem of domestic energy shortages and deficiencies. About 50% of the households in South Africa are electrified (Eskom, 1996). Provinces with the lowest electrification rates include those in which the majority of the former "homelands" are located. The Northern, KwaZulu-Natal and Eastern Cape Provinces are particularly affected by overall low electrification rates. (See Chapter Three for a more detailed analysis of provincial electrification.)

2.8 CONCLUSIONS

The spatial inequalities of energy needs and the subsequent fuel uses manifest, in South Africa and elsewhere, the familiar patterns of rich and poor. Energy supply reflects worldwide a bias towards economically more advantaged areas and people. The availability of energy sources is sometimes mistakenly being portrayed as the major stumbling block in efforts to remedy circumstances of energy deficiency. To make a more dependable and safe fuel, like electricity, more accessible to low-income communities, has apart from economic considerations, much to do with the political and social will that can drive service delivery efforts.

Although Eskom, South Africa's biggest electricity utility and one of the world's five largest, generates more than 60% of Africa's electricity, many South Africans did not have access to electricity until fairly recently. At the beginning of the 1990s a mere 33% of the country's population had access to electricity (Dingley, 1990: 3). The fact that Eskom was for the largest part of its history a state-owned parastatal, can explain

to a certain extent the lack of political and social will power by the then government to make electricity more accessible to the majority of the population. From a technical point of view, Eskom generates more than enough electricity on the grid to fulfil all household energy needs of South Africans. The means to ensure access to electricity for all, is however, the challenge facing South Africa. In the following Chapter the electrification process, as a means to address domestic energy needs in South Africa, is analysed.

CHAPTER THREE

FACTORS INFLUENCING HOUSEHOLD ELECTRIFICATION

3.1 INTRODUCTION

South African households consume 22% of the country's energy. Although more than 50% of households are electrified, contrary to popular belief, electricity constitutes only 17% of the average household energy consumption (South Africa, 1998: 16). Table 3 provides a synopsis of the proportional contributions of various household fuels to the average national household energy consumption in the country.

TABLE 3 : NATIONAL HOUSEHOLD FUEL USES IN SOUTH AFRICA, 1995

Fuel	*% Contribution to household use*
Fuelwood	65
Electricity	17
Coal	9
Paraffin	8
Gas and others	1
TOTAL	100

(Source: South Africa, 1998: 16)

It is evident that fuelwood, coal and paraffin are still very important fuels. It is therefore clear that the mere access to electricity is not necessarily a guarantee that it will become the mainstay of the household energy-use pattern. (This issue will be highlighted in the analyses in Chapter Five.) This trend shows once again the complexity of multiple fuel use in specifically low-income households.

Electricity is an important catalyst for development although it is not a solution in itself (World Energy Council 1997: 4). It is, however, accepted that electricity is the most effective way of satisfying domestic energy needs. The many advantages that electricity has, relative to other forms of energy such as fuelwood, plant and animal residues, paraffin, batteries and candles, make electrification specifically for low-income households, almost a necessity. Electricity is a clean, effective and controllable fuel that has no storage requirements. The use of electricity by low-income households can be an empowering experience as well. Theoretically people would have better control over their energy expenditure, better management of their time, wider application possibilities if compared with other fuels and it can also facilitate the use of information and educational media such as radio and television (*National Electricity Regulator*, 1996).

The history of the electrification of poor households in South Africa up till fairly recently, has shown that only a small portion of the society had access to the essential empowering advantages of electricity. At the beginning of the nineties, South Africa had an average household electrification level of a mere 33% (Dingley, 1990: 3). At that stage Eskom, South Africa's and Africa's biggest electricity utility, was already one

of the five biggest electricity generation and sales utilities in the world. In the context of Eskom's capabilities alone, the level of electrification was, despite other structural impediments (such as political influences and costly grid extensions to accommodate remote areas), unacceptably low. It is also important to note that it is not the high cost of electricity itself, but rather the initial connection and wiring costs that puts it out of reach of many people in the low-income categories.

Following the political changes in South Africa, the electrification level has improved to approximately 50% of all households (Eskom, 1996). Large portions of (previously) disadvantaged and low-income communities are now starting to enjoy the advantages of electricity.

The purpose of this Chapter is to contextualise domestic electrification processes by looking at the generation, distribution and supply of electricity in South Africa. An overview of the factors that shaped electrification in South Africa will be provided in order to revisit the circumstances that led to the wide-scale commercial application of the system of prepayment electrification. Advances in electrification technology as well as widespread problems related to the culture of non-payment for municipal services such as water and electricity, provided ideal conditions for the introduction of the system of prepayment electrification in South Africa.

3.2 SPATIAL INEQUALITIES OF ELECTRIFICATION

A proper understanding of the political-economy (as discussed in Chapter One) that

shaped the commercial application of electricity in South Africa is essential for a critical appreciation of the status quo. The impact that the very use of electricity had in shaping the political-economy at the beginning of the century also needs to be understood.

Electrification worldwide slots into the global pattern that is basically manifested in a fossil fuel dependent industrialised world against an energy deprived developing world, largely dependent on non-commercialised and less reliable forms of energy. This energy utilisation gap is still widening, thereby constantly perpetuating the status quo. This pattern is almost duplicated if individual (developing) countries are the units of analysis. The bias of electricity supply towards larger urban areas and dominant economic core regions relative to more marginal areas and their economic and service activities, is all the more prevalent in South Africa.

The past and present scenarios clearly show that large imbalances exist in the geographical extent of electricity application in South Africa. Electricity generation and the ultimate supply to end users reflect the following pattern: major supplies to energy intensive mining and industrial sectors with marginal (total) supplies to people, specifically poor societies. In South Africa energy demand sectors such as manufacturing, commerce and mining account in total for about 60% of the total commercial energy consumption. (South Africa, 1998: 19).

Specific electrification targets, to be monitored by the National Electricity Regulator, are however being set to try and address these imbalances. The government's Reconstruction and Development Programme, for example, targets 450 000 connections

per annum up to the year 2000 (National Electricity Regulator, 1996). At the end of 1998 a cumulative total of 1 451 503 homes had already been electrified by Eskom since 1994 (*Eskom Annual Report*, 1998: 17). There are however, still a lot of (geographical) imbalances in the electrification process.

Table 4 provides an idea of current household electrification imbalances and the stark differences on a provincial as well as rural-urban level in South Africa.

TABLE 4 : HOUSEHOLD ELECTRIFICATION IN SOUTH AFRICA, 1995

Province	*Urban %*	*Rural %*	*Total %*
Eastern Cape	67,2	5,8	28
Free State	67,6	32,5	53
Gauteng	77,7	54,4	77
KwaZulu-Natal	78,7	14	43
Mpumalanga	59,4	37,2	45
North West	69,9	20,5	46
Northern Cape	76,1	46,8	66
Northern Province	71,2	23,7	29
Western Cape	88,1	47,1	82
Average	72,9	31,3	52,1

(Source: National Electricity Regulator, 1996: 12)

The figures clearly show the geographical imbalances in electrification countrywide. The fact that five of South Africa's nine provinces (namely the Eastern Cape, KwaZulu-Natal, Mpumalanga, North West and Northern Province) register total

electrification figures of less than 50%, is a call for major concern. This pattern is also largely a result of the former homelands system because the bulk of the former self-governing territories were located in these five new provinces. In combination with the direct impact that this historical legacy has, the high percentages of rural population and the remoteness of some of these areas are indirectly responsible for the low electrification rates in these provinces.

Apart from the legacy of apartheid and the negative impact that it had, and still has, on electricity supply, practical considerations such as high costs of grid extensions into sparsely populated areas, relatively low electricity consumption by new rural consumers, resource and financial constraints of local governments, etc., should also be borne in mind.

3.3 URBAN ELECTRIFICATION

Due to the massive scale of urbanisation in South Africa the capacity of local authorities to provide in the growing need for municipal services, is progressively becoming a major problem. Important needs like employment and housing are therefore top priorities that must be addressed urgently alongside energy services (Van der Berg, 1992). Van der Berg (1992: 136) maintains that: "... electrification is not the most basic need and it will have to compete with many other desirable objectives and social needs ... it is likely to be tied to the housing process ...".

Large parts of South Africa's metropolitan space are occupied by informal settlements as a result of the dire housing need. The fact that informal houses are not electrified in the conventional way necessitates electrification via the more adaptable prepayment system. Unlike rural areas, where household energy needs can in certain instances be satisfied by fuelwood and other biomass forms, the urban scenario does not provide for all these options. The possibilities for using fuelwood and other business forms in urban areas are far less if compared with rural areas. Due to the sometimes unavailability of fire wood sources in urban areas, the selling and buying of wood for energy purposes become therefore the solution.

In the past urban electrification was prone to a variety of influences that could mainly be related to the socio-political status quo under apartheid. For example, the recurrent costs induced by the then very fragmented supply industry, as well as installation costs, seriously hampered electricity supply specifically to so called sub-economic and informal housing schemes. Apart from Eskom, the supply industry consisted of more than 400 municipal supply units countrywide (Dingley, 1990: 15).

An example of this undesirable situation was to be found in one of the case study areas, Delft, on the Cape Flats. Although the electrification of many sub-economic housing schemes was the responsibility of the then Western Cape Regional Services Council, it was basically administered by the older Divisional Council of Stellenbosch with its offices some twenty kilometres away from Delft. Problems that could not be solved by the local housing office in the township, therefore necessitated a trip to Stellenbosch by the affected resident(s). Wallacedene on the other hand, was directly supplied by

Eskom although it is situated within the then municipal boundaries of Kraaifontein. (The impact of this situation, apart from the questionnaire results analysed in Chapter Five, is also reflected in responses from officials with whom structured interviews have been conducted.)

Inefficient urban electrification in the larger Cape Metropolitan region was therefore not merely a result of technical and financial constraints, but also a result of local political-administrative arrangements that perpetuated the situation.

3.4 SUPPLY AND DISTRIBUTION PROBLEMS

South Africa's former apartheid planning strategies regarding municipal service delivery such as water supply, electrification and sewage and waste disposal had devastating results on the mutual trust between service providers and communities. It also impacted on the environment, the fabric of communities and on the services themselves. According to Christie (1984: 204), electricity in particular, had, since the turn of the century, played a significant role in the maintenance of class and race relations as well as vested interests. An important hegemonic role has been played by the electricification and/or the non-electrification of certain areas. In doing so the socio-economic strata of South African society was kept intact.

Efforts to change the political status quo have also been reflected in various forms of dissatisfaction with service delivery to marginalised and oppressed communities. Rent boycotts, non-payment of electricity and water bills, destruction and vandalism of

infrastructure, etc. were all expressions of that dissatisfaction. Cobbett (1992: 46) maintains that apart from fundamental political considerations, various communities had valid reasons for many of the aforementioned actions, because of the unreliability of the technical services. Until fairly recently it was not uncommon that black areas experienced, many more electricity blackouts or power failures than white areas (Cobbett, 1992). The non-payment for electricity (deliberately or due to genuine financial inabilities) became the vehicle through which social, economic and political grievances have been voiced (Rosen and Anderson, 1992: 3).

The very (fragmented) nature of the electricity supply industry in South Africa also had (and still has) its impact on electrification related problems. South Africa was one of the first countries in which the commercial supply of electricity was made the responsibility of local municipalities and subsequently also that of private power stations (Theron, 1992: 4). However, the Electricity Act 41 of 1987 paved the way for the establishment of the then *Evkom*, that had the primary responsibility of generating and supplying electricity to the whole of South Africa via a national grid that could link all major centres. Although this development decreased the responsibilities of municipalities to supply electricity, they still maintained their authority regarding distribution and reticulation of electricity to people, businesses and industries within their own jurisdictions (South Africa, 1987).

Consequently, major fragmentation exists within the electricity supply and distribution industries. Prior to 1994 more than four hundred individual municipalities, distribution agencies, state departments and councils, former provincial administrations and

Regional Services Councils, the former TBVC regions as well as Eskom were involved in electricity generation, supply and distribution (Dingley, 1999). Although this situation is to a certain extent still in place, attempts, under the auspices of the National Electricity Regulator, are currently underway to try and rectify this situation.

Drastic consequences forthcoming from this fragmentation included (specifically in former black local authorities) the following: administrative complexity and major duplication of work, ineffective service delivery, fiscal constraints and above all wide financial and geographical discrepancies regarding the setting of tariffs, metering and billing (Cobbett, 1992; Dingley, 1990; Theron, 1992). The advent of prepayment electricity in the late eighties and the large-scale commercial application thereof in black communities in particular, was underpinned by a whole range of ideological-political, administrative, socio-economic and technical problems.

3.5 RESTRUCTURING THE ELECTRICITY SUPPLY INDUSTRY

From the expositions in the previous sections it is clear that restructuring, or at least the rationalisation, of the supply industry must become a priority. Apart from the highly politicised nature of the supply industry until recently, there are also other aspects that lead to the problems associated with the fragmentation of the industry.

Gauged against economies of scale the present situation is indeed inefficient. The duplication of resources, technology, administration and salaries add up to huge sums of money within relatively limited geographical space. The following citation from

Prepayment Electricity (May/June 1994: 12) encapsulates the situation prevailing in 1994: "South Africa's electricity supply industry is the most fragmented in the world. With 450 suppliers serving 3,5 million consumers, the South African suppliers average a uniquely low 7800 consumers each ...". The situation has improved since, but it is still far from satisfactory. Sharing of human resources and experiences was also seriously hampered by the fragmentation and the subsequent costs reached far beyond mere quantifiable figures.

Rationalisation and restructuring will in itself raise many problems. A major concern is the surpluses generated by big electricity users such as industry and commerce. These surpluses normally go to local authorities who can use it for the subsidisation of other services such as waterworks and roads. If this income is, for argument's sake, terminated under a new supply structure, it can have disastrous effects on local service delivery.

In 1994, under the auspices of NELF (National Electrification Forum) and in conjunction with Eskom and the government's Reconstruction and Development Programme, different models for restructuring the electricity industry have been discussed, each with a number of advantages and disadvantages (*Prepayment Electricity*, January/February 1994: 23, 24). Four are briefly set out in the next section.

3.6 MODELS FOR RESTRUCTURING

The first option is based on a single national distributor that would operate closely with

central government. As the single authority over the distribution of electricity in South Africa, it would facilitate national electrification plans more coherently as well as the reallocation of broad-based expertise in areas (for example the former homelands) where it is lacking. The affinity that such an organisation would have with government as well as its "untouchable" status, makes such an approach suspect and open to a lot of criticism.

A second model suggests a small number of distributors that can cover areas that will be defined by financial viability instead of regional boundaries. Such an idea would be more sensitive to financial imbalances within and between regions. It would ensure better and more effective monitoring and control within a manageable geographical area. The insensitivity of such an approach towards "political boundaries" that includes different tax and government structures can, however, cause a lot of problems.

A third approach, based on the province as entity would be cognisant of political realities, financially independent, and accountable to central government. Such an approach assumes economic homogeneity of regions which, of course, is far-fetched. For example, some provinces do not have the funds to embark on wide-scale electrification programmes.

The fourth approach advocates the merging of existing electricity suppliers into metropolitan distributors. If such an approach is followed, the current situation whereby rural electrification is seemingly less important than urban electrification, will persist. Under such a scenario central or regional government intervention will, in any case, be

necessary to address geographical imbalances in electrification.

Parker in *Prepayment Electrification* (May/June 1994: 18) comes to the conclusion that the only way out is "... the establishment of a national fund to balance things out and subsidise electrification - and with that we are heading back to the idea of a national controlling body".

3.7 CONCLUSION

This chapter has made it clear that electricity as a commodity that could have been provided to needy people in a more efficient way, had become a political issue. If the historical prelude to the implementation of prepayment electricity as well as its dominant target groups are used as frameworks, it is clear that apart from its technical flexibility and efficiency a major function was also to try and curb the problem of non-payment and the subsequent repercussions. The prepayment concept differs essentially from the conventional concept in that payment for the service precedes use. It means that prepayment users can regulate their own consumption rate and resultant expenditure. The continuation of the service is in the hands of the end-user. The many household advantages of prepayment also need to be weighed up against all the other systems factors that have shaped the industry up till now.

Based on South Africa's electrification history, different perspectives on the prepaid system can be provided. It can be seen as a true solution to the problems of household fuel needs and subsequent energy management. The prepaid system can also be seen

as a mere remedial measure to address problems such as the non-payment of electricity bills, high cost of conventional electrification, etc. From a more radical perspective, the prepaid system can also be seen as a punitive measure that discriminates against financially poorer people. The next Chapter will partially reflect on this fundamental question as well as providing an overview of the technical aspects of the prepayment system.

CHAPTER FOUR

THE SYSTEM OF PREPAYMENT ELECTRIFICATION

4.1 INTRODUCTION

Prepayment systems are in essence based on the vending concept that is characterised by payment that precedes the use of a service and/or a commodity rendered by a machine or object. The history of the vending concept and some of its first applications date back to Ancient Greece. Prepayment meters for services other than electricity supply have long histories and the concept is well-known and widely used. Public services, like parking meters, soft drinks and cigarette vending machines, public telephones, laundries, etc., that do not necessarily need physical monitoring by human beings, are earmarked prepayment services that can be found basically everywhere.

Although the concept is not entirely new in its application to electricity dispensing, it has a young history as far as the extent of its commercial-geographical use is concerned. The history of coin-operated electricity dispensing meters for household purposes, dates back to uses in the early nineteen hundreds in the United Kingdom (Die Suid-Afrikaanse Tesourier, 1988 : 165).

Impediments on the implementation of the system at that stage were related to practical considerations such as the provisions of (costly) extra machines, regular collection of money and tampering with devices (Die Suid-Afrikaanse Tesourier, 1988 : 165). The

nature of prepayment services has since reached such high levels of sophistication and technological advancement, that the very essence of the service needs closer scrutiny, specifically in its application on the South African electrification industry.

4.2 THE DAWN OF PREPAYMENT ELECTRIFICATION IN SOUTH AFRICA

Coin-operated systems for energy provision have been widely applied in holiday and recreational areas that were not supplied by electricity via the national grid. The concept was based on providing a triggering mechanism for the combustion of commercial gas in furnaces to provide hot water, lighting and space heating to holiday makers and tourists. On a household scale the concept has been applied as a means to uplift and develop poorer people's social and household responsibilities. During the early eighties, in the Grabouw region of the Western Cape, coin-operated electricity dispensing meters were, for example, installed in the houses of farm workers (personal observation).

The application of household prepayment electricity meters operated or triggered by mechanisms other than coins, started to gain momentum since the late 1980s. Common reasons for the dawn of prepayment electricity during that time, had definite political-economic underpinnings. As discussed previously, electricity payment boycotts as a means to voice mass opposition against apartheid and the quality of its related municipal service delivery programmes are perhaps the most important reasons in this regard. Cobbett (1992: 49) summarised this problem very aptly a number of years ago when he said that:

> "From the outset, it is necessary to state that pre-paid meters in and on themselves, do not constitute a 'solution' to the problems of urban electricity. As a response their treatment is merely symptomatic - they do not address delivery, tariff, the supply authority or many other issues of concern".

Since that time, a lot of that criticism has withered as a result of improved technology, the introduction of a definite electrification plan driven by Eskom and the new government, and improved customer services for prepayment electricity users. Gauged against the socio-economic status of its users however, it is still a technological application that cannot really be separated from South Africa's political past. Poorer people and lower-cost housing areas also remain the biggest target groups and areas for prepayment electrification. Despite the good intentions of the prepayment technology *per se*, the context within which it operates, is still very much an old South African one. The electricity supply industry is still very much fragmented and largely in the hands of local authorities despite the current transformation of the latter. Depending on the nature and structure of new municipal or metropolitan substructures, different electricity rates may still prevail. Tariffs can therefore differ in areas with similar socio-economic conditions that are located geographically in different jurisdictions. Eskom's tariff settings, although cognisant of people's financial capabilities, are simultaneously very "prescriptive". (See Chapter Five for a discussion in this regard.)

Household energy supply, which is a basic need for social, economic and educational empowerment, is to a certain extent limited by the very fact that payment should

precede the use of electricity. An analysis of the results of this survey indicates that 14,7% of respondents are frustrated and limited by this fact, so much so that they do not use electrical appliances in the wake of decreasing credits on the meter. When the energy need under such conditions becomes dire, almost 6% of respondents would use money budgeted for food, transport, amongst others, to buy more electricity.

People (who are in most cases financially more able) with conventional metering in their houses are not confronted by this situation. The very essence of addressing the energy needs of the poor is therefore becoming a complex play-off between the allocation of money for essential other needs and the urgency for energy sustenance.

4.3 MANUFACTURING ASPECTS OF THE PREPAYMENT SYSTEM

A variety of role players and manufacturing companies such as Plessey, Advanced Engineering from Germany (AEG), Altech Industrial Electronics and Conlog have been involved in the prepayment field since the concept gained widespread commercial momentum in the late 1980s. The open market created provided different products with a wide array of advantages and disadvantages to the electricity supply industry which consists largely of local authorities.

These circumstances created ideal conditions for a non-standardised prepayment electricity industry. This serious concern was summarised in a document on Eskom's views on standardisation (*Prepayment Electricity*, Jan/Feb 1994: 26):

"... the diverse characteristics and incompatibilities of the prepayment products offered by the varying [sic] manufacturers would complicate the management and implementation of prepayment systems ...".

This diversity could have had dramatic effects on areas and people if different, incompatible systems were applied concurrently. This very problem was encountered during the survey in Delft. Meters, that were driven by card technology, were in operation concurrently with the so-called Budget Electricity Controller meter (that is code or pin driven) of Plessey in the same area.

Apart from the differences in the quality of the products, it seems as if important variables like the socio-economic profile of users, the impact of climate and weather on the meter, the administrative support structure and the technical back-up service, have not been properly assessed during the decision making process (on what product to use) in Delft. These assessment related problems could be considered as the normal "teething" problems that are being encountered if new innovations come into effect. The growing problems related to the prepayment system created a lot of misconceptions among end-users. Some of the negative perceptions regarding the system, are still in place (see Chapter Five). Eskom subsequently embarked on large scale standardisation programmes to allow complete interchangeability between different meters and vending systems.

4.4 TECHNICAL BASES OF THE SYSTEM

The system, at household level, consists of an electricity *dispenser or meter* that is fixed onto a panel or wall in the house or (informal) structure. Most meters used in South Africa are *code-operated* by a twelve digit encrypted code and have a numeric/keypad and a LCD (liquid crystal display) on their faces. Other meters that are *card-operated* obviously look different.

Technically the prepayment meter acts as a valve which shuts down as soon as there is no mechanism or force that can keep it open. Electricity is cut as soon as the credit is exhausted. Reconnection can only take place if the encrypted code or another transport mechanism (such as a magnetic card) "activates" the meter with additional credit again. Technically, the function of a simple circuit-breaker in the meter is terminated in order for it to allow supply through again.

During the survey a few anonymous people were bold enough to admit that they tried to tamper with their meters, meaning to make the circuit-breaker dysfunctional. Those who have been successful did precisely that, meaning bypassing the circuit-breaker to ensure constant supply of electrical current.

A *ready-board* which is linked to the meter and is basically a box instrument supplied with two or three plugs and sometimes an overhead light. The ready-board provides the basis for further intra-house connections and extensions for which the homeowner takes responsibility. (Intra-house reticulation will be discussed in more detail in Chapters Five and Six.) Table 5 provides a summary of how different types of prepayment dispensing

meters compare with each other.

TABLE 5 : COMPARISON OF PREPAYMENT DISPENSING METERS

	Coins	Disposable Magnetic Card	Plastic Card	Smart Card	Smart Token	Bar Code	Keypad
Independent of Machine Readable Data							X
System Running Cost	X					X	X
Elimination of Mechanics & Readers							X
Token as Communication Medium							X
Security				X	X	X	X
Token Vandalism						X	X
Token Cost	X						X
Token Damage	X						X
Token Replacement		X	X	X	X	X	X
Vending Flexibility							X
Vending System Cost	X						X
Vending Audit Trail				X	X		X
Vending System Security				X	X		X
Vending/Meter Feedback				X	X		X
Ease of Use	X			X			X
Tamper Resistant		X	X	X	X	X	X
Maintainability							X
Sealed Enclosure							X
Inherent Reliability							X

(Source: Electricity Dispensers - Supplement to *Elektron, January 1992)*

In Table 5, the X denotes distinct advantages over the other technologies. It is clear that keypad meters operated by a Credit Transfer Number (CTN) have clear advantages over the others. The original card-operated system introduced in Delft was, according to the information acquired, not tamper resistant. Problems related to the Credit Dispensing Unit (CFU) and the management of the System Master Station (SMS) also added to the tampering problems.

4.5 THE OPERATIONAL-ADMINISTRATIVE BASES

After the installation of the hardware in dwellings, the system operates on the following basis:

- The owner purchases electricity from the local authority or Eskom by either quoting the specific number of the meter or the number of the card if it is card-operated. This takes place at a *vending point/station* or *credit dispensing unit* that can be located at a municipal office, an Eskom office, the corner shop, the utility store, or any retail outlet for that matter.
- A certain amount of units, depending on the purchaser's needs and budget are then paid for.
- This information is then entered into a computer system and a corresponding cash register.
- The units purchased additionally is then reflected in a 12 digit computer-generated code printed onto a ticket (if the meter is keypad-operated) or credited onto the magnetic strip of the card (if the meter is card-operated). The ticket (in the case of a keypad-operation) in essence serves as a receipt and it contains

information regarding the purchaser's name, the meter number, the date, amount of units bought, the cost and the code.

- At home the purchaser enters the digits on the ticket by using the keypad, or he/she will slide the magnetic strip of the card through a detector (if the meter is card-operated).
- The units purchased will then be added to the existing credit and the combined total, which can then be used, will be shown on the LCD.

These operations seem to be very simple and straight forward, but a small portion of the respondents in the study indicated that they are too difficult for them to follow due to their illiteracy (see Chapter Five for details).

4.6 PREPAYMENT IN THE REST OF THE WORLD

Other parts of the world also rely on prepayment electrification - the developing world more so than the more developed countries. South Africa's prepayment industry plays a very important role in this global expansion. The example of the geographical "invasion" of the electricity dispenser *Cashpower 2000*, jointly manufactured by Spescom and Siemens in South Africa, is worthwhile highlighting in this regard. It is used in more than 25 countries around the world, including First World societies like New Zealand and the United Kingdom. Major contracts and programmes have also been established and launched in developing countries such as Argentina, Ghana, Fiji and Zimbabwe. Other companies such as Conlog have operations in Tanzania (*Metering International*, 1996). These technologies are widely applied and the role that South

Africa's technological advancement plays in this regard, is very important.

4.7 CONCLUSIONS

Against the background of what generally seems to be technically and administratively a very sound system, evaluating prepayment electricity's role and suitability for poor people becomes very much circumstantial in a geographical and socio-economic sense. The analysis of the survey results in the following Chapter will also include some of the obvious problems of the systems such as tampering, the applicability and level of sophistication of the products, climatological influences, infestation by insects, tariff setting and problems at vending stations. Addressing these problems and their prevalence in the study areas should provide more coherency and holism to an understanding of how appropriate or suitable such systems can be in similar conditions elsewhere.

CHAPTER FIVE

ANALYSIS OF THE EMPIRICAL DATA

5.1 INTRODUCTION

The purpose of this Chapter is to analyse the questionnaire data and highlight the factors that impacted on the system of prepayment electrification as encountered in Wallacedene and Delft. The analysis will also be supplemented by the information obtained from officials, community representatives and local people through structured interviews and informal discussions. Permission to conduct the surveys was granted by the local representative bodies of the areas. Both the Delft Liaison Forum and the Wallacedene Residents' Committee granted permission for the surveys to be conducted. The surveys started in 1994 and were completed in 1995 with the help of field-workers who administered the completion of the questionnaires. In a few cases people completed the questionnaires in their own time after which they were collected by field-workers.

Interviewees (electricity officials) were consulted in advance regarding the aim of the survey, as well as the purpose of the interviews. Two of the interviews were recorded on audio tape and transcribed. The informal discussions with 27 non-sampled households were based on accidental sampling. Accidental sampling is an example of non-probability sampling and it is based on the availability of subjects - in this case people - who are willing to co-operate with the researcher at a specific time and place (Bless and Higson-Smith, 1995: 94).

The following section provides a brief description of the study areas. The maps in the Addendum show the physical layout and street patterns of the areas. The systematic sampling procedure on which the questionnaire survey was concentrated, was largely based on those layouts.

5.2 PROFILE OF WALLACEDENE

Wallacedene is a structured informal settlement with an absolute location of 33° 51' 30" - 33° 52' South and 18° 43' 30" - 18° 45' East. The township is located southeast of Kraaifontein, a suburb in Oostenberg which is one of the Cape Metropolitan Region's municipal substructures. A structured informal settlement refers to an area of informal housing, within which infrastructure and services like roads, a sewerage system, potable water and water toilets are provided by the responsible local authority. The township covers an area of approximately 80 hectares. It expanded due to the further subdivision or sub-letting of the plots by the owners in order to accommodate more people. The settlement was originally called Uitkyk after the farm on which it originated. It consists mainly of a black population although more and more coloured people are becoming residents of Wallacedene. The people currently residing in Wallacedene came mainly from the surrounding farming areas of the Boland, the nearby Scottsdene township, as well as from other areas in the Metropole. In 1994 Wallacedene consisted of 1712 serviced plots (Information provided by town planners Steyn, Larsen & Partners in 1993). Prepaid electricity is only provided on request. Keypad-operated Plessey meters are installed in dwellings with a maximum current limitation of 35 amperes (information obtained through the interview with the responsible Eskom Official).

5.3 PROFILE OF DELFT

Delft is a big sub-economic housing scheme with an absolute location of 33° 57' - 33° 59' South and 18° 37' - 18° 39' East and is geographically part of what is called the Cape Flats. The area is located east of Cape Town International Airport. The mean rainfall for areas near the airport is 554,8 mm, mean temperature 16,6°C and the highest speed that the dominant Southeasterly wind reaches between October and March is 37,7 meters per second (m/s). The dominant Northwesterly wind over the traditional winter period can reach speeds of more than 32 m/s (Climatological Data for Cape Town International Airport, 1956 - 1996.)

Delft used to be administered by the former Western Cape Regional Services Council, but it currently falls within the municipal boundaries of the metropolitan substructure called the City of Tygerberg. Delft is located on 780 hectares of sandy, unconsolidated soils which are largely covered by the very resilient and alien Port Jackson trees. The area consists, in terms of its population, mainly of coloured people. More black people are moving into the area. Four towns, namely Voorbrug, Roosendaal, The Hague and Eindhoven form what is called the Delft Development. Three other towns will be developed at later stages (Delft Development - Information Brochure, 1993). The former two towns were established in 1989 after which the latter two took shape in the early 1990s. The development consists of various categories of low-cost houses. Depending on a prospective buyers' financial capabilities he/she could have chosen from a range of houses. Houses at the bottom end of the range offer just the bare essentials such as a bathroom, a kitchen corner and two open-planned rooms. Houses

at the top of the range offer more "luxuries" such as individual rooms fitted with lights and power plugs.

Delft is a result of the planning of the former House of Representatives in the tri-cameral apartheid government prior to 1994. The basic aim of the development, in the wake of increased urbanisation, was to provide low-cost housing particularly for coloured people, who could otherwise not be accommodated in existing coloured townships. The establishment of Delft was, therefore, geographically, politically and racially a result of apartheid spatial urban planning. The area is characterised by many housing, administrative and municipal service delivery problems (acknowledged by officials in the area). Cracking walls, exposed foundations and leaking roofs are some of the structural problems experienced in this area (personal observation).

All the houses in the area have been provided with prepaid meters and each residential stand is earmarked for a 2,5 kVa maximum consumption at a time (kilovolt amperes/kVa is a unit that is sometimes used interchangeably with the unit Kilowatts). Electrical power, i.e. the rate at which electricity is produced by a generator or the rate at which it is consumed by a device, is measured in Watts (1 kW = 1000 W/1 kWh = 1000 Wh). Depending on the sophistication of the house bought, intra-house electrical wiring would have been provided by the developers or otherwise it would have been left as the responsibility of the owner him/herself.

Studies conducted by Theron (1992) showed wide variations in the average electricity consumption levels of different low-income communities on the Cape Flats. An annual

average level of 252 kWh per month was recorded for Khayelitsha. On the other hand, households in Langa and Gugulethu recorded a summer average of 585 kWh/month and a winter average 644 kWh/month. As time progresses, people tend to steadily increase their levels of consumption "presumably as newly electrified households buy electrical appliances" (Theron 1992: ii). The assumption that people with a low income normally use less electricity, is therefore not always true.

5.4 QUESTIONNAIRE ANALYSIS

The following analysis provides some understanding of how people in Wallacedene and Delft experienced and perceived the system of prepayment electrification. A copy of the questionnaire is included in the Addendum and it consists of a variety of direct and open-ended questions under categories for data related to *socio-personal information, characteristics of dwelling, the prepayment meter, electricity consumption*, and *service rendered.*

A total of 182 questionnaires was analysed and the outcomes, mainly based on the whole sample, are highlighted. Peculiarities regarding the different areas will be treated where comparisons and differences need a more comprehensive understanding. The analyses are mainly based on the statistical interpretation of frequencies and correlations as well as information acquired through the interviews.

5.5 INFLUENCES ON THE SYSTEM OF PREPAYMENT ELECTRIFICATION

From the analysis of the empirical data it is clear that a variety of factors impact on the system of prepayment electrification. These factors are discussed in the following sections. The different ways in which the system impacts on the consumers are also analysed.

5.5.1 SOCIO-ECONOMIC PROFILE OF RESPONDENTS

Questions in this section of the questionnaire focus on socio-economic variables such as home ownership, household size, household income and monthly expenditure on electricity. Table 6 provides a summary of the data acquired for these variables.

TABLE 6: SELECTED SOCIO-ECONOMIC VARIABLES

	Ownership		*Average household size*	*Average monthly income*	*Average monthly electricity expenditure*	*Household Head*	
	Owner	*Tenant*				*Male*	*Female*
Wallacedene	90,8%	9,2%	4 persons	R747,38	R72,04	63,2%	36,8%
Roosendaal	95%	5,0%	5 persons	R799,56	R83,20	32,2%	67,8%
Eindhoven	100%	-	4 persons	R659,00	R30,23	32,4%	67,6%
Total	95,3%	4,7%	4 persons	R735,31	R61,82	42,6%	57,4%

(Source: Surveys in Wallacedene and Delft, 1994/95)

High scores of more than 90% home ownership was recorded in all the sampled areas. From this figure, it can be inferred that a large number of the respondents could have

a good idea of the demands of running a household, paying for services and having bond repayment responsibilities (in the case of Delft). Additionally, women who constituted 57,4% of the total sample, were either the homeowner or main breadwinner. The fact that such a significant percentage of respondents were women, necessitates a more genderised interpretation. Women normally play an important role in the allocation and management of money and other resources necessary for the smooth-running of the household. It can therefore be assumed that there may be differences in electricity expenditure and consumption between women and male household managers.

Although the average household sizes do not differ significantly as suggested by the figures, there were differences between the two areas. In Wallacedene with its larger permanent and non-permanent (extended) family structures, maximum households sizes of 12 have been recorded while the maximum for both areas of Delft was 9.

As displayed in Table 6, the variation in monthly income among the sampled areas is not very large. The figures suggest further that 8,4% of people's income is spent on electricity. Against the background of the generally poor socio-economic circumstances prevailing in these areas, such an expenditure is therefore relatively high.

The expenditure on electricity can also be correlated with the type and quality of the house or structure in which the electricity users are staying. Prior to the large-scale implementation of prepayment electrification, people who were not staying in proper houses have been "disqualified" from the electrification process, because the structural qualities of houses were important considerations in the conventional system of

electrification. The following section provides an overview and empirical proof of how the quality and structure of dwellings/houses in both Wallacedene and Delft impacted on the prepayment system.

5.5.2 QUALITY OF HOUSING

The question and answer of whether respondents were staying in a proper or an informal house, were self-evident in the two areas. All the respondents in the Wallacedene sample were staying in shanty structures while the Delft respondents occupied proper houses. A proper house would be a unit built of brick and mortar according to plan approved by the building administration section of a local authority. The issue was handled with the necessary sensitivity by field-workers who filled in the answer to the question themselves.

Space heating of houses in both Wallacedene and Delft appeared to have been a major problem because 87,4% of houses in the whole sample, did not have ceilings or any other form of insulation. The heating of living spaces and the subsequent expenditure can pose a major problem for these people, particularly during the notorious Cape winters. The fact that the proper houses of Delft are characterised by poor quality of workmanship also aggravated the problem of space heating (personal observation).

Since the establishment of Delft, the windy and rainy winter conditions on the Cape Flats have already severely damaged many houses. The conditions in Delft attracted much attention from the central and local government. A visit by the State President of

South Africa to the area took place in May 1994. Various commissions of enquiry (nationally and provincially) and task teams have been established to investigate a spectrum of issues facing the Delft area.

The quality of housing has a direct impact on prepayment electrification seeing that ready-boards and meters can only operate effectively in a protected and dry environment (Information obtained from officials and technicians). Photographic material has been collected by the researcher during site visits to severely damaged houses in Eindhoven after heavy storms lashed the Cape Flats in May/June 1994. In some instances prepayment meters and ready-boards were ripped from the walls on which they had been mounted. Poor quality housing can have a negative impact on the those essential components of the prepayment system.

Other than with conventional electrification where the approved quality of a house is a precondition, prepaid electrification can (theoretically) be provided under almost all possible circumstances - as long as there is a solid and sturdy under-roof panel/wall/post onto which the meter and ready-board can be mounted. This "easiness" in providing electricity, also explains why the service is sometimes labelled as "poor man's electricity".

5.5.3 THE USE OF ELECTRICAL CORDS

Due to the fact that prepayment electrification excluded intra-house wiring in Wallacedene and some parts of Delft, people were by implication forced to provide their

own plugs and/or lights in rooms other than the one in which the meter and ready-board were installed. A maximum of three rooms per dwelling were recorded for 52,7% of the sample. The occurrence of additional structures on plots (specifically in Wallacedene) was recorded for 12,1% of the sample. These figures suggest that the use of electrical cords for inside and outside wiring extensions, is almost a necessity.

In the Wallacedene settlement was a high incidence of people staying in backyard structures. In most cases those additional backyard structures were also informally electrified through self manufactured leads/cords. From the interviews with respondents in the incidental sample, it became apparent that these non-standardised and often dangerous cords had caused many accidents in Wallacedene. Although no fatalities had occurred, it was reported that specifically young children, have been shocked in the past by poorly insulated wiring that crosses streets, pathways and fences in the township.

One way of addressing the problem of dangerous extension cords is by using standardised electrical leads, the so-called *Lunaloop* (for distribution of lights) and *Powerloop* (for power socket distribution). As extensions to the ready-board, these leads are automatically under the protection of the earth leakage unit and circuit-breaker of the ready-board (*Prepayment Electricity*, July/August, 1995: 12).

Although this is a solution to the symptoms of the problem, the fundamental cause, i.e. the absence of decentralised intra-house wiring, still exists. The do-it-yourself intra-house wiring that is one of the saving hallmarks of the prepayment system can easily

backfire if the necessary safety precautions are not adhered to by the consumers.

Electrical cords (standardised and home-made) were used by 65,7% of the respondents for a variety of reasons. Table 7 summarises the reasons for using electrical cords as recorded in Wallacedene and Delft.

TABLE 7 : REASONS FOR USING ELECTRICAL CORDS

Reasons	*Frequency*	*Percentage*
To be able use essential household appliances (fridge, iron, stove, etc.)	47	29,2
To be able to use entertainment appliances (stereo, television, etc.)	39	24,2
Supplying other rooms with plugs	34	21,1
Supplying other rooms with lights	23	14,3
To be able to use power tools (drill, sander, welding machine, etc.)	6	3,7
Supplying electricity to people staying in the backyard	5	3,1
Other uses/reasons	4	2,5
Supplying electricity to next door and across the street neighbours	3	1,9
Total	*161*	*100*

(Source: Surveys in Wallacedene and Delft, 1994/95)

Based on the figures in Table 7, it is clear that the use of electrical cords is mostly related to use appliances (29,2%), the use of entertainment devices (24,2%) and for intra-house extensions (21,1%). Essential household, entertainment, and entrepreneurial needs, as well as supplying electricity to other people, were thus facilitated by the use of the extension cords.

In Wallacedene specifically, self-manufactured cords used to distribute electricity to people across streets and even farther away, were running in all directions. The spatial distribution of electricity to others through this method, was not specifically examined by the questionnaire. In order to get an idea of the physical extent of this unauthorized distribution, the field-workers were requested to roughly measure the lengths of some of the cords that came across. It was done unobtrusively by counting the number of steps taken to cover the length of the cord. The field-workers reported instances of more than 100 steps per cord. Based on such measurement it was possible to estimate that some cords were in excess of 40 metres.

This dangerous practice of informal electricity distribution is seemingly unpreventable (information received by Eskom Official in Wallacedene). This illegal practice has financial advantages for the "supplier". It provides additional income to households, because those whom they are supplying are charged for the "service".

The use of electrical cords to supply other people with electricity might have other repercussions as reported by discussants and observations by field-workers:

- The practice can lead to complacency with regards to getting one's own meter. Those who are being supplied do not really have to apply for a meter and this can lead to the perpetuation of the problem (from discussions with four respondents in Wallacedene who were supplied by someone else, it was apparent that they did not consider the possession of their own meter as a priority at that stage).
- The "electricity tenants" are also at the mercy of the supplier's attitude and the

availability of credit on the latter's meter. Cords can be unplugged if controversy arises between the parties, supply can be terminated if the credit runs out or if vandals steal or damage the supply cords. (One incident was reported where the supply was terminated due to a disagreement between the "tenant" and the supplier.)

- The protection of the cords is seemingly the shared responsibility of both the supplier and the "tenant". Three ways of protecting cords were observed in Wallacedene:

  (i) cords were ensheathed in hosepipes across streets; (ii) cords were fitted into narrow grooves that were chipped into the surfaces of streets and covered by a thin layer of sand; trees, (iii) poles or any other tall structures on both sides of roads served as a means for overhead distribution.

- The supplier can theoretically determine his/her own profit by charging the "tenants" more. The fact that the supplier also uses electricity, makes charging the "tenant" per unit very difficult. In Wallacedene and Delft, people reported that they had agreements with suppliers to pay, apart from a "service charge", at least half of the electricity expenditure per week or per month. One person in Wallacedene reported that they share all expenditure on an equal basis.

- Managing the control over the use of appliances at the supplier's and "tenant's" places can cause interpersonal, as well as overloading problems. In both study areas it was reported that overloading the supply capacity during peak hours of electricity consumption in the households, led to many frustrations and subsequent changes in agreements. The latter included, in some instances, that the preparation of food, ironing of clothes and the boiling of water should take

place in mutually exclusive time-slots.

The ultimate "emancipation" of poor people from household energy deficiencies can, therefore, be hampered by these informal electrification agreements discussed in this section.

In an attempt to find out if there was any relationship between the variables namely, type of house in which respondents were staying and the use of electrical cords, a correlation exercise was done. A positive correlation (r = 0,51) was found. Whether the relationship was necessarily casual, was not determined. Multiple frequencies also showed a higher incidence (63%) of the use of electrical cords in Wallacedene if compared with Delft where 55% was recorded. Based on observation during the survey, it was noticeable that the use of electrical cords was more prevalent in the households of Wallacedene.

5.5.4 POSSESSION AND USE OF ELECTRICAL APPLIANCES

A variety of appliances owned and used by the respondents was recorded. The situation, to a certain extent, contradicted the low average monthly household income recorded for sampled areas. The fact that essential appliances such as kettles, two-plate stoves and irons are sometimes provided by Eskom's service outlets at affordable prices when prepaid meters are installed, could maybe serve as a possible explanation for this apparent contradiction.

A certain amount of free electricity was offered to buyers by certain furniture outlets such as Savells if people were willing to buy appliances from them (*Power Life Style*, May/June 1995:24). Purchasing of appliances is but one of the hidden costs involved in the electrification process. The following quotation aptly summarises the impact of this hidden cost:

> " ...buying an appliance is like buying on an instalment plan. The purchase price is only a down payment; the rest of the cost is paid to your utility company through gas and electric bills, month after month, for as long as you use the appliance"
>
> (*Consumers' Research*, September 1988: 6).

The fact that 65,9% of respondents in the whole sample used electricity as household energy source somewhere else prior to them settling in Wallacedene and/or Delft, could possibly also explain some of the scores (for appliances owned) recorded in Table 8.

The responses do not correspond with the sample size seeing that respondents in most cases owned more than one piece of electrical equipment. The frequency and the simultaneous use of these appliances can be functions of the availability of credit on the meter, the strength of the current supplied, as well as the energy needs prevailing at specific times. During winter the balance that needs to be reached among these factors becomes critical. From the informal discussions with people in both areas, it was reported that during winter, the use of electric stoves was temporarily terminated to allow the use of electrical heaters (for space heating). Fuel mixes would then come into play whereby the use of a gas or a paraffin stove would supplement the electric stove.

TABLE 8 : OWNERSHIP OF ELECTRICAL APPLIANCES

Appliance	*Responses*	*% owning the appliance*
Iron	134	73,6
Television Set	130	71,4
Fridge	115	63,2
Stove	111	60,9
Kettle	111	60,9
Music Centre	79	43,4
Heater	41	22,5
Freezer	24	13,2
Fan	10	5,5
Toaster	2	1,1
Washing Machine	2	1.1
Urn	1	0,5
Dishwasher	1	0,5

[Source: Surveys in Wallacedene and Delft, 1994/95 (n=182)]

Crucial energy needs are constantly being reshuffled and reprioritised against the background of influences such as weather conditions, strength of current supplied and financial ability. Thirty three and a half percent (i.e 61 out of 182) of the respondents did not use and/or did not have previous access to electricity. The fuels used by this group of respondents in areas where they used to stay prior to their settling in Wallacedene and/or Delft, are reflected in Table 9.

The figures in Table 9 sketch a fuel use scenario similar to that of people who are living in unelectrified dwellings throughout South Africa (Eberhard, 1986; Henderson, 1992). These fuel use patterns are, to a lesser extent, also prevalent where households have

TABLE 9 : FUELS USED BEFORE TRANSITION TO ELECTRICITY

Fuel	*Frequency*	*% Previous users*
Paraffin	43	70,5
Gas	33	54,1
Candles	13	21,3
Wood	12	19,6
Batteries	6	9,8
Coal	4	6,6

[Source: Surveys in Wallacedene and Delft, 1994/95. (n = 61)]

been electrified. Theron's (1992) analysis of household energy patterns in Cape Town's black townships also bears testimony of this tendency.

It seems as if some inertia exists if households switch to electricity. This "impasse" may be the result of the interplay among many factors such as tradition/culture, misconceptions and household conditions. The inertia might also be explained by what Leach and Mearns (1988: 241) have referred to as the difficulties in "climbing" the *fuel ladder*. Electricity, the ideal household energy source, is at the top of this ladder, followed by bottled gas, paraffin/kerosene, charcoal/coal, firewood, and animal and crop residues. Electricity has this position owing to its versatility, controllability and non-storage requirements. The system of prepayment electrification fits this description better than conventional electrification.

From interviews with some of the older residents of Wallacedene who never used electricity before, it transpired that electricity is less acceptable to them compared to

gas, paraffin or wood. In Wallacedene it was found that 56,1% (i.e. 23 out of 41) of the respondents had resided in the farming areas and peri-urban surroundings of Kraaifontein before they moved to the township. People in those areas did not have access to electricity.

Misconceptions (such as the believe that electricity is more expensive than wood or gas even if they realise that the former is on average more efficient), that some respondents had about electricity were to a certain extent understandable. The fact that first-time electricity users had been *alienated* from electricity for the larger part of their lives serves as an explanation for such perception. These believes can also serve as explanation for fuel mixes in such households..

5.5.5 THE DISPENSING METER AND READY-BOARD

The prepayment meter and the ready-board in people's houses are the key hardware components of the system of prepaid electrification. The installation of prepayment meters should be accompanied by an introduction or some sort of demonstration to people regarding the functioning thereof.

This introduction is normally done by technicians or officials or by means of a simple booklet or brochure that people can consult. In Wallacedene and Delft 40,1% of the respondents reported that no introduction/explanation/demonstration has been offered to them. In Wallacedene the figure was 59,8%. This was an undesirable situation considering that more than half of Wallacedene's respondents were first-time electricity

users. But these figures should be treated with circumspection because Mr George Samuels, the Eskom Official, reported in an interview that the people of Wallacedene have been introduced to and prepared for use of the meters. The figures might also include respondents who had been introduced but due to a lack of understanding reported otherwise. The role played by fellow residents in explaining the functions is worth mentioning. It was recorded that 7,6% of respondents in both areas were helped by neighbours and friends. Over time people became more accustomed to the meters and their functioning and less problems occurred so that only 7,1% of the respondents still had problems in understanding the operations of the meters at the time of the survey.

From discussions with people in this latter category, it transpired that most of the problems are related to illiteracy and innumeracy. Some aged people even expressed a "fear" for touching the meter. Consequently 27,7% (i.e. 5 out of 18) of the 7,1% who had problems with the meter, recorded that they did not know how to enter the encrypted code on the keypad of the meter. Mechanical failures such as faulty plugs on the ready-board, inaccurate display of information on the LCD of the meter and power surges could have aggravated the alienation of some (illiterate) people from the meter.

Only 18,1 % (i.e. 31 out of 171) of respondents reported that they, at that stage, had problems with the effective functioning of their meters and/or ready-boards. The problems highlighted by the respondents are summarised in Table 10.

TABLE 10: PROBLEMS EXPERIENCED WITH METERS AND READY-BOARDS

Nature of the Problem	*Frequencies*	*Percentages*
Meter trips (even with enough units left)	10	32,2
Some plugs on ready-board do not work	9	29,1
Sometimes individual plugs trip	5	16,1
(Inside) wiring of meter caught fire	4	12,9
Meter is noisy if plugs are on	2	6,5
No correspondence between units displayed and amount purchased	1	3,2
Total	***31***	***100***

(Source: Surveys in Wallacedene and Delft, 1994/95.)

The problems listed in Table 10 should be seen in proper context. They could have occurred due to genuine mechanical/technical failure or they could have been user-induced. In most cases the latter seems to be the more acceptable explanation. The tripping of a meter can be caused if the current limit is exceeded by having too many appliances plugged in at the same time. People were seemingly unaware of this limited capacity of the supply to the dwellings. This ignorance was underlined by the fact that tripping or cutting out of meters has been recorded as a frequent occurrence by more than thirty percent of the respondents who listed these problems. These frequent occurrences were reported to coincide with the times of peak electricity uses in the household, i.e. during cooking periods and episodes of space heating.

The general assumption that there is a direct correlation between low socio-economic status and low electricity consumption is not always true. It can be a result of mechanical problems, as was the case with the card-operated meters in Delft prior to the

installation of the code-operated Plessey meters in the area.

5.5.6 REASONS FOR AND USER PERCEPTIONS OF METER PROBLEMS

Apart from the possibility of failures that could have been caused by technical, environmental or structural reasons, the perceptions of or explanations for these failures offered by certain respondents are also important. Table 11 subsequently provides a summary of the perceptions recorded for 29 such respondents.

The fact that more than half of respondents to the question about the cause of the problems could not ascribe their problems to any specific reason(s) is probably attributable to the low levels of education of the respondents. Although the educational levels of respondents were not recorded through the questionnaire, it appeared as if the levels of formal education were lower in Wallacedene than in Delft. Field-workers reported instances in which householders/breadwinners asked the investigators to come back at other times so as to make sure that someone whom they knew and who could read and write, was present during the completion of the questionnaire.

TABLE 11 : REASONS GIVEN FOR METER FAILURES

Reasons	*Frequency*	*Percentage*
Do not know	15	51,8
Meter is faulty	6	20,9
Electrical current not strong enough	2	6,9
Due to power failures	1	3,4
Due to poor installation	1	3,4
Cabling is faulty	1	3,4
Wrong code provided	1	3,4
Electrical appliances are faulty	1	3,4
Other reasons	1	3,4
Total	***29***	***100***

(Source: Surveys in Wallacedene and Delft, 1994/95)

5.5.7 TAMPERING WITH METERS

The problems listed in Table 11 led to specific actions being taken by the consumers affected. The majority (68,9%) contacted the technicians or Eskom's personnel. Although only 1% of the valid cases in the sample recorded that they tried to fix the meter themselves, they were aware of tampering by other people. Tampering with meters is unlawful and it is a criminal offence to bypass a meter to get free electricity. A few respondents (3,6% or 5 out of 139) knew other people who had deliberately tampered with their meters. Whether such actions brought the desired results could not be ascertained with certainty although three respondents reported that the tamperers they knew, have been successful in their efforts. There were cases of tampering had been brought to court.

The bypassing of a meter was reportedly relatively easy during the beginning stages of the system in Delft. This fact was acknowledged by Mr Groenewald, the former electricity official for Delft, during an interview. According to an installation official at the Eskom's Kraaifontein branch, tampering with electricity dispensing meters in Wallacedene, is almost non-existent. It was admitted by officials in Delft that tampering caused many problems The situation was further aggravated by Systems Master Station (SMS) management problems. Data basis management and general checks were not run regularly, which resulted in a situation where tampering was only detected in a situation after a period of time. However, culprits had been caught and brought to book at later stages. A certain Mr Williams of Delft was sentenced to a year imprisonment for tampering with and bypassing of a meter *(Metro Burger,* 17 March 1994). With the continuous improvement in technology and the standardisation of the prepaid industry (to comply with *Standard Transfer Specification (STS)* and *Common Vending System (CVS)* conditions) tampering becomes almost impossible.

Standard Transfer Specification (STS) refers basically to a protocol that defines how information is passed form the credit dispensing unit to the meter, how the data is managed and what is maintained in the system. Common Vending System (CVS) defines aspects of the vending system related to the Credit Dispensing Unit (CDU) at a vending station and the System Master Station (SMS). It includes issues such as machine interface, communication between the CDU and the SMS, as well as database management. CVS compliant vending stations generate STS compliant tokens i.e. an encrypted code or information on a card. The CDU generates tokens/codes for prepayment meters while the SMS manages a number of CDUs by co-ordinating and

consolidating CDU transactions.

5.5.8 CLIMATIC AND WEATHER INFLUENCES

The frequency of some of the problems highlighted in the previous section also seemed to have coincided with meteorological changes. Apart from problems related to overloading the supply 2,7% (i.e. 5 out of 182) of respondents reported frequent failures during mid-winter when it is very windy and rainy. Exposure of meters and ready-boards to water due to leaking roofs in Wallacedene caused a number of power failures in some households. (This has been confirmed by the Eskom Official, Mr George Samuels.) Supply of prepayment electrification can, therefore, be seriously hampered if the structures of dwellings are prone to damages by the natural elements. Moodley (1996) has documented various examples of houses in rural KwaZulu-Natal where prepayment electricity was terminated due to unsafe and dilapidated housing structures. This highlights the problems associated with prepayment electrification and the quality of houses in which it is being installed.

Although not really characteristic of the Western Cape, the problems mentioned earlier can also be aggravated if there is no proper lightning and surge protection on meters. This is very much a problem in summer rainfall areas of South Africa's interior. Laudin, (in *Prepayment Electricity* September/October 1994: 12) maintained that most prepayment meters in South Africa at that stage were prone to over-voltages and subsequent damages because of inappropriate arrestors that had no diversion to the earth. When this happens the meter and its arrestor have to be removed in order for

reparations or replacements to be done. Under such circumstances consumers are temporarily *deprived* of electricity for which they have paid in advance.

Surge technology is, however, constantly being improved judging by the range of surge arrestors manufactured by companies such as Siemens, Strike Technologies and Merlin Gerin. The adaptability of the technology to extreme weather conditions is important if its appropriateness for people and the physical environments in which they are living, are considered.

Moodley (1996) has highlighted the role that other geographical factors such as soil properties, can play in mass electrification in South Africa. He maintains that the electrical conductivity of a soil may be used to significantly enhance the efficiency of electrical earthing systems and thereby reduce the costs of mass electrification programmes in South Africa.

5.5.9 IMPACT OF INSECT INFESTATION ON METER FUNCTIONING

Due to the sensitive nature of problems related to household pests, no question on vermin infestation was included in the questionnaire. Field-workers were asked to be unobtrusively observant and, in particular, be on the look-out for cockroaches in the houses. Apart from reports on unhygienic conditions in some houses, there were no reports of cockroaches. Cockroaches normally prefer a warm and dark habitat and they hide away during daytime and when there is a lot of movement around. The fact that the surveys have been conducted during daytime while members of households were busy

in the house, probably explains why cockroaches were not observed. In discussions with respondents who were part of the incidental sampling, six people admitted (2 in Delft and 4 in Wallacedene) that cockroaches caused problems in their households in general as well as around the meters and ready-boards. No confirmation could be given on whether the cockroaches actually invaded the meters and ready-boards. It was, however, mentioned that small cockroaches had been found in the holes of plugs on ready-boards on occasions. In the interview with the Eskom Official for Wallacedene, it became apparent that cockroaches are indeed infesting the meters in the area.

Two species of cockroaches are identified as pests in kitchens, bakeries and warehouses, namely the German cockroach (*Blatella germanica*) and the American cockroach (*Periplaneta americana*). The infestation of meters and ready-boards by cockroaches can cause disruptive problems. It has been found that the smaller, very resistant German cockroach " ...was able to hold to ransom the supply authorities and manufacturers, and disrupt the lives of end-users of prepayment electricity" (*Prepayment Electricity*, May/June 1994: 20). They are able to crawl through the slimmest of cracks and openings. Tests conducted showed that their excrement on and among the circuitry of meters, is highly conductive. The conductivity of their deposits can form a bridge for the current between points and that can lead to the malfunctioning of meters.

Infestation of meters and ready-boards by insects has no geographical boundaries according to the experts of companies such as Spesscom and Conlog. Some areas like the Eastern Cape and parts of Johannesburg are more prone to infestation (*Prepayment Electricity*, May/June 1994). Malfunctioning meters infested by insects can sometimes

lead to a general failure after which meters have to be fumigated before repairs can be done. Repair costs are normally covered by the supplier or local authority and they can run into "several hundreds of rand" (*Prepayment Electricity*, May/June 1994: 20).

Apart from the natural geographical distribution of vermin, unhygienic circumstances and poorly ventilated living spaces that sometimes characterise dwellings in squatter settlements, create ideal conditions for the infestation of meters and ready-boards by insects. Although preventative measures (like the complete sealing off of meters and the spraying of an insect repellent coating over the circuit-board) can make these hardware components "vermin proof", the poor conditions under which people are sometimes living present a constant "threat" to the appropriateness of the technology.

5.5.10 ELECTRICITY CONSUMPTION AND FUEL MIXES

The extent to which other fuels were used in combination with one another as well as with electricity, was also determined by the survey. Only 47,5% (i.e. 86 out of 181) of the respondents used electricity exclusively while the other 52,5%, as a rule, used electricity in combination with other fuels. These fuels and their proportional distribution among users, are summarised in Table 12.

The supplementary fuels listed in Table 12 correspond with those listed earlier in Table 9 providing additional evidence of the fuel use inertia discussed in section 5.5.4. Paraffin and gas are the most popular fuels when it comes to supplementing electricity use. Some of the interviewees still believed that those fuels were cheaper than

TABLE 12 : ADDITIONAL FUELS USED

Fuel	*Frequency*	*% of Users*
Paraffin	60	50,8
Gas	49	41,5
Wood	7	5,9
Candles	1	0,9
Coal	1	0,9
Total	***118***	***100***

(Source: Surveys in Wallacedene and Delft, 1994/95.)

electricity. The monthly adjustment of prices of liquid fuels like petroleum, diesel and paraffin by the government is another factor that can influence the monthly energy expenditure of households seeing that paraffin is still widely used.

The reasons given for the use of these additional fuels were varied. From the 133 responses the following important reasons transpired: for cooking (39,1%); to be able to save electricity (20,3%); and because of a lack of electrical cooking appliances (15,8%). Clearly these fuel uses, in combination with electricity, form a crucial part of the households' basic approach towards their energy sustenance. However, an understanding of these figures in a closer household context is important.

Apart from financial considerations, these supplemental fuel uses are functions of specific tasks at hand. In Wallacedene respondents reported, for example, that the cooking of offal, which can be a lengthy process in the absence of utensils such as pressure cookers, necessitated the use of wood which was in their opinion cheaper. Electricity would on the other hand, be used for less energy demanding tasks like

cooking of rice and porridge. It seemed as if fuel mixes in Wallacedene in particular, had little to do with other important considerations such as time, effort and efficiency involved in their applications.

The amount and frequency of electricity purchases evidently depends on the availability and/or unavailability of money at specific times. Reasons to this effect have been recorded by more than half (53,3%) of the sample. Others cited the following reasons, (amongst others) for their way of purchasing: "it coincides with our household budgeting" (9,3%); "to prevent over-consumption or misuse by other members of the household" (1,1%) ; "to have electricity in reserve" (2,7%); and "to provide in the needs of those people to whom electricity is informally supplied" (1.1%).

The majority (63%, i.e. 109 out of 173) of the respondents reported that despite financial constraints, there was a balance between their electricity purchases and their consumption. In an attempt to find out whether there was any correlation between those balanced uses and the length of the time of exposure to the use of the meter, it was established that a positive correlation (r = 0,16) did exist. It can then be deduced that imbalances could have been the result of a lack of exposure (time wise) to meters as a lack of experience in using electricity. The other 37% cited reasons, such as the following, for the imbalances between their purchases and consumption: "we cannot control the consumption of those we supply electricity to"; "due to faulty appliances" and "due to the excessive use of electricity by our backyard enterprises".

5.5.11 THE IMPACT OF CREDIT MONITORING

The fact that the credit indicated on the face of the meter should constantly be monitored by people who cannot afford to buy large amounts of electricity at a time, resulted in a variety of interpretations and (re)actions by people in the survey. Table 13 summarises those interpretations and reactions of 136 respondents.

The interaction between human beings and the metering technology is crucial, because it provides some indications as to how people are experiencing the system. It is evident from the figures in the table that the majority of the respondents did not have any real problem with the monitoring of their credit. The financial-educational advantage of the system is also evident in the first two reactions. Although the negative aspects of this process were registered with the minority of the respondents, it is still significant.

TABLE 13 : IMPACT OF MONITORING CREDIT ON METERS

Impact /(Re)action	*Frequency*	*Percentage*
No impact	62	45,5
Seen as guide to use electricity sparingly	28	20,6
Often forced to temporarily terminate use of certain appliances	20	14,7
Helps with household budgeting	12	8,8
Sometimes forced to use money budgeted for food, clothes, etc.	8	5,9
Causes frustration in the household	5	3,7
Causes embarrassment (if other people know about it)	1	0,8
Total	***136***	***100***

(Source: Surveys in Wallacedene and Delft 1994/95.)

The fact that people had to sacrifice the advantages of certain electrical uses if credits were low, or that people were forced to sacrifice other basic needs to buy more electricity, are some of the repercussions of prepaid electricity as applied in low-income communities where basic survival is the order of the day. Financially more capable people with conventional electricity in their houses are generally not confronted by the problems highlighted above. Eskom has done a lot to address these problems through flexible tariff structures. Individual household energy needs *cannot,* however be constrained by innovations such as "off peak", "peak", "standard" and "time of use" tariffs (see Chapter Six).

On the question of whether respondents would change to conventional electrification if they could, only 13,2% (23 out of 174) provided a "yes" response. This figure suggests the popularity of prepayment electricity in these communities.

The prepayment system can be seen as harsh in the wake of disadvantaged people's financial inability. Conventional electricity and the payment thereof is far less demanding on financially more advantaged people. It is understandable that people who expressed their preference for conventional electricity considered prepaid electricity to be "unfair" and sometimes not supportive to the plight of poor people. With conventional electricity people who cannot fulfil their payment responsibilities, have the opportunity to negotiate with officials before their service is terminated. The prepaid users do not have this privilege - they primarily interact with a technologically driven system that allows for no negotiation.

Only 13,2% (23 out of 174) of the respondents would have opted for conventional electrification if they had a choice between the latter and prepayment. Although they are the minority, the reasons offered by them are significant for this study. Reasons such as "it is unfair - first work and then pay" as well as "less restrictedness", encapsulated some understanding at the very household level of the issues examined by the survey.

5.5.12 SUPPORT SERVICES RENDERED TO USERS

Questions on the quality of support services rendered, were asked to get an idea how people rated the service provided by technical and administrative personnel. The location of vending stations and service hours at the vending sites were also analysed. In Wallacedene the single vending station, that was operated by only one person at that stage, caused many problems. The fact that the station was open only during office hours on weekdays and till 13h00 on a Saturday, excluded a lot of the people who were in need of electricity after hours (personal observation). The nearby Eskom Office in Kraaifontein alleviated some of those problems. The situation is currently much better seeing that additional vending points have opened in the township.

Although there were no vending points in Eindhoven during the survey, the situation in the rest of Delft was slightly better, because a number of corner shops in the various towns were provided with CDUs that could see to people's purchasing needs. People of Eindhoven had to travel approximately two kilometres (round-trip) to purchase electricity in Voorbrug, one of the other towns in Delft. The fact that some points were closed on Sundays was also met with a great deal of opposition.

Minor problems related to the attitudes of officials at the community offices in Delft were also reported. Unfriendliness and paternalism were some of the problems highlighted by the respondents. Most people felt that longer service hours should prevail. Suggestions for a 24-hour service were voiced in Wallacedene and Delft. The introduction of AVM (Automatic Vending Machines) can solve the problems related to limited purchasing hours at vending stations. Unmanned machines can issue tokens after hours to make electricity vending less of a time constraint activity.

The company, ADO Combined Technology, illustrated through the installation of AVM's at pilot sites in the Parow and Ravensmead areas of the Cape Metropole, that the concept was indeed healthy and widely accepted by customers. It has been shown that the frequency of electricity purchases at those machines increased dramatically (*Prepayment Electricity*, July/August 1995: 22).

In both Wallacedene and Delft people were generally satisfied with the service rendered by technical personnel. In Wallacedene, however, 13,2% (9 out of 68) of the respondents complained that they had to wait in excess of two weeks for technicians to come and do repairs and in some instances they never showed up. Specific problems related to long waiting lists for the installation of meters in Wallacedene were also aggravated by political upheaval and crime in the area in the 1993/4 period.

In an interview with Mr George Samuels of the Eskom Office in Kraaifontein under whose jurisdiction Wallacedene falls, it was mentioned that white technicians were scared to enter the township. He was the go-between through which communication between Eskom and the residents took place. Owing to his "political acceptability"

among the people during that period (1994/95), he apparently also had to "stand in" for maintenance and installations. There were thus external impediments related to service rendering that influenced the whole prepaid system negatively.

5.6 CONCLUSIONS

Based on the analysis of data and information from the questionnaire and interviews reported in this Chapter, it is clear that a whole range of factors impact on the wider system of prepayment electrification as well as the use of the ultimate commodity, i.e. electricity, within the individual's household. The very use of prepaid electricity also has an impact on the financial planning of households, and by implication also on developmental aspect of families. Despite the general acceptability of prepaid electricity, the effectiveness and appropriateness under specific conditions, should be carefully weighed up against the sum of those influences. The results have shown that prepayment electrification *per se* seems to be the solution but that its socio-economic, structural and environmental suitability needs closer scrutiny.

The last question on the questionnaire provided an opportunity for the respondents to come up with suggestions as to how the prepayment system could possibly be changed or adapted to make it more effective. The suggestions by the people of Wallacedene and Delft as a response to the question provide some bases for the recommendations made in Chapter Six.

CHAPTER SIX

SUMMARY AND RECOMMENDATIONS

6.1 INTRODUCTION

The purpose of this Chapter is to draw the necessary conclusions from the analyses in the previous Chapter. Suggestions as to how some of the problems that transpired from the empirical analyses can be addressed, will also be made. This will be done by revisiting all the issues that underlie these problems and merge them with the specific suggestions and ideas articulated by the people who participated in the study. As mentioned earlier, it is beyond the scope of this study to expertly evaluate the technological aspects of the system. The perceptions and experiences of the people in relation to the system will also receive emphasis.

The results have shown that the system of prepayment electrification was not problematic for the majority of the respondents in the survey. It seems as if the system can be *the* answer to urban household energy problems. The negative aspects of the system were overshadowed by its resounding positive attributes. Those negative aspects need more critical scrutiny because of their real significance to the affected households.

All the issues that emerged from the analysis in the previous Chapter have definite spatial underpinnings. The assessment of the suitability of prepayment electrification for low-income communities within their specific physical and socio-economic environments is geographically significant. Prepayment is also used (although on a limited scale) by financially more capable users such as businesses, small scale

TABLE 14 : SUGGESTED CHANGES TO PREPAYMENT ELECTRIFICATION

Suggestion	*Frequency*	*Percentage*
Provide more plugs	28	15,6
Provide leads for intra-house wiring	2	1,1
Mount plugs on separate boards	2	1,1
Provide lights in rooms as well as outside (for safety)	11	6,1
Mount meter and ready-board properly	3	1,7
Provide more durable plugs and switches	5	2,8
Underground instead of overhead cabling	2	1,1
Provide a separate plug(nozzle) for electric stoves	2	1,1
Eskom/authority should do intra-house wiring	3	1,7
Provide geysers	2	1,1
Supply stronger current	4	2,2
Reduce electricity rates	25	14,0
Scrap instalment fee for meter	2	1,1
Provide an allowance scheme if people do not have money to buy electricity	1	0,6
Put up more vending points	5	2,8
Longer service hours at vending points/24 hour service	4	2,2
Do something about electrical cords crossing streets	1	1,1
More education on the save and efficient use of electricity	1	1,1
Scrap the payment of VAT on electricity	7	3,9
Charge the same rate in all areas	3	1,7
Disseminate information regarding electricity increases in advance	2	1,1
Re-introduce the card-operated meters	1	0,6
Would prefer coin-operated meters	1	0,6
Would prefer an account of consumption	1	0,6
Mount meters out of children's reach	2	1,1
Enhance user-friendliness of administrative and technical personnel	1	0,6
Allow mobiles to sell electricity	1	0,6
Faster response during emergencies	2	1,1
Satisfied with the system	55	30,7
TOTAL	**179**	**100**

(Source: Surveys in Wallacedene and Delft 1994/95.)

industries and individuals. Such users cause and experience almost no problems with the system.

For the urban poor, the management and payment for a service such as electricity is only part of a larger system within which a daily struggle for survival by them is at the order of the day. The suitability and appropriateness of technological solutions such as prepayment electrification can therefore also be seen against the traditional geographical parameters such as where, what and how. Where people are staying, the nature of their physical and socio-economic environments, how they are living, etc. are also important consideration for this study.

The range of influences and their interrelationships with one another, as well as with the prepayment system, are brought together in the following sections in order to contextualise the recommendations. The essence of some of the recommendations that are given are not unique seeing that Eskom and the local authorities are already busy addressing some of them. Different emphases, as advocated in this Chapter can, however, supplement those endeavours.

Table 14 provides a summary of the respondents' suggestions as to how the system of prepayment electrification should be adapted or changed to make it more suitable for their circumstances. It is clear that a substantial number of people were indeed satisfied with the system as it operated in Wallacedene and Delft at that stage (in 1994/95). From the spectrum of suggestions, it is also clear that energy needs are similar for all kinds

of people - poorer people also need the "luxuries" of conveniences made possible by electricity (for example, warm water from a geyser), that economically more privileged people consider as essential.

Specific emphases and needs can be identified if the proportions of the suggestions are looked at. The figures suggest a relatively big demand for intra-house wiring that can facilitate the provision of extra lights and plugs in the other rooms of a house. Financial pressures related to electricity expenditure are also evident if the percentages for the suggestions for a lower electricity rate (12,7%) and the scrapping of value added tax (VAT) on electricity (3,4%) are considered.

Emphasis on issues like these is almost universal and would also have received attention from economically more privileged people if they were affected by it. Basic needs that have to be fulfilled by domestic energy uses are, therefore, not different for different socio-economic classes. This very fact makes poorer people's concerns about these issues even more acute.

The discussion, conclusions and subsequent recommendations that follow are based on specific problems that emanated from the five sections out of which the questionnaire consists namely, socio-economic data of respondents; characteristics of the dwelling; the prepayment/dispensing meter; data on electricity consumption, and service rendered. It will be supplemented by conclusions drawn from information provided during the interviews with officials and non-sampled respondents.

6.2 SOCIO-ECONOMIC INFLUENCES AND RECOMMENDATIONS

Due to increased urbanisation the South African metropolitan areas became the nodes of influx by mainly rural, financially poor people who are looking for better job opportunities and living conditions. The urbanisation process is out of phase with the provision of jobs, houses and the rendering of public services to these people (Bernstein 1989:18). The apartheid history and the way in which it shaped people's attitudes towards municipal services, as well as their financial (in)ability to pay for them, created legacies that will be grappled with for years to come. The rationale and "objectivity" of the system of prepayment electrification are, therefore, questionable against the background of South African history.

Theoretically South Africans have a choice between conventional electrification and prepayment. Cognisance is taken of the use of prepayment electricity by financially more advantaged people, but its applications are currently largely aimed at lower-income communities. The use of the system can be seen as a reflection of the socio-economic stratification in the country.

Although prepayment electrification is technologically suited to address the household energy needs of the impoverished masses in urban areas, by its very nature it can impede energy sustenance in the wake of people's financial inability. It is, in essence, not different from situations that characterise people's financial inability to buy paraffin, gas or wood. This argument does not negate the principle that everyone has the responsibility to pay for his/her use of services provided by local authorities.

As discussed previously, the social, political and economic realities from which the widespread application of prepayment electrification originated cannot be wished away and consequently the following recommendation is made.

6.2.1 RECOMMENDATION : PURCHASE ADVANCES

Against this background, and the fact that 39% of the respondents could only afford to buy R10 of electricity per week, an argument for the building of more flexibility into the prepayment system is advocated. Through technological advancement the prepayment system was for example also used to "collect" arrears from households whose houses were electrified in the conventional way. Due to people's unwillingness and/or real inability to pay their arrears, their switch to prepaid electricity also coincided with debt collection. A portion of the money used to make electricity purchases would be allocated to the settling of debts in a piecemeal way.

The implementation of the prepayment concept for household water use would allow consumers to still have access to water (even if it is in a trickling or dripping form). By the same token prepayment users who are not in arrears, but financially incapable at a specific time, could be accommodated. If such a process is carefully monitored and based on sound communication with the parties involved, there need not to be fears about the development of a possible debt spiral. In practical terms it means that checks and balances have to be in place if electricity advances are granted when affected parties do their purchases. The fact that financial surpluses gained by local authorities' electricity supply functions are used to subsidise other services, would make it

theoretically possible to also subsidise advances on electricity purchases for needy prepayment users.

6.2.2 RECOMMENDATION : TARIFF PARITY

The tariff structure of Eskom allows for flexibility in terms of electricity rates. The choices offered to customers in the low-income bracket of the society as far as their supply is concerned are based on two options.

The one is based on the rationale "Cheaper tariff for fewer appliances" and the other one on "More expensive tariff for more appliances" (information from brochures available at Eskom's Elektro Wise Centres). The first choice corresponds with a 20 ampere supply and the latter with a 60 ampere supply. These choices obviously make financial sense, but electricity needs cannot be so easily categorised, as shown in the present study.

Tariff setting, and its impact on different sectors of society, cannot be separated from the endeavours to restructure the fragmented electricity supply industry. Only when parity is reached between the tariff structures of Eskom and those of local supply authorities, can tariff problems be addressed in a more comprehensive way.

6.3 POLITICAL-ADMINISTRATIVE AND SERVICE RENDERING INFLUENCES

Prepayment as a specific system of electrification, cannot be separated from the wider issues that impact on electrification in general. Apart from the highly politicised nature of electrification in South Africa, the distribution market is also highly fragmented and non-standardized with regard to the setting of tariffs, metering and general support services. The following citation from the Cape Argus (27 January 1997: 10) summarises this situation aptly:

> "At present, distributors nationwide levy 2 000 different tariffs, netting municipalities an estimated R1,7 billion in surplus funds to cross-subsidise other services"

One of the duties of National Electricity Regulator is to try and rationalise the more than 400 electricity distributors (mainly municipalities) into a number of financially viable regional distributors or one big centralised distributor. Until such time, discrepancies will continue to exist. Due to this fragmentation spatially adjacent communities falling under different jurisdictions might be treated differently.

As highlighted earlier (see section 3.5), this very fact impacted quite negatively on service delivery in Delft during the initial stages of the prepayment system there. The former Western Cape Regional Services Council was the umbrella structure responsible for services in Delft. Administered from one of its branch offices in Stellenbosch, some 25 kilometres away, effective service delivery was highly ineffective (information

provided by Delft's former electrification official).

6.3.1 RECOMMENDATION : RATIONALISATION OF SUPPLY INDUSTRY

The eradication and/or the effective rationalisation of the fragmented electrification industry needs to be sped up as a matter of urgency in order to enhance its financial and administrative efficiency. This process is underway and it is accompanied by major problems of restructuring.

As discussed in Chapter Three, it is evident that the restructuring of the electricity supply industry according to the proposed models, will be a complex process. Concerns such as staff relocations, transfer of assets, establishing new depots, etc., are some of the issues that hamper the process. While these more institutional concerns take centre stage, a lot of unelectrified communities and poor households are struggling for fuel/energy sustenance. It is therefore crucial to speed up rationalisation by putting more emphasis on people's energy needs relative to the individual concerns.

6.4 EDUCATION AND PERCEPTIONS

The fact that one in three of the respondents in the sample never used electricity prior to their being introduced to prepaid electricity, provides some understanding for their perceptions as highlighted in Chapter Five. Myths concerning the high cost of electricity relative to other fuels like gas, paraffin/kerosene, wood and batteries do exist. As shown in the analysis, it is believed by some that electricity is more expensive

and should be regularly substituted/supplemented with other energy forms in order to save money.

These ideas are mainly based on inadequate educational preparation of people who are sometimes illiterate and innumerate. It can also stem from the results of chronic financial shortages as well as entrenched traditions. Cooking on open fires in black townships like Wallacedene is part of a wider cultural tradition as explained in Chapter Five. Any attempt to rectify some of those distorted perceptions, should be accompanied by an appreciation for the real conditions in which the people are living.

6.4.1 RECOMMENDATION : HOLISTIC ENERGY AND ELECTRICITY MANAGEMENT GUIDANCE

The study has shown that fuel mixes are more than just a means to solve household energy emergencies. The preparation and assistance offered to "unprepared" customers by Eskom's Electro Wise Centres should be extended to cover the safe and effective use of *other* fuels. Issues related to illiteracy and traditions must be handled with the necessary understanding and sensitivity.

Eskom's advisory service is very target group specific. The different services target the residential customer (Elektrowise), the commercial customer (Elektroserve), the agricultural sector (Agrelek), the industrial sector (Industrelek) and the local distribution authority (Utili-Mark). The main purpose of the Elektrowise service is to advise residential customers on "the safe and economic use of electricity" (Eskom's Prices for Products and Services, 1998: 42).

The results of this study have shown that due to the many informal entrepeneural activities that are taking place in the township, some residential customers can also be classified as commercial customers. A more holistic advice service is necessary.

6.4.2 RECOMMENDATION : FOSTER AN UNDERSTANDING FOR EFFICIENCY OF DIFFERENT FUELS

The fact that more than half of respondents used paraffin in combination with electricity can have more repercussions. Apart form the health risks and indoor air pollution dangers that can be caused by the use of paraffin appliances, it can also be interpreted as a refection of the people's vulnerability to outside market forces controlling the price of paraffin. Paraffin's price can fluctuate with the prices of petrol and diesel. Paraffin's wholesale price has increased with more than 20% since June 1995 (Die Burger, 27 November 1996).

Individual retailers are legally allowed to increase their selling price by a third of the wholesale price. Seeing that very little control can be exercised over the profit margins of retailers at the corner and spaza shops of townships, paraffin users can therefore easily be overcharged. The selling of paraffin over the counter in any possible container, e.g. cool drink bottles, creates ideal circumstances for people to be disadvantaged (in terms of getting the correct volumes of paraffin relative to prices paid for it). Educating people about the prices and efficiency of other fuels relative to specific tasks that need to be performed, may change the fuel mix trends observed in Wallacedene and Delft. This education process should ideally be undertaken by community-driven organisations such as advice offices and development forums in collaboration with

different fuel energy suppliers. Such an educational process should, however, be handled with the necessary sensitivity to prevent paternalism and the possible alienation of people from positive household fuel transformation processes.

6.4.3 RECOMMENDATION : DESTIGMATISE PREPAID ELECTRICITY

Poor people cannot afford to buy more than the essential electrical appliances, and often opt for cheaper paraffin and gas appliances such as paraffin heaters and gas stoves. Perceptions regarding prepaid electricity as *poor man's electricity, punishment* for pay boycotts, and *debt collection* on outstanding accounts, still exist. Some of these ideas are, in fact, perpetuated by the very introduction of prepayment meters that keep households connected while paying off arrears in a piecemeal way. The so-called ECON meters, (as an example of the aforementioned), manufactured by a company called Plessgem, were bought in their thousands by the former Cape Town City Council in 1995 to serve as dispensing unit and debt collector simultaneously *(Prepayment Electricity*, July/August 1995: 4). Destigmatisation of the prepayment concept can at best be undertaken by the supply industry through information dissemination at public gatherings such as community and political (ward) meetings.

6.4.4 RECOMMENDATION : REFLECT ON UNINTENDED CONSEQUENCES

Officials involved in prepayment electrification have to focus on the broader issues that impact on the system as well. One would like people to think about the prepayment technology as a *liberator* from energy constraints and not as a *threat.* Barbour (1980:

35) cautioned all stakeholders involved in the application of any technology to carefully assess an application's impact relative to the technology's development, its implementation and its anticipated outcomes for people and their environments. In their deliberations and interaction with people, officials have to try and explain some of the unintended consequences of the system.

6.5 ENVIRONMENTAL CONCERNS AND HOUSING STRUCTURE

Some of these unintended consequences include the unforseen impact that bad weather might have on meters, vermin infestation, and a higher expenditure on electricity as more appliances are bought for space heating and lighting.

6.5.1 RECOMMENDATION : FAMILIARISATION WITH THE PHYSICAL ENVIRONMENT

If customers are not prepared, they need to be made aware (preferably by the supply authority's officials) of the fact that all these environmental influences can have impacts on the effectiveness of the prepaid system. As explained in section 4.2, there are very few preconditions regarding the structural quality of dwellings within which prepayment meters have to operate. The installation and mounting of these meters and their ready-boards are sometimes just earmarked for the most stable panel or pole in a shanty dwelling. Such positionings leave the meters relatively unprotected and vulnerable to external damages. Important improvements had been made already to try and reduce the vulnerability of dispensing meters against vandalism, tampering and harsh climatic conditions. Eskom's Technology Research and Investigation section

frequently puts electricity dispensers through various tests in order to determine whether they comply with the specifications and standards laid down by the industry and the South African Bureau of Standards. A detailed description of these tests is not relevant to this study, but it includes subjecting electricity dispensers/prepayment meters to the same variation in the intensity of parameters such as temperature, humidity and supply voltage in a laboratory setup (Lings, 1994).

According to Lings (1994: 3) these tests were too limited because they excluded important environmental parameters such as salt, mist, rain, household solvents, insects and solar radiation, as well as mechanical parameters such as bumpings, shocks and various tampering techniques. Prepayment meters are supposed to last at least 10 years, according to the specifications. The technological reliability of the meters in the houses of the people who have been sampled in 1994/5 were, therefore, against those testing parameters, also prone to environmental influences. Even if prepayment meters can be made totally reliable, they still have to operate in a variety of non-laboratory circumstances where other parameters might render them ineffective.

6.5.2 RECOMMENDATION: CONSIDER AND IMPROVE STRUCTURE OF DWELLINGS

Although prepayment electrification sets very limited preconditions for the structural quality of houses/dwellings, every effort should be made to try and promote structural improvement. (The electricity official of Wallacedene mentioned in an interview that electricity is provided anywhere in the township on request regardless of the quality of the dwelling.)

The costs involved in reticulating electricity to informal settlements as well as the expenditure on the installation of meters and ready-boards in structurally unsound dwellings, can increase the overall electrification costs over the long term dramatically if problems occur due to poor or inappropriate building materials and structure..

6.6 ENERGY CONSUMPTION INFLUENCES

The projected energy needs in the study areas were sometimes also out of phase with the realities that prevailed in the communities. One of these realities is that electricity is also used for informal economic activities, ranging from backyard mechanic work to hairdressing. These activities are sometimes the only way by which unemployed township people make a living, i.e. a survival strategy.

Although only 2% (i.e. 4 out of 196) of the respondents requested a stronger current as a result of the aforementioned tendency, many more people were involved in informal activities in both Wallacedene and Delft. Based on that reality, the following recommendation is made.

6.6.1 RECOMMENDATION : CONSIDER REAL INSTEAD OF THEORETICAL ENERGY NEEDS

The assumption that most people with low income will also use relatively less electricity, is unfounded. The strength of the electrical current supplied to poor people needs revision and it should be based on a more informed assessment of people's energy needs.

6.7 MANUFACTURING AND MARKETING OF PREPAYMENT METERS

Both the manufacturing and the marketing of meters and ready-boards are fairly deregulated and a number of companies compete for contracts offered by Eskom and local authorities as discussed in Chapter Three. Although national manufacturing requirements are in place, each company has its own patents and unique characteristics which make the market a very competitive, but a fairly "confused" one. De Beer (Finansies en Tegniek, 1993: 29) has argued that from an economic point of view, the existence of such a large manufacturing core, is not justifiable. He reckoned that the economies of scale involved in a possible rationalisation of the manufacturing industry can have major advantages for the electrification process and the price of electricity.

Currently the manufacturing standards of all meters have to comply with the Standard Transfer Specification (STS) protocol, but some areas are supplied with meters that are not compliant with this protocol. (The protocol defines how information is passed from the credit dispensing unit to the meter, how the data is managed, and what is maintained in the system.) Replacing the meters (as happened in Delft) or extending or adapting the technology to also incorporate the areas excluded from this protocol, therefore, needs attention.

6.7.1 RECOMMENDATION : MONITORING OF THE MANUFACTURING INDUSTRY

The rationalisation of the manufacturing industry can have advantages for the end-user as well if electricity can be offered at a lower price per unit. A compromise between the

electricity supply industry and the manufacturers needs to be worked out in order to facilitate agreements that can serve the interest of all stakeholders.

6.8 RETICULATION INFLUENCES

As a cost-saving mechanism, formal reticulation through overhead cabling with centrifugal distribution to individual dwellings, has been embarked upon in both Wallacedene and Delft. Overhead cabling, despite its relative inexpensiveness, also has some disadvantages. It is particularly prone to theft because the copper wiring inside the cables can be sold at metal recycling outlets. It is also vulnerable to destruction due to fires, as has happened in Wallacedene at least once a year since 1992. Overhead cabling can also be unsightly. The centrifugal reticulation whereby the supply is distributed from a single point to dwellings around or in the immediate vicinity of such a point/electrical pole, can leave all the households that are supplied by that point, without electricity during emergencies.

6.8.1 RECOMMENDATION : SAFEGUARD RETICULATION INFRASTRUCTURE

Although the opportunity costs involved in overhead cabling is lower, local authorities need to weigh up the overall costs and benefits of overhead cabling compared to underground cabling over the longer term, for informal settlements in particular. (Only two respondents from the total sample suggested in their recommendations that overhead cabling should be substituted with underground cabling. Protection and maintenance of reticulation infrastructure are costly, but it needs to be done.)

6.9 INTRA- AND INTER-HOUSE WIRING

Informal intra- and inter-house wiring refer to the distribution of electricity from the ready-board to other rooms in the dwelling and the "hiring" out of electricity to neighbours or backyard dwellers by means of electrical cords, respectively. These, sometimes unearthed and unprotected cords, can run for considerable distances over and along streets, property boundaries and pathways. The possible dangers of this practice have been discussed in the previous Chapter (see section 5.5.3).

6.9.1 RECOMMENDATION : MORE COMMUNITY RESPONSIBILITY AND CONTROL OVER TAMPERING

The danger of tampering with live electrical wiring, should, as a matter of urgency be addressed by authorities and local people. Seeing that a law enforcement approach is apparently not working, attempts should be made to try and change people's attitudes. Instead of opting to be an "electricity tenant" people must be made aware of the advantages of having their own meters.

6.10 INFLUENCES ON TECHNICAL AND ADMINISTRATIVE SUPPORT

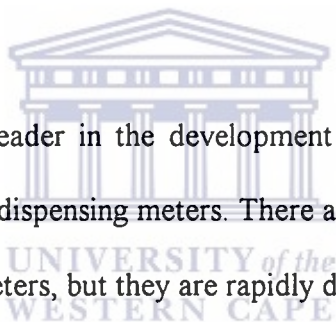
Technical and administrative support services that are essential to the success of prepayment systems have been evaluated with scepticism by the participants. Criticisms range from technicians who are afraid to go into informal settlements to incompetent personnel at vending points. Progress with regard to after-hours and self-help vending points can alleviate some of these problems.

(The success of Automatic Vending Machines (AVM) in some urban areas has been highlighted in Section 5.5.12.)

6.10.1 RECOMMENDATION : MORE SENSITIVITY FROM OFFICIALS

Officials and technical personnel have to be made aware on a continuous basis that they are dealing with people who are financially and educationally disadvantaged. The problems that the customers might have with certain aspects of the system need to be addressed with the necessary understanding.

6.11 METER RELIABILITY



South Africa is a world leader in the development of technologically reliable and tamper-resistant electricity dispensing meters. There are tampering techniques devised by people to bypass these meters, but they are rapidly declining due to law enforcement and technological improvements. The fact that only about one in five respondents in the sample recorded having experienced problems with their meters suggested a high degree of satisfaction and, by implication, good reliability. The most common problems causing malfunctioning of the meters appeared to stem from water contact (during heavy rains and due to leaky roofs), faulty electrical appliances and the use of too many appliances simultaneously (overloading).

6.11.1 RECOMMENDATION : "DECENTRALISATION" OF ADVICE

Through continuous education on the effective and safe use of electricity and electrical appliances, the technological reliability of the prepayment meter can be enhanced. The advice and services offered at Electro Wise Centres could possibly be taken out of the office to the people in their houses if needs be. (The practicality of such a suggestion might be far-fetched, but the effort might deliver the desirable results.)

6.12 POLICY ISSUES

Policy issues on national, provincial and local level will eventually impact in different degrees of intensity on the energy and electricity use of people. This will subsequently also impact on development and how people are living. Mr PM Maduna, South Africa's Minister of Minerals and Energy has concluded in his ministerial foreword to the South Africa's Draft White Paper on Energy Policy (South Africa, 1998: iv) that "Energy production and distribution should not only be sustainable, but should also lead to the improvement of the standard of living for all of the country's citizens".

The broad policy recommendations and considerations spelled out in the Draft White Paper on Energy Policy for households, as a specific energy demand sector, include the following:

- appropriate appliance/fuel combinations to meet energy service needs of households in different areas of the country;
- households' abilities to acquire these fuels and appliances;

- the availability of efficient and safe appliances and fuels;
- the impact of pricing structures and financing mechanisms on the affordability of fuels and appliances.

The White Paper further emphasises the need for more research on these aspects as well as the contribution of all stakeholders towards capacity building, education and information dissemination in the field of household energy issues.

6.13 CONCLUSION

It is evident from the study that the success of prepayment electrification is dependent on a variety of other factors and not only technology. This study tried to contribute to a better understanding of how the plethora of factors interplay by focussing on specific factors such as energy, development and technology. Although people are, by means of this system, theoretically in control of their own electricity expenditure and consumption, it cannot materialise if the issues that emerged from the study, are not comprehensively addressed in a systematic, pro-active and consultative way.

The study showed that the success of the prepayment electrification system is interlinked with the important variables that have been analysed such as financial ability, quality of housing, fuel mixes and the influences of the physical environment. Coerced and uninformed fuel mixes by poor people to satisfy their basic energy needs can have a detrimental effect on their living conditions as well as the broader urban environment. It is therefore important to put a stronger emphasis on the general energy

flows created by poor people if (main stream) urban environmental concerns are addressed. If it is not addressed holistically, then the prepayment system can be seen as yet another remedy instead of a real solution for the energy needs of poor people. The words of Odum & Odum (1981: 32) perhaps encapsulate this question best where they say that:

> "Those systems that survive in the competition among alternative choices are those that develop more power inflow and use it to meet the needs of survival".

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ADDENDA

Dear Respondent

The following questionnaire aims to collect data pertaining to certain aspects that may influence the relationship between you and the use of your prepayment meter.

It forms an essential part of research conducted by Michael Dyssel of the Department of Geography and Environmental Studies at the University of the Western Cape.

It will very much be appreciated if you can complete the questionnaire (with the help of the fieldworker if necessary).

All information will be treated with confidentiality and only be used in its academic context and in so far as it can help the communities involved.

Thanks in advance for your co-operation.

Geagte Respondent

Die doel van die volgende vraelys is om data van aspekte wat die verhouding tussen u en die gebruik van u betaalmeter mag beïnvloed, in te samel.

Die vraelys vorm 'n belangrike deel van 'n navorsingsprojek waaraan Michael Dyssel van die Departement Geografie en Omgewingstudies aan die UWK, werk.

Dit sal baie waardeer word indien u die vraelys kan beantwoord (met die help van die veldwerker indien nodig).

Alle inligting sal met konfidensialiteit hanteer word en dit sal slegs binne 'n akademiese konteks en in soverre dit die betrokke gemeenskappe tot nut kan wees, aangewend word.

By voorbaat dank vir u samewerking.

UNIVERSITY OF THE WESTERN CAPE

CARD NO./ KAART NO.	AREA CODE AREA KODE	SCHED. NO./ SKED. NO.
☐	☐	☐☐☐
1	2	3 4 5

A. SOCIO-PERSONAL/SOSIO-PERSOONLIK

FOR OFFICIAL USE ONLY

1. Are you the homeowner?/ Do you rent the place? Is u die huiseienaar?/ Huur u die huis?

Homeowner Huiseien	1
Tenant/ Huurder	2

☐ 6

2. Sex/Geslag:

Male/Manlik	1
Vroulik/Female	2

☐ 7

3. Are you the main breadwinner?
Is u die hoofbroodwinner?

Yes/Ja	1
No/Nee	2

☐ 8

4. Size of household (number of inhabitants):
Grootte van huishouding (aantal inwoners):

..... ☐☐ 9 10

5. Total net income of household:
Totale netto inkomste van huishouding

weekly/weekliks
.....
monthly/maandeliks

☐☐☐☐ 11 12 13 14

6. Average amount spent on the weekly/monthly purchasing of electricity:
Gemiddelde bedrag gespandeer op die weeklikse/maandelikse aankoop van elektrisiteit:

..... ☐☐☐ 15 16 17

B. CHARACTERISTICS OF DWELLING/EIENSKAPPE VAN WONING

7. Are you staying in a "proper" house or "informal" dwelling?
Woon u in 'n "regte" huis of "informele" woning?

Proper/Regte	1
Informal/ Informeel	2

18

8. How many rooms has the dwelling?
Hoeveel vertrekke het die woning?

.....

19

9. Do you have any additional structure(s) outside the dwelling in which people live?
Het u enige addisionele struktuur buite die woning waarin mense woon?

Yes/Ja	1
No/Nee	2

20

10. How many rooms have been provided with an electrical plug and/or a light?
Hoeveel vertrekke is voorsien van 'n elektriese kragpunt en/of lig?

plug / kragpunt	1
plug & light / kragpunt & lig	2
light / light	3

21
22
23

11(a) Do you use any extension cord/leads in the house?
Gebruik u enige verlengingskoord(e) in die huis?

Yes/Ja	1
No/Nee	2

24

11(b) Why do you use these leads?
Waarom gebruik u hierdie koorde?

.....

.....

.....

.....

.....

25 26

27 28

12. Do you have any (ceiling) isolation in the dwelling?
Het u enige (plafon) insolasie in die woning?

Yes/Ja	1
No/Nee	2

29

13. Indicate which of the following electrical appliances do you have?
Dui aan watter van die volgende elektriese toebehore het u?

Yes/Ja	1
No/Nee	2

Stove/Stoof		30
Kettle/Ketel		31
Iron/Yster		32
Fridge/Yskas		33
Freezer/Vrieskas		34
Dishwasher/Skottelgoedwasser		35
TV Set/TV-Stel		36
Music Centre/Musieksentrum		37
Heater/Verwarmer		38
Fan/Waaier		39

C. THE PREPAYMENT METER/DIE BETAALMETER

14. Did you before you've occupied this dwelling, use electricity as energy source?
Het u, voordat u hier kom woon het, al van elektrisiteit as energiebron gebruik gemaak?

Yes/Ja	1
No/Nee	2

40

15. If yes, where and for how long?
Indien ja, waar en vir hoe lank?

(a) Where/waar

.....

.....

41 42

(b) Period/Periode

less than 1 year minder as 1 jaar	1
1 year+ - 5 years 1 jaar+ - 5 jaar	2
5 years + 5 jaar +	3

43

16. If no, what form(s) of energy did you use?
Indien nee, watter vorm(e) van energie het u gebruik?

Gas	1
Paraffin/Paraffien	2
Wood/Hout	3
Batteries/Batterye	4
Coal/Steenkool	5
Other/Ander Please specify below/Spesifiseer hieronder asb.	6

44

.....

17. Have you been introduced to the purpose and functioning of the prepayment meter prior to your first electricity purchase?
Was u met die doel en funksionering van die betaalmeter vertroud gemaak voordat u u eerste elektrisiteitaankope gemaak het?

Yes/Ja	1
No/Nee	2

45

18. If yes, how did it take place?
Indien ja, hoe het dit geskied?

.....

.....

.....

.....

46 47

48 49

50 51

19. For how long do you have this meter now?
Vir hoe lank het u nou al hierdie meter?

less than 1 year minder as 1 jaar	1
1 year + 1 jaar +	2
2 years + 2 jaar +	3
3 years + 3 jaar +	4
4 years/jaar +	5

52

20. Do you fully understand how the meter functions?
Verstaan u ten volle die funksionering van die meter?

Yes/Ja	1
No/Nee	2

53

21. If no, name/explain what you do not understand.
Indien nee, noem/verduidelik wat u nie verstaan nie.

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54 55

56 57

58 59

22. Have you experience any problem(s) with the effective functioning of the meter in the past?
Het u al enige probleem(e) in die verlede ondervind met die effektiewe funksionering van die meter?

Yes/Ja	1
No/Nee	2

60

23. If yes, please explain.
Indien ja, verduidelik asseblief.

.....

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61 62

63 64

65 66

24. How frequently does the problem(s) occur?
Hoe gereeld ervaar u die probleem(e)?

..... per week/per month (maand)

67 68

25. When does it normally occur?
Wanneer vind dit gewoonlik plaas?

.....

.....

.....

69 70

26. What would you say, cause these problem(s)?
Wat sou u sê is die oorsaak van hierdie probleem(e)?

.....

.....

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.....

71 72

73 74

75 76

KAART NO./ CARD NO.	AREA KODE/ AREA CODE	SKED. NO./ SCHED. NO.
2		
1	2	3 4 5

27. What do you normally do when you face these problem(s)?
Wat doen u gewoonlik as hierdie probleem(e) opduik?

.....

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6 7

8 9

28. Have you already tried to "repair" the meter yourself?
Het u al probeer om self die meter "reg" te maak?

Yes/Ja 1

No/Nee 2

10

29. If yes, were you successful or not?
Indien ja, was u suksesvol of nie?

Successful/ Suksesvol	1
Unsuccessful/ Onsuksesvol	2

11

30. If successful, please explain what has been done.
Indien suksesvol, verduidelik asseblief wat gedoen was.

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12 13

14 15

31. Do you know people that deliberately tamper with their meters to get "more" out of them?
Weet u van mense wat doelbewus aan hul meters "tamper" om "meer" daaruit te kry?

Yes/Ja	1
No/Nee	2

16

32. If yes, were they successful?
Indien ja, was hul suksesvol?

Yes/Ja	1
No/Nee	2

17

Arrival slip

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Dyssel, Michael
A geographical analysis of the energy needs, development and the system of prepayment electrification in two low-income communities of the Cape metropole.
Bellville : University of the Western Cape, 1999.

Arrival date: 20/03/2000

Number of items: 2

Shipment date:

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33. If yes, what reason(s) can be offered for the success?
Indien ja, waaraan kan die sukses toegeskryf word?

18 19

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20 21

.....

34. Did technicians detect whether tampering with the meter took place?
Kon tegnici bespeur of daar enige "tampering" met die meter plaasgevind het?

Yes/Ja	1
No/Nee	2

22

D. ELECTRICITY CONSUMPTION/ELEKTRISITEITSVERBRUIK

35. Do you only use electricity?
Maak u slegs van elektrisiteit gebruik?

Yes/Ja	1
No/Nee	2

23

36. If no, specify what other forms of energy do you use.
Indien nee, spesifiseer wat ander vorme van energie u gebruik.

24 25

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26 27

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37. When/under what circumstances do you normally use the other forms?
Wanneer/onder watter omstandighede maak u gewoonlik van die ander vorme gebruik?

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28 29

30 31

32 33

38. How many times per week/month do you normally purchase electricity?
Hoeveel keer per week/maand koop u gewoonlik elektrisiteit?

Once/Een keer	1
Twice/Twee keer	2
Thrice/Drie keer	3
More than 3 times/ Meer as 3 keer	4

34

39. Why do you prefer to do your purchasing in such a way?
Hoekom verkies u om u aankope op so 'n manier te doen?

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35 36

37 38

40. Do you buy in such a way that you have a reserve if you suddenly need more electricity?
Koop u sodat u 'n reserwe kan hê indien u skielik meer elektrisiteit benodig?

Yes/Ja	1
No/Nee	2

39

41. Motivate your answer in 40.
Motiveer u antwoord in 40.

.....

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40 41

42 43

44 45

42. Would you say that there is a balance between your electricity purchases and consumption?
Sou u sê dat daar 'n balans tussen u elektrisiteitsaankope en -verbruik is?

Yes/Ja	1
No/Nee	2

46

43. Motivate your answer in 42.
Motiveer u antwoord in 42.

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47 48

49 50

51 52

44. What, if any, influence(s) had the monitoring of the credit in the meter on the functioning of the household?
Watter, indien enige, invloed(e) het die monitering van die krediet in die meter op die funksionering van die huishouding?

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53 54

55 56

57 58

45. If you have a choice will you have opted for the "conventional" way of electrification?
Indien u 'n keuse het, sou u die gewone manier van elektrifisering verkies?

Yes/Ja	1
No/Nee	2

59

46. Motivate your choice in 45.
Motiveer u keuse in 45.

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60 61

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62 63

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64 65

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E. SERVICE RENDERED/DIENSVERSKAFFING

47. Have you ever been provided with a wrong/ code after purchasing?
Was u al ooit voorsien van 'n verkeerde/ kode nadat u aankope gemaak het?

Yes/Ja	1
No/Nee	2

66

48. Indicate how you feel about the following:
Dui aan hoe u oor die volgende voel:

(a) location(s) of electricity vending points
ligging(s) van elektrisiteitverkooppunte

Satisfied/ Tevrede	1
Too far/ Te vêr	2
Too inaccessible/ Te ontoeganklik	3
Not enough/ Nie genoeg	4
Other/Ander Please specify/ Spesifiseer asb.	5

67

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(b) Motivate your choice in 48(a).
Motiveer u keuse in 48(a).

68 69

.....

70 71

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72 73

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(c) service hours/verkoopure

Satisfied/ Tevrede	1
Too short Te kort	2
Inconvenient Ongeleë	3
Other/Ander Please specify/ Spesifiseer asb.	4

74

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(d) Motivate your choice in 48(c).
Motiveer u keuse in 48(c).

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75 76 | 77 78 | 79 80

CARD NO./ KAART NO. 3 — 1

AREA CODE/ AREA KODE — 2

SCHED. NO./ SKED. NO. — 3 4 5

(e) service rendered by administrative personnel/ diens gelewer deur die administratiewe personeel

Very good/ Baie goed	1
Good/Goed	2
Average/ Gemiddeld	3
Poor/Swak	4
Other/Ander Please specify/ Spesifiseer asb.	5

6

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(f) Motivate your choice in 48(e).
Motiveer u keuse in 48(e).

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7 8

9 10

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11 12

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.....

(g) service rendered by technical personnel/
diens gelewer deur die tegniese personeel

Very good/ Baie goed	1
Good/Goed	2
Average/ Gemiddeld	3
Not helpful/ Onbehulpsaam	4
Other/Ander Please specify/ Spesifiseer asb.	5

13

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(h) Motivate your choice in 48(g).
Motiveer u keuse in 48(g).

14 15

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16 17

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18 19

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49. Name anything that you want to see being changed in the whole system of prepayment electrification.
Noem enigiets wat u verander sou wou sien in die hele stelsel van betaalmeter-elektrifisering.

20 21

.....

22 23

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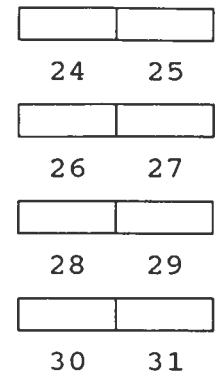


DELFT : ROOSENDAAL

Sampling Aspects and Data Collection:

* Total amount of households/serviced plots for the whole Delft is approximately 6836
* 3% sample to be drawn = 205 questionnaires
* Systematic Sampling on a 3% draw:

$$\frac{6837}{205} = 33.35$$

Therefore each 33rd household/plot should be surveyed

* The following amount of questionnaires should thus be completed in Roosendaal with its 2264 households:

$$\frac{2264}{33} = 68 \text{ questionnaires}$$

* Start at a specific point/plot at the beginning of a street/street block (or immediately next to it if no one is at home) on the map, and work your way in a liniar continuous fashion/north-south/east-west to survey each 33rd plot (meaning the 34th count after the one that has been surveyed).

* If no one at the next (33rd) household can assist you in completing the questionnaire or when the responsible individuals are not at home, choose the household immediately on the right or lefthand side of the earmarked one by means of the toss of a coin (to ensure randomness).

DELFT : ROOSENDAAL

Guidelines & Instructions to Field Workers:

* Present yourself and the purpose for the survey in an "acceptable" and understandable way to the people ... consider levels of education ...

* Fieldwork should adhere to, or display the necessary scientificness and ethics that go along with research ...

* Although the survey is quantitative (empirical) in nature, fieldworkers should also be susceptible for the qualitative (human/participatory) nature of it ...

* The philosophy of "the interviewee is right" should be your approach ...

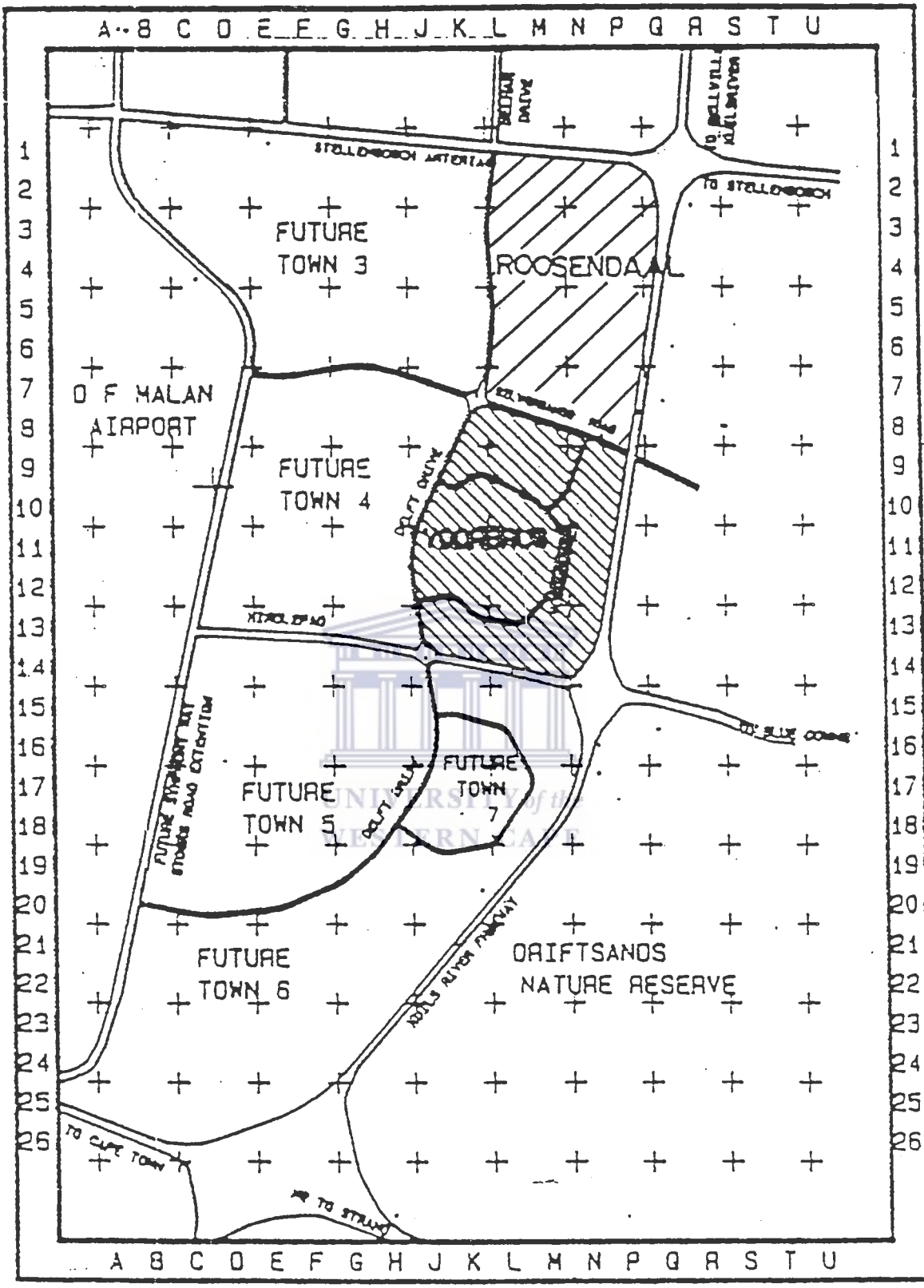
* Be sensitive and try to adapt to the circumstances prevailing in the communities ...

* Please realise that the realities facing the community are real life issues and should not be seen as "pure" study and academic issues ...

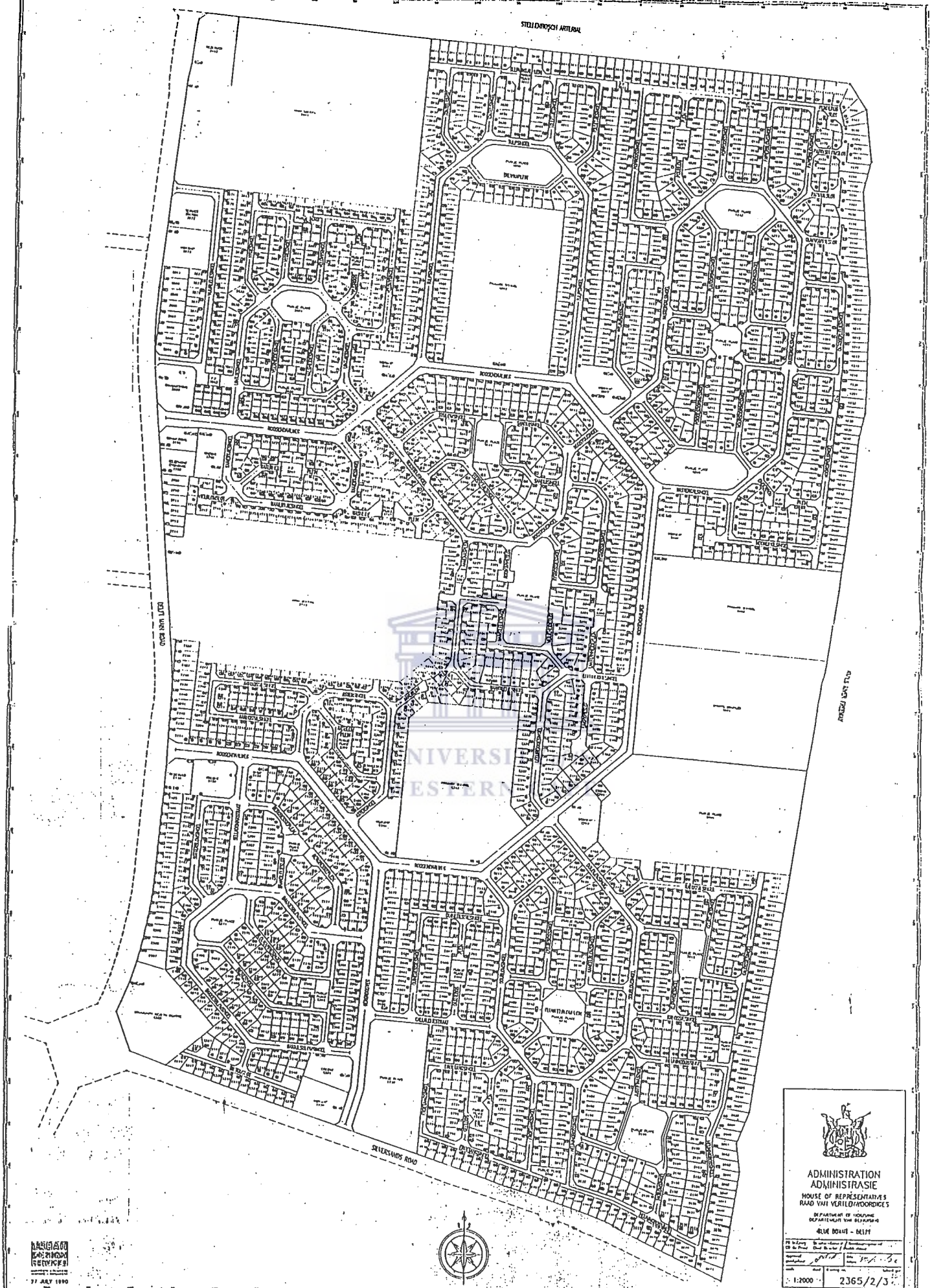
* Use your discretion and wit when it comes to sensitive issues in the questionnaire e.g. questions 4, 5, 6, 7 and 8 and all the open-ended questions

* The necessary consultation in terms of the acceptability of the study for the community at large has been completed and any queries and problems from the residents' side can be solved by referring them to the different community leaders who constitute the DELFT LIAISON FORUM. The names of Mr F. Ryklief and Ms R. Fischer, chairperson and secretary respectively, can be mentioned if necessary.

LOCALITY PLAN



POSTAL NUMBER PLAN



DELFT – ROOSENDAAL

DELFT : EINDHOVEN

Sampling Aspects and Data Collection:

* Total amount of households/serviced plots for the whole Delft is approximately 6836
* 3% sample to be drawn = 205 questionnaires
* Systematic Sampling on a 3% draw:

$$\frac{6837}{205} = 33.35$$

Therefore each 33rd household/plot should be surveyed

* The following amount of questionnaires should thus be completed in Eindhoven with its approx. 1168 households:

$$\frac{1168}{33} = 35 \text{ questionnaires}$$

* Start at a specific point/plot at the beginning of a street/street block (or immediately next to it if no one is at home) on the map, and work your way in a liniar continuous fashion/north-south/east-west to survey each 33rd plot (meaning the 34th count after the one that has been surveyed).

* If no one at the next (33rd) household can assist you in completing the questionnaire or when the responsible individuals are not at home, choose the household immediately on the right or lefthand side of the earmarked one by means of the toss of a coin (to ensure randomness).

*PS If time allows you, try to sample as much of the households that have been devastated in the recent storms in addition to the prescribed amount.

DELFT : EINDHOVEN

Guidelines & Instructions to Field Workers:

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* Although the survey is quantitative (empirical) in nature, fieldworkers should also be susceptible for the qualitative (human/participatory) nature of it ...

* The philosophy of "the interviewee is right" should be your approach ...

* Be sensitive and try to adapt to the circumstances prevailing in the communities ...

* Please realise that the realities facing the community are real life issues and should not be seen as "pure" study and academic issues ...

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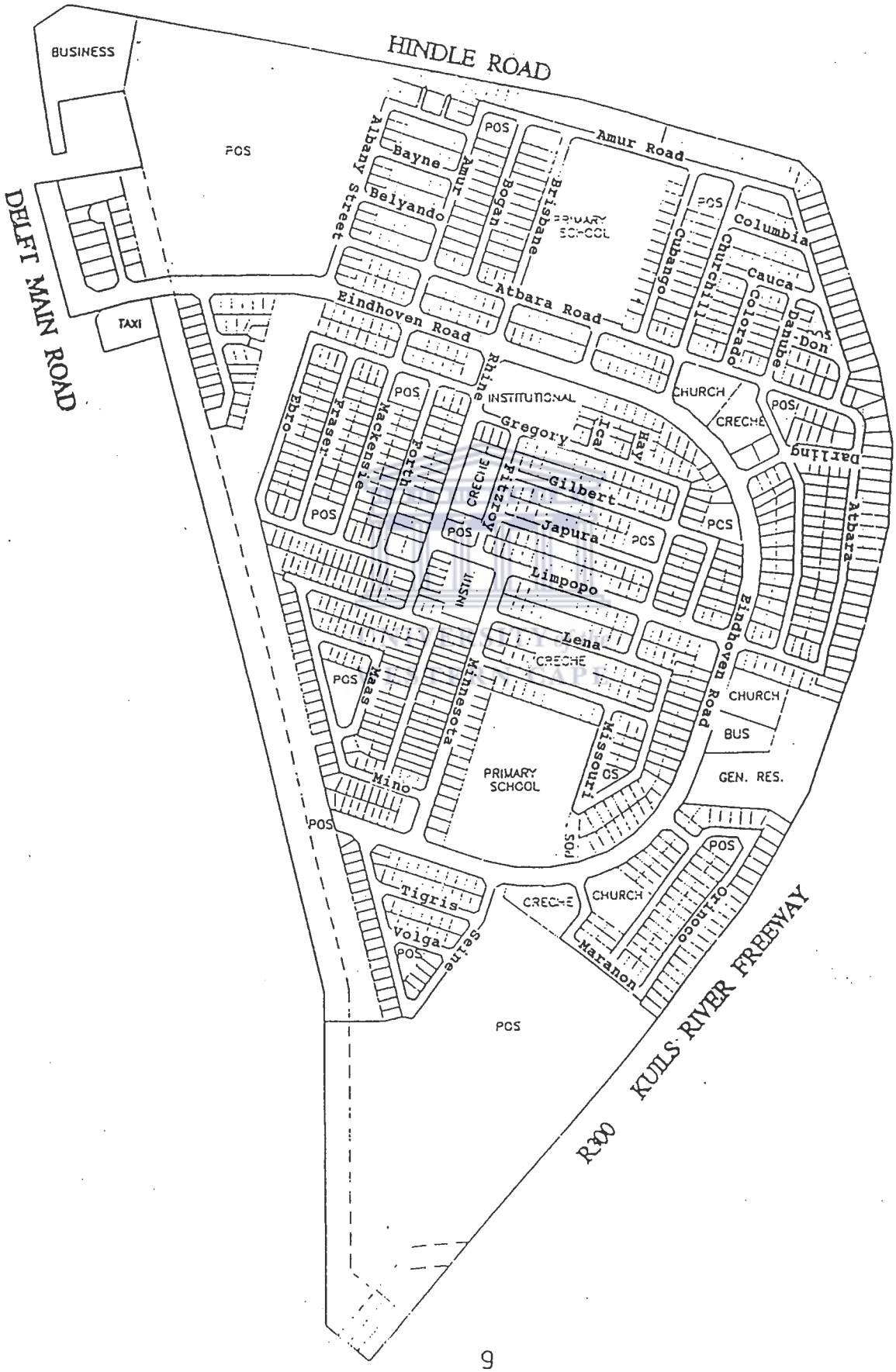
3

DELFT - EINDHOVEN

TOWN 7 LAYOUT PLAN DORP 7 UITLEGPLAN



WALLACEDENE

Sampling Aspects and Data Collection:

* Total amount of households/serviced plots approximately 1712
* 5% sample to be drawn = 85 questionnaires
* Systematic Sampling on a 5% draw:

$$\frac{1713}{85} = 20,15$$

Therefore each 20th household/plot should be surveyed

* The following amount of questionnaires should thus be completed in the 14 designated blocks/areas on the map:

A	= 5	H	= 5
B	= 8	I	= 6
C	= 4	J	= 4
D	= 8	K	= 8
E	= 8	L	= 6
F	= 9	M	= 4
G	= 5	N	= 5/6

* Start at the points/plots indicated with the arrows (or immediately next to it if no one is at home) on the map and work your way clockwise to the centre of the block to include every 20th plot (meaning the 21st count after the one that has been surveyed)

* If no one at the next (20th) household can assist you in completing the questionnaire or when the responsible individuals are not at home, choose the household immediately on the right or lefthand side of the earmarked one by means of the toss of a coin (to ensure randomness)

* If more than one dwelling appear on a plot, survey the one closest to the road or the outside toilet on which the plot numbers have been indicated

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Guidelines & Instructions to Field Workers:

* Present yourself and the purpose for the survey in an "acceptable" and understandable way to the people ... consider levels of education ...

* Fieldwork should adhere to, or display the necessary scientificness and ethics that go along with research ...

* Although the survey is, quantitative (empirical) in nature, fieldworkers should also be susceptible for the qualitative (human/participatory) nature of it ...

* The philosophy of "the interviewee is right" should be your approach ...

* Be sensitive and try to adapt to the circumstances prevailing in the communities ...

* Please realise that the realities facing the community are real life issues and should not be seen as "pure" study and academic issues ...

* Use your discretion and wit when it comes to sensitive issues in the questionnaire e.g. questions 4, 5, 6, 7 and 8 and all the open-ended questions

* The necessary consultation in terms of the acceptability of the study for the community at large has been completed and any queries and problems from the residents' side can be solved by referring them to Mr Owen Magadla, chairperson of the Residents' Committee, Mildred Rd 13050, Wallacedene