RENEWABLE ENERGY STRATEGIES FOR LOW COST HOUSING IN SOUTH AFRICA: CASE STUDIES FROM CAPE TOWN

by

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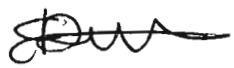
DECLARATION

I hereby declare that this dissertation, unless specifically stated otherwise within the text, is my own original work and has not previously been submitted in any form, to any other university, for the purposes of obtaining a degree.

Signature: 

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ABSTRACT

This dissertation explores renewable energy strategies for low-income housing in South Africa using several case studies from the City of Cape Town and surrounding areas.

The paper engages with the background and theories underpinning renewable energy for low income housing, analysing the key literature and focusing on renewable energy policies and current research in Cape Town, South Africa. It attempts to analyse the implications of current policy, the practical implications of renewable energy in low income housing developments and the conflicts that can occur between environmental and poverty interventions.

The research for this paper involved face to face interviews with individuals working in the renewable energy for low income housing field or exposed to projects of this type. From these interviews it emerged that renewable energy interventions in housing can more significantly reduce environmental impact when applied in middle and upper income housing developments, but also that particular kinds of renewable energy and energy efficiency interventions are suitable for low income housing developments. It became clear that the role of the town planner is central in ensuring the success of renewable energy projects, and that political will is also a key factor.

CHAPTER 1
INTRODUCTION TO RESEARCH

1.1 INTRODUCTION

The following dissertation emerged out of the author's strong interest in environmental and energy issues combined with a desire to examine their links to and impact on a town and regional planning context, specifically within the South African low income housing arena. The dissertation broadly touches on the issues surrounding the relevance and provision of renewable energy systems in South Africa, and does so examining case studies and experiences. The research was conducted in Cape Town and surrounding areas.

1.2 AIM AND OBJECTIVES

The aims and objectives of the research can be summarised as follows:

- To investigate current government, private and local, community-based initiatives to provide efficient, renewable sources of power for the low cost housing sector.
- To analyse the viability of the continuous and sustainable provision of alternative energy in low cost housing projects.
- To make recommendations for future housing and planning policy with regard to alternative energy.
- To contribute to the existing literature on alternative energy systems for low cost housing.

1.3 RESEARCH PROBLEM

Strategies to alleviate poverty often seem to stand in opposition to environmental and social sustainability, particularly in the realm of energy provision (De la Court, 1990, pgs10-15). Government low-cost housing projects, due to budget constraints and a focus on speedy delivery, often fail to investigate renewable strategies for the provision of power to low cost housing. (Davie, 2006, pgs1-2)

There is a significant international body of literature on the use of renewable energy alternatives in housing, most frequently for application in individual affluent homes (Potts, 1993; Merrill & Gage, 1978), and while there is also some South African literature

on this topic, usually in newspaper articles, (Steenkamp, 2006, p7; Gedye 2006, p10) the concept of renewable energy systems in low cost housing developments appears to remain at a conceptual and policy level. The documentation of local low cost housing projects attempting to investigate and implement renewable energy strategies is minimal, despite major gaps in service delivery to low cost home owners and growing local concerns about the ability of Eskom to provide sufficient energy for South Africa's needs.(Gedye, 2006, p10)

There is a need to investigate the reasons for the wide gaps in information on alternative and renewable energy and seek energy provision solutions that are affordable as well as environmentally and socially sustainable, so that low cost housing delivery can be achieved in a holistic manner. It is also important to analyse key examples of renewable energy strategies for low cost housing which are in use around South Africa in order to determine what can be learnt from and improved on in these case studies.

1.4 OVERVIEW OF THE CONCEPTUAL/THEORETICAL FRAMEWORK

The premise upon which renewable energy rests is one of humankind's holistic, sustainable and continued survival on the planet, by employing renewable, environmentally friendly strategies to improve or maintain an acceptable standard of living. The study will thus undertake a pragmatic investigation into renewable energy strategies for low cost housing, informed by environmental and humanist theory, derived from documents such as the Brundtland Report and the UN HABITAT Global Report on Human Settlements.

The Brundtland Report, or 'Our Common Future' (WCED, 1987), was one of the first international studies to acknowledge the link between poverty and environmental problems, to warn about the limitations of fossil fuel reserves, and to encourage the use of renewable energy strategies.

The Global Report on Human Settlements (UN HABITAT, 1996) almost ten years later argued that little had been done to improve the energy strategies of people in developing countries, and that their health and the condition of the environment had deteriorated as a consequence.

Because an environmental theoretical position demands a holistic approach, an attempt will be made to reconcile the usually conflicting environmental and humanist discourses, through establishing whether the agendas of low-cost housing and environmentalism in the form of renewable energy strategies are compatible in the South African context.

The study takes as its premise, from previous research such as the documents mentioned above, that the implementation and use of renewable energy systems will provide a significant benefit to both society and the environment.

1.5 KEY QUESTIONS

Key Question:

What is the place of renewable energy systems in low cost housing developments in South Africa?

Subsidiary Questions:

1) What are the alternatives in renewable energy supply to low cost housing?

2) Which are the most appropriate alternatives in the South African Low Cost Housing Sector?

3) What renewable energy projects run by the public, private, NGO and Civil Society sector are currently underway?

4) How effective are these in supplying cheap renewable energy to residents of low cost housing projects?

5) What recommendations can be made for policy making based on the above research?

1.6 RESEARCH METHODOLOGY/DATA ANALYSIS

1.6.1 Primary Research

1.6.1.1 Target Groups:

- Academics and researchers in renewable energy

These interviews were necessary to explore the links that exist between civil society, non-governmental organisations (NGOs) or the private sector and renewable energy projects for low cost housing. Questions were asked to establish what kinds of renewable energy systems are promoted and the reasons for this, how communities get access to these systems, which organisations provide funding, what kind of standards

are used (e.g. the voltage/wattage deemed appropriate for each household), and what links exist between these projects and government policy, programmes and funding on renewable energy for low cost housing.

- Low income community member

This interview aimed to investigate the renewable energy strategies to be implemented in one of the communities, the extent to which the government, the private sector or NGOs are actively attempting to implement renewable energy systems in the community, and those that may have been installed by individuals. The knowledge and perceptions of renewable energy within the community, and possibly even unconventional strategies which these residents employ to reduce energy use were also of interest. Only one respondent was secured for this interview.

- City of Cape Town representative

This interview attempted to determine what programmes the City of Cape Town has put in place or is currently undertaking to explore renewable energy systems for low cost housing in its communities. Also of interest was any other renewable energy applications used by the city in other areas (e.g. street lighting, schools, hospitals, civic buildings etc.) The municipality representative was asked about the influence of central government renewable energy policies, and how much focus they are expected to place on renewable energy strategies for low cost housing developments.

- Representative from Eskom

It would have been desirable to interview a representative from this large national electricity parastatal, particularly in terms of their role in electricity provision, energy efficiency and renewable energy initiatives in the Cape Town area, and would have established the nature of Eskom's involvement in all three of these areas, and unravel discussions around the threat of renewable energy to conventional profitable electricity provision. Email contact was made, and questions sent in July, but to date no response to these was received.

1.6.1.2 Research Approach

Qualitative research was the most appropriate approach to use, as the study primarily attempted to understand what kind of renewable energy strategies are being undertaken

to assist communities inhabiting low cost housing, how supportive various government policies and initiatives are of these strategies, and to place the future of renewable energy systems in planning and housing both on the drawing board and on the ground.

1.6.1.3 Research Design

The most effective research design for the topic, and the one that has been used is Case Study Design, as the nature of my research demanded that an analysis and comparison of two or more cases in which renewable energy strategies are used by communities occurred. In-depth interviews with key informants (experts in renewable energy and representatives of the study communities), were conducted to observe how effective these renewable energy strategies performed in providing basic energy requirements. A degree of analysis also occurred to identify and extract the major other issues that emanated from the interviews, as these proved to be highly valuable.

1.6.1.4 Sampling Procedure

Purposive sampling was undertaken with most of the interviews, as it is crucial that the 'experts' lend their knowledge to my study. Snowball sampling was also extensively used, as up to date information on alternative energy projects was not readily available, and the unfamiliar context of Cape Town demanded that I be referred to the most useful informants. Two renewable energy low-cost housing projects in Cape Town (Kuyasa Low-Income Urban Housing Energy Upgrade Project and the Oude Molen 'eco suburb' project), formed the basis of much of my questioning, and although other case studies of relevance emerged their discussion was limited by the scope of the paper .

1.6.1.5 Research Instruments

These included in-depth interview schedules and a direct observation checklist.

1.6.1.6 Data Analysis Plans

I primarily made use of a Thematic Analysis, including:

- A comparison between different kinds of renewable energy,
- advantages and disadvantages of each,
- how easy they are to incorporate into current low cost housing projects,
- affordability, and
- the level of government involvement.

1.6.2 Secondary Sources of Data

Extensive review of literature on the topic of renewable energy systems in low-cost housing projects was essential in order to frame, inform and lead the primary research process. The following bodies of literature were critically examined in the study:

- Books, including texts on environmental ethics and principles, overviews of low cost housing strategies, collections of alternative energy case studies and technical manuals on appropriate alternative energy technology.
- Journal Articles from Peer Reviewed Journals, including such journals as Housing Studies, Renewable Energy World, Housing in Southern Africa, Environment and Urbanization and Urban Green File.
- Newspaper and Magazine Articles, including the Mail & Guardian, the Sunday Tribune, The Independent on Saturday and Biophile.
- Policy Documents, including the Reconstruction and Development Programme (RDP) White Paper, the Housing Act 107 of 1997, The White Paper on Renewable Energy (Nov 2003) and others.
- Websites, including those of the departments of Housing, Minerals and Energy and Environmental Affairs

1.7 CHAPTER OUTLINE

The dissertation is divided into 5 chapters of which this is the first. Chapter 2 is the first part of the literature review, and discusses the background and theories underpinning renewable energy for low income housing discourse as well as engaging with the key literature. This chapter is broken into a discussion on environmental theories informing renewable energy development and use, limitations that occur within these theories and resources and applications of renewable energy in South Africa.

Chapter 3 forms the second part of the literature review, with a focus placed on domestic renewable energy policies and current research. It is divided into the implications of policy for environmental and renewable energy theories, how renewable energy can be practically applied in low income housing developments and a review of literature pertaining to renewable energy case studies.

Chapter 4 is the research findings from the interviews, and categorizes respondents' responses. It additionally outlines other findings derived from the author's observations of the case studies and other buildings, and provides a contextual map of Cape Town and surrounding areas and photographs from one of the case studies.

Chapter 5 is the final analysis of the research, drawing out the 7 key themes that emerged and discussing them. It presents the final conclusions to be made from the analysis and makes recommendations for future policy and practice in renewable energy for low income housing.

CHAPTER 2
LITERATURE REVIEW (A)
BACKGROUND, THEORIES & KEY LITERATURE

2.1 - INTRODUCTION

The following first part of the review of the literature attempts to analyse the role of renewable energy in low cost housing developments in several thematic categories, and where possible using the most recent and relevant sources. This discussion on the available literature has thus been broken into themes as follows:

- Environmental Theories that Inform Renewable Energy Development and Use
- Limitations of Renewable Energy and Environmental Theory
- Renewable Energy Resources and Applications

The review will also attempt to clarify what renewable energy really is, and how it is best used.

For the purposes of this study, the types of renewable energy sources discussed will include passive solar building techniques, passive solar water heaters, photovoltaic (p.v.) cell solar generators, wind turbine generators and biodigester or fuel cell technology. This does not mean that these are the only forms of alternative or renewable energy sources available or in use, but these are, to my knowledge, the most applicable in a South African context. Hydro-electric power, for example is a widely used renewable energy source, but because South Africa is a water-poor country is mainly unsuitable, (DBSA/ISES, 2000). Nuclear power was omitted, because including it in the discussion would make this study far too extensive, and also because it does not fulfill enough of the environmental principles outlined below.

2.2 - ENVIRONMENTAL THEORIES THAT INFORM RENEWABLE ENERGY DEVELOPMENT AND USE

There are numerous documents that have been produced outlining environmental theories and principles. It is important to establish the theoretical origins, informants and parameters of renewable alternative energy strategies, but due to the limits of this project, the literature reviewed on this topic is not by any means exhaustive.

The Four Principles for Environmental Policy (Dommen, 1993) influenced by the Brundtland Report have framed many countries approaches to environmental issues. These principles are firstly the Polluter-Pays Principle, secondly the User-Pays Principle, thirdly the Precautionary Principle and finally the Subsidiary Principle.

Of the four environmental principles above, the Precautionary and Subsidiary Principles are the ones which frame this particular study into renewable energy in low-cost housing, as they encourage community-based, preventative solutions to environmental energy problems.

The Precautionary Principle states that it is the duty of environmental measures to "anticipate, prevent and attack the causes of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation" (Dommen, 1993, p2).

The Subsidiary Principle states that environmentally based political decisions should be taken at the lowest level, when they are more effectively achieved at community rather than national level. This principle promotes community participation in environmental issues, and was also an integral part of the Rio Declaration in 1992 (Dommen, 1993, p3)

Our Common Future, (also known as the Brundtland report) published by the World Commission on Environment and Development is the first report to have resulted from an international environmental study, and argues that society will always need energy in one form or another for its survival and development, and that sources of energy should ideally be: "dependable, safe and environmentally sound." (WCED, 1987, p168)
The WCED argues that there are dangers linked to society's significant consumption of energy which is non-renewable and polluting, including depletion of natural resources, health impacts as well as secondary environmental impacts such as air pollution. The results of this increasing consumption may also have longer term consequences such as climate change caused by greenhouse gasses (most importantly CO2) which are released into the atmosphere when fossil fuels are burnt, air pollution from urban and industrial sources, acidification caused by both the above pollutants, and dangers and

pollutants resulting from nuclear energy plants. In developing countries there is the added problem of the over consumption of wood for fuel. (WCED, 1987, p172) This strengthens the argument for the development and utilization of renewable energy systems.

The Brundtland Report emphasises that renewable energy should form the foundation of the global energy structure in the 20th century, and countries should facilitate this through research, development and pilot projects. The report does acknowledge, however, that in the development of renewable energy systems, it is not the technology but the social and institutional frameworks that need significant development. The commission also notes that renewable energy systems are most suitable when used at a small or medium scale (WCED, 1987, pgs192-195). Thus, it is not just the energy systems that need to be developed, but social structures and a refocus within development from the macro to the micro level.

Thijs De la Court (1990) argues that the Brundtland Report made a crucial link between poverty and environmental problems, but that many environmental and developing world thinkers have criticised the report for ignoring the inherent contradictions in the notion of 'development'. They argue that the western standard of living, by which notions such as 'poverty' and 'underdevelopment' are measured, is the root cause of overpopulation, poverty and environmental degradation. (De la Court, 1990, pgs10-15)

De la Court provides six basic principles of sustainable development which he argues go further in addressing causes and consequences of unsustainable development than the Brundtland Report. Firstly, the Principle of Cultural and Social Integrity of Development argues that development must come from and respond to local communities. Secondly, the Ecological Principle, which states that development must work with and restore diversity, and be dependant on sustainable resources. Thirdly the Solidarity Principle, where development must promote equity and provide basic standards for all people. Fourthly, the Emancipation Principle argues that development must promote local control of resources, self reliance, participation and empowerment of local people. Fifthly, the Non-Violence Principle, where development must be peaceful, both directly and within institutional structures; and finally the Principle of Error-Friendliness, in which

development must allow for error without compromising the ecosystem and resources. (De la Court, 1990, pgs 135-6)

In the realm of building construction, there are several environmental principles which can be followed to ensure energy efficiency. Brenda and Robert Vale (1991) offer several overlapping principles for green architecture, of which the following apply to energy use (Vale, B & Vale, R. 1991, pgs 188-192):

- Conserving Energy: the construction of a building should reduce the need for its inhabitants to use fossil fuels, and should work in clusters of buildings rather than individually; and
- Working with Climate: buildings should have a design that is compatible with the local climate and natural energy sources.

These two principles inform particularly energy efficient housing construction, and suggest that there are methods of ensuring that the building structure itself is conducive to energy efficiency, before alternative energy strategies are applied. The process of energy-efficient housing construction does not nessicarily involve expensive technology, and can be as simple as orientation of the building in relation to the sun. These techniques will be expanded and explained in chapter three. These techniques link to the holistic aspect of environmental theory, where responsible energy use is directly connected to responsible energy provision. Irurah and Boshoff support this, arguing that the built environment should be "responsive to the resource and sink limits of the planet". (Irurah, D. & Boshoff, 2003, pg 247)

Many negative effects result from energy usage, particularly for the poor. The UN HABITAT Global Report on Human Settlements in 1996 argues (making reference to the World Health Organisation) that among other factors, the extent to which the structure of a shelter protects its occupants from heat and cold, and the presence of indoor air pollutants from cooking and heating, both significantly affect the health of those living in it. The report also argues that this indoor air pollution may be seen as the most detrimental form of air pollution in the world, causing among other health problems, lung infections, asthma and the exacerbation of Tuberculosis symptoms. Indoor air pollution has the greatest impact on the poor, who usually have no access to electricity or gas cooking and heating systems. (UN HABITAT, 1996, pgs133-4)

A similar situation exists in South African low income residential sector, where many people use paraffin, coal or LPG gas to provide energy functions within their homes, (Kenny, A, 2006). Winkler lists as one of the 3 major challenges in energy provision for the South African residential sector as "a more widespread adoption of 'clean energy' in order to reduce concentrations of pollutants within residential houses" (Winkler, H. 2006. pg 33-4)

Winkler states that it is possible in the current low cost housing programmes to attain 50-90% in energy efficiency savings with a cost increase of 1-5%, which indicates that energy efficiency in low cost housing is a real and achievable goal. (Winkler, H. 2006. pg 34)

A lack of sufficient energy supply and insulation in housing developments can be a major cause of health problems. A longitudinal study of the health effects of housing improvements in Glasgow, Scotland, found that damp, mould and cold are significant factors resulting in poor health (Hopton, J & Hunt, S. 1996). The study was conducted over 12 months with 2 sets of interviews conducted with the same residents and the start and end of one year. In the first set of interviews 532 residents were interviewed, and in the last set 258 of the same residents were again interviewed. The study compared those who had heat and those who didn't, and it was found that the elimination of dampness and cold improved the overall symptomatic health of the children. However, it should be noted that other poor socio-economic conditions impacted on the children's health, including the poor construction of the dwellings which made them difficult to heat. This occurs particularly where houses are built without insulation and provides ideal conditions for mould, viruses, bacteria and dust mites, which can cause complaints such as allergies and lung damage. Energy aware construction, combined with heating was shown to improve both the dampness and cold, and in the long term, improve the health of residents, particularly children, who suffered less from cold and 'flu complaints as well as more serious respiratory illnesses. (Hopton, J & Hunt, S. 1996)

The irony of this situation of negative health impacts from energy consumption and poor, inefficient supply of energy, is in the fact that poor communities and populations in low income countries use far less non-renewable resources than the wealthy and those in more affluent countries, usually due to the inability of the poor to afford excessive resource consumption (UN HABITAT, 1996, p153). Thus the poor simultaneously suffer

most from energy related pollution while making the least impact on the consumption of non-renewable energy resources.

In the ten years between the Brundtland Report and the Global Report on Human Settlements, there was very little progress in limiting the use of non-renewable resources and in controlling the disposal of non-biodegradable wastes, (UN HABITAT, 1996). The Human Settlements Report states that there still exists a need to: "halt or modify investment decisions which imply serious social and environmental costs either in the immediate locality or in distant ecosystems or for future generations." (UN HABITAT, 1996, pgs 399-400) Thus it is clear that a more direct implementation of renewable energy strategies along with other environmental initiatives need to occur within the global market in order to ensure a sustainable future.

There are several ways in which the human and natural agendas can both be addressed through the implementation of renewable alternatives in energy provision. The Human Settlements report argues that certain resource conserving production shifts can also minimise the impact on employment, including through the replacement of jobs being lost in the coal, oil, natural gas and electricity industries with employment in energy conservation, renewable energy systems construction and maintenance in the tapping and storing of renewable energy. The report also argues that "investments in energy conservation are generally far more labour intensive than investments in increasing the energy supply." (UN HABITAT, 1996, pgs 401-2) Thus renewable energy strategies may actually create more employment than current sources, particularly in small-scale enterprises.

2.3 - LIMITATIONS OF RENEWABLE ENERGY AND THEORIES OF THE ENVIRONMENT

It is important to emphasise that much of the discourse surrounding environmental issues is bound to particular sets of values and ideologies, and environmental arguments can thus become highly subjective in nature. In perceptions of energy, the phrasing of environmental language can divide types of energy supply into value-laden categories of 'good energy' and 'bad energy'. The former category usually describes sources of energy such as solar and wind, which are perceived to be limitless and non-

polluting, and the latter sources such as nuclear and coal-derived energy, perceived to produce radioactive waste and greenhouse gasses (Baarschers, 1996, p105).

Thus it should be pointed out, as Baarschers argues, that all energy, regardless of its source has one common scientific limitation: according to the second law of thermodynamics, every process involving energy will move from a state of more to a state of less energy, with a transfer of energy to the surrounding environment during the process always guaranteed to occur. This means that even renewable energy sources suffer loss of energy through the process of their use (Baarschers, 1996, p107-110). No method of generating energy can therefore ever be completely efficient, but only more or less so.

Renewable energy is also often described as 'clean energy', with no pollution by-product. However, this is not the case, and in the production of energy or renewable energy technologies there are always by-products, from heat and energy loss, to waste from the manufacture of energy systems such as photovoltaic cells and wind turbines (Baarschers, 1996, p118). However, Alternative and renewable energy does, on the whole, produce less pollution and use less resources.

The Organisation for Economic Cooperation and Development (OECD) conducted a study in 1988 into the environmental impacts of renewable energy technologies, and found that, unlike fossil fuel energy sources, which release mainly chemical pollutants, renewable energy sources have more of a physical impact on the environment (OECD, 1998, p7).

Active Solar systems for heating or cooling, were found to be high in consumption of materials such as glass, copper, aluminium, steel and insulants, may be polluting when the heat transfer fluid and coolants used in these systems are disposed of, as well as occasionally being prone to release airborne pollutants. Photovoltaic cells are non polluting while in use, but their manufacture requires toxic materials, produces toxic substances during refining, and their eventual disposal could be polluting. Wind technologies may cause visual pollution, take up large tracts of land, may cause the disruption of electromagnetic communications, and can also create excessive noise.

Biomass and biodigester processes can result in the release of a range of chemicals, some of which have the potential to be polluting or harmful.

The report found, however, that despite these disadvantages, in the long term renewable energy sources were less polluting than, and preferable to, nuclear and fossil fuel energy generation (OECD, 1998, pgs7-10).

Some energy theorists argue that there are sufficient fossil fuel resources on the planet to satisfy energy needs, and these can be treated to make them non-polluting. Mark Jaccard, professor of resource and environmental management at Simon Fraser University in Vancouver, argues that fossil fuels are, in fact sustainable, particularly if producers move from oil to coal and from fossil fuels to renewables (Sutherland, J, 2006, p30). He maintains that coal can be rendered virtually pollutant free through converting it to combustible gas, and then capturing and pumping carbon dioxide deep into the earth. He also argues for the exploration of alternative sources of oil, such as those in oil sands and its extraction from biomass. He believes that the right sort of technology already exists, it is only government and corporate policy that really needs to change.
This concept of the need to change and re-think the policy framework to make energy sustainable is addressed in the following section.

One of the most significant limitations of renewable energy technology in South Africa is its high capital cost relative to electricity from the grid. Although the government successfully electrified a third of South African households, bringing the rate of electrification in South Africa in 2001 to 66%, the levels of consumption for newly connected households over the last few years have remained at 100-150 kWh per month rather than the predicted 350 kWh. Winkler argues that this is mainly due to the inability of most households to afford a full electricity supply and therefore a continued use of traditional polluting fuels in addition to grid supplied electricity. (Winkler, H. 2006. pg 28-9). This is despite the low cost of the electricity supply in South Africa when compared to most other countries in the world.

Winkler also argues that energy saving interventions such as solar water heaters are more affordable for upper and middle income groups than for low income households. Even relatively cheap methods of energy conservation such as ceiling installation would

usually require government subsidies for these households. (Winkler, H. 2006. pg 33-5). Therefore even if it is advantageous from a social and environmental viewpoint to provide renewable energy interventions for low income households, it remains beyond their financial capacity.

Another important point to consider when arguing for the environmental benefits of renewable energy provision for low income residential development, is that the residential consumption of energy in South Africa is not the most significant contributor to energy related pollution. In 2000, The residential share of final energy consumption in South Africa was only 10%, dwarfed by industry (45%) and transport (20%) among other uses. The demand for energy by industry increased the most in all sectors in the years between 1992 and 2000. Thus, although it is not within the scope of this study, it is important to note that renewable energy solutions need to be investigated for energy provision to South African industry and transport if a significant difference is to be made to the level of polluting emissions and the efficacy of demand side management of electricity supply (Winkler, H. 2006. pg 24-5).

2.4 - RENEWABLE ENERGY RESOURCES AND APPLICATIONS

Not all kinds of renewable energy are suitable for use in all parts of the world, and indeed, suitability of technologies can range widely even within the different regions of a particular country. This is also applicable to South Africa, and so here follows a brief indication of the most appropriate technologies:

2.4.1 - Biomass

Applications - Biomass is useful for generating biodiesel, ethanol, methanol and hydrogen, and has the potential to generate employment and income in South Africa, although this may pose a threat to food supply and biodiversity. (Kenny, A. 2006. pg 48-49)

Resources - Even though South Africa has forest on only about 1.2% of its area and is approximately half covered by desert or semi-desert making biomass resources scarce, an estimated 10 million tons of wood are nevertheless used for heating and cooking as well as an uncalculated quantity of dung and vegetable matter, (Kenny, A. 2006. pg 48-

49). These energy uses occur mainly in poor households in rural areas, but also in many formal and informal settlements on urban fringes, (Kenny, A. 2006. pg 48-49) .

2.4.2 - Hydro-electric Power

Applications - Isolated systems supplying a mini grid or grid connected systems. (DBSA/ISES. 2000. pg 40-41)

Resources – While South Africa has few rivers suitable for generating hydroelectricity, there are an estimated 3500 to 5000 potential sites for mini-hydropower generation, mainly along the country's eastern escarpment. Other countries in southern and central Africa have significant potential for generating hydroelectricity, some of which could be exported to South Africa, although this possibility generates debate that, because of space and focus constraints, cannot be explored in this dissertation (Kenny, A 2006. pg 50).

2.4.3 - Solar Energy

Applications - domestic hot water supply and swimming pool heating (Solar water heating), rural household electrification, telecommunications, school and clinic electrification, water pumping (Photovoltaic systems) (DBSA/ISES. 2000 pg 40-41)

Resources - South Africa's optimal levels of solar radiation occur in the Northern Cape, but most of the interior of the country also benefits from extremely high levels. The average annual 24 hour solar radiation in South Africa is 220 W/m², which compares favourably with parts of the USA (150 W/m²) and Europe (100 W/m²) which successfully make use of solar energy. (Kenny, A. 2006. pg 50-51)

Kenny estimates that approximately 70 000 households, 250 clinics and 2 100 schools make use of photovoltaic panels primarily in rural areas, with the numbers increasing by up to 1 000 households per month. No electricity is yet being generated in this way for the grid. Solar water heating is also increasing, but mainly in middle income households. (Kenny, A. 2006. pg 58-59)

2.4.4 - Wind Energy

Applications - mechanical water pumps, battery charging, grid connected wind farms. (DBSA/ISES. 2000. pg 40-41)

Resources - Wind energy resources are best in costal regions. This energy is in the process of being integrated into the grid, with the Darling Wind Farm in the Western Cape about to begin generation. (Kenny, A. 2006. pg 50-59)

2.4.5 - Landfill Gas

Applications - landfill gas or gas extracted from a biodigester has the potential to provide gas for direct use or to be converted into generating electricity.

Resources - South Africa does not currently use its waste for the generation of flammable gas, but there are many sites all over the country that are suitable for this application. Municipal waste in landfill sites in South Africa has the potential to produce 11 000 GWh per year in the form of direct incineration or conversion into biogas and methane. (Kenny, A. 2006. pg 59)

2.5 - CONCLUSION

The chapter above attempts to show that, despite the extensive and detailed literature that exists on renewable energy, much of this policy and research remains at discussion level and has not been put into practice. This absence is particularly apparent at the community scale, in low cost housing within South Africa.

It is also clear that different types of alternative energy are best suited to different applications, for example, biodigester energy generation is most suitable for new developments in semi rural areas, p.v. solar systems are most effective for installation in established homes in high densities, and wind turbine energy generation is best in more remote areas with high wind speeds.

It is evident that there are also other passive ways of conserving energy in housing developments, such as energy efficient house construction and the use of energy efficient light bulbs, which need more effective implementation in low cost housing developments.

CHAPTER 3
LITERATURE REVIEW (B)
POLICIES FRAMEWORK & CURRENT RESEARCH

3.1 - INTRODUCTION

The second half of the review of the literature focuses on policy, the legal framework and current research occurring in the field of renewable energy for low cost housing. The chapter has been divided along the following themes:

- Policy Framework & Implications for theories about Environment and Renewable Energy
- Practical Applications of Renewable Energy in Low Cost Housing
- Case Studies of Renewable Energy Strategies

This chapter will attempt to analyse what the literature argues is the place of renewable energy systems in low cost housing developments in South Africa, what alternatives there are and which of these are the most appropriate in the South African low cost housing sector.

3.2 - POLICY FRAMEWORK & IMPLICATIONS FOR THEORIES ABOUT ENVIRONMENT AND RENEWABLE ENERGY FOR HOUSING

The role of housing in environmental practice is an important one, and Brown and Bhatti (2003, 505-515) argue that, although much has been achieved in terms of sustainable development since the Brundtland Report in 1987, the discipline of housing still needs to make progress in topics such as health, housing, poverty and the environment. Environmental responsibility, in particular, has been given much lip service in housing policy and literature, but this has contributed little to critical analysis or practical solutions. Brown and Bhatti suggest a theoretical movement towards housing's contribution to economic growth, social integration, sustainability and fair competition, a strengthening of the environmental agenda in housing policy, as well as looking to and learning from international best practice examples in informing green housing construction. Housing policy and practice is thus one area that particularly stands to benefit from environmental theory in the realm of alternative energy.

The following policy documents and debates have been analysed according to their particular focus areas of energy and housing.

3.2.1 - Energy

Some of the recent energy policies that have been instituted by the South African Government and particularly the Department of Minerals and Energy include:

The National Electrification Programme, which was implemented between 1994 and 1999, and intended to provide electricity to low income households in urban and rural settings that had been neglected during apartheid. The funding for this programme came from the national government which formed a partnership with Eskom in order to implement it. (Davidson, O. 2006. pg 7)

The White Paper on Energy (1998) was the result of public consultation, public comment, a National Energy Summit and a final paper published in late 1998. Among its five policy objectives, the three that directly relate to this study were to increase people's access to affordable energy services, to reduce the negative health and environmental effects related to energy activities and to diversify sources of energy supply to ensure energy security.

Renewable energy was designated appropriate for non-electrified households, particularly in rural and remote regions where it would be costly to extend the grid; and the provision of renewable energy systems, including solar, would be facilitated by the government for these regions. The white paper also stated that the establishment of renewable energy standards, codes and guidelines would be considered. (Davidson, O. 2006. pp 7-9). The establishment of these does not seem to have effectively occurred.

The Integrated Energy Plan (2003) was published by the Department of Minerals and Energy (DME) for use in energy policy decisions and to stimulate the development of different energy sources. It was used to project energy reserves, demand and consumption in South Africa up to 2020 in varying scenarios. (Davidson, O. 2006. pg 11)

White Paper on Renewable Energy (2002) was published by the DME to ensure that renewable energy technologies received government, local and international support

and investment and were encouraged through fiscal incentives. Proposed policies included the development of pricing, tariff, legal and regulatory frameworks as well as standards and codes of practice to integrate renewable energy into the South African Economy. Research and development to strengthen and optimize these technologies was also proposed. (Davidson, O. 2006. pp12-13)

Electricity Basic Service Support Tariff (2003) This tariff was provided by the government as a social responsibility measure to meet the basic electricity needs of the poor, providing 50 Kilowatt hours per month free. The other positive spin off was that this tariff reduced the fees for users of solar home systems in the non-grid electrification programme. (Davidson, O. 2006. pg 13) This effectively assisted the development and expansion of solar systems in rural developments.

Davidson argues that in order for the government to increase the local production of locally manufactured parts for renewable energy technology, as stated in the White Paper on Renewable Energy, there is a need for policy and government sponsored action that will endorse this local manufacture. Davidson argues that this should ideally occur in the form of limited period subsidies and tax incentives, and longer term funding schemes (Davidson, O. 2006. pg 20). The Renewable Energy Finance and Subsidy Office was established in late 2005 for this purpose.

The City of Cape Town Draft Energy and Climate Change Strategy of 2005 states that in the residential sector, household energy costs are a major burden on poor households, contribute significantly to poverty, and that even in households where there is an existing electricity supply, a range of energy sources are often used. While most formal houses have electricity connections, and "in spite of an active informal dwelling electrification focus", informal settlements have low electrification rates of 10-15%. (City of Cape Town, 2005, p16)

The Draft Energy and Climate Change Strategy has 3 energy visions for the residential sector. The first involves a city where "all people have access to appropriate, affordable, safe and healthy energy services". The goals in this vision are universal access to electricity in households, affordable electricity for poor households (eg social tariffs), that

households use paraffin and candles more safely (reduced poisoning and fires) and for the city to have clean air, free from pollution from sources such as the burning of coal.

The second energy vision is for Cape Town "to be a leading African city in meeting its energy needs in a sustainable way, and thus fulfilling its constitutional obligations and global responsibilities". The goals in this vision are to increase the contribution of renewable energy to the city's energy supply, and to reduce dependence on unsustainable sources of energy (beginning with the most financially viable options). The city's targets are to have 10% of all households and 10% of housing owned by the city to be equipped with solar water heaters by 2010. This would involve the short-term promotion of the use of solar water heaters and the long-term establishment of a solar water heater financing scheme for households and for solar water heaters to be compulsory for all new houses.

Winkler argues that although solar water heaters have significant potential in South Africa, and despite support from the Global Environment Facility for the Department of Minerals and Energy, they have not been significantly pursued. Lwandle township near Somerset West is the only low cost residential project to have solar water heaters installed in the public sector, with most activity occurring in the private sector with a focus on middle and high income households. (Winkler, H. 2006. pg 33-5)

Government support of the renewable energy agenda can be aided by improvements and innovations in technology. The South African government subsidises older solar energy systems that cost approximately R7 000 with about R2 000. Newly developed solar panel technology devised by Prof Vivian Alberts of the University of Johannesburg's Physics Department may, with the existing subsidy, be able to supply basic electricity to poor households for R2 000 (Steenkamp, W. 2006, 7). This makes the option of alternative energy more achievable in low cost housing developments. A small 2-3 bedroomed house using power of about 1 kilowatt per day can also be converted to solar powered for about R14 000 all inclusive, making a continuous energy supply a reality for those with established homes who are able to afford this amount. This excludes the poor, but makes alternative renewable energy systems achievable for the previously excluded middle class.

The new solar panels are made of a unique cheap metal alloy that converts light into energy. This alloy is thin, light and flexible, and may, in the future be able to cover roof tiles, and be installed during the roofing stage of the house construction (Steenkamp, W. 2006, 7). With the technology thus in place, all that needs to occur is the standardization of renewable energy in housing policy and practice.

The South African government appears to have accepted the concept of renewable energy alternatives, at least in theory. Salim Fakir predicts that South Africa's renewable energy sector will grow significantly in the next 10 years, and has not done so yet, due mostly to the low cost of current electricity production in this country (Fakir, S. 2006, p5). However, with the cost of electricity set to rise above inflation, the government has set aside a renewable energies subsidy valued at about R100 million for the next three years. Projects in co-generation of energy such as the extraction of biomass gas from landfill sites, micro-hydro generation and solar power are seen as the renewable energy sources with the most potential. Sectors including the NGO sector, the government, the private sector, donors and investors have all expressed interest in opening up this market that shows good potential. The market is thus enthusiastic and supportive of this technology, and there is no reason why housing policy should not actively implement alternative energy systems.

According to Earthlife Africa, a major solution to energy problems (particularly extensive power blackouts such as those experienced by the Western Cape in 2005-2006) is a refocus from macro to micro level solutions (Gedye, L. 2006 p10). Between 35-40% of all residential electricity supply is used to heat water, and individual passive solar systems are perfectly able to absorb that percentage, thus easing the peak electricity demand, (Gedye, L. 2006 p10). This strategy has not been adopted my most home owners, mainly because electricity is seen as a far cheaper option by consumers. Eskom recently researched the use of solar powered water heaters by installing these in 50 pilot households around South Africa for a period of 6 months from March 2006. According to the Earthlife report: "The most polluting energy sources are highly subsidised, while we are neglecting the abundance of renewable energy sources in this country." (Gedye, L. 2006 p10)

The energy efficiency strategy promoted by the Department of Minerals and Energy includes several goals regarding social, environmental and economic sustainability. The goals that have relevance to this study include improving the health of the nation through the reduction of harmful emissions, job creation, the alleviation of energy poverty, the reduction of environmental pollution and the enhancement of energy security. (Winkler, H. Howells, M & Alfstad, T. 2006. pg 111)

In order to facilitate sustainable residential energy provision in South Africa for rich and poor, urban and rural households, the most important factor to consider is the vastly differing energy use patterns between these household typologies, with urban and rich households using a significantly greater amount of energy than poor and rural households. Virtually 100% of urban rich households have access to electricity, while about half of urban poor households have no access to electricity. In rural areas, rich households are 84% electrified, while less than 30% of rural poor households have electricity access. (Winkler et. al. 2006. pg 119-121)

Multiple energy sources other than electricity, such as coal, paraffin, LPG gas, wood and candles are used in the South African residential sector for the purposes of cooking, space heating, water heating, lighting, electrical appliances and other uses. Often these energy sources are used simultaneously for different functions. (Winkler et. al. 2006. pg 122)

Winkler et. al. argue that: "Energy policies for the residential sector should start with water heating... However, given the high capital costs of solar water heaters (SWHs), such an approach would be more suitable for middle and upper income households, primarily those in urban areas... a simpler intervention, with lower initial costs, is the installation of geyser blankets, which provide a substantial energy saving." (Winkler et. al. 2006. pg 127). They recommend that all new urban upper and middle income houses be required to install hybrid solar-electric water heaters in place of conventional electric geysers, saving 60% of household electricity use, while geyser blankets save 12%.

Passive solar water heaters are not beyond the capacity or level of acceptance of a developing country, as has been proved in a study in Botswana. Since the early 1990s, the Botswana government has been involved in research into the viability of renewable

energy sources, particularly photovoltaic and solar hot water systems (Pelgrim, R. 2006, p10). The results showed that these systems were "highly socially acceptable, increased economic activity and even improved medical care." A national photovoltaic rural electrification programme was set up in 1997, which offered credit to people wanting to purchase this technology, and has been offering photovoltaic energy to the residents of 88 villages at an 80% subsidy. The Botswana government has also encouraged the installation of solar geysers on schools, hospitals, other government buildings and even on two diamond mines, (Pelgrim, R. 2006, p10).This is a fairly progressive energy policy position for a country in Southern Africa, and may, in the context of this study, be used as an example of best practice with regards to governmental renewable energy strategies.

The Botswana energy example may be compared to the South African government's response to increases in energy demand. Eskom have announced increases in electricity tariffs to fund the construction of more coal and nuclear power stations (Peters, M. 2006, p5). This development is occurring despite retired Eskom council member Christo Viljoen's acknowledgement that coal power stations are extremely costly to run and director of UCT's Energy Research Centre Kevin Bennett's admission that coal was a very polluting method of obtaining power. Both of these experts in the energy field continue to support the development of more nuclear energy stations as they appear to be overly focused on a macro level energy generation scenario.

In terms of the comparative costs of the expansion of nuclear energy generation versus renewable energy systems for South Africa, Kevin Davie, a business analyst, argues that with the amount spent by the government on developing nuclear power sources, every household in South Africa could have been provided with a passive solar water heater (Davie, K. 2006, p1-2). This is a particularly staggering statistic when Davie explains that Koeberg, the country's only nuclear power plant, supplies only 3.3% of South Africa's electricity. R580 million of funding has been allocated by the government for the development of the as yet unproven Pebble Bed Modular Reactor, but tax breaks for solar power have been refused, and its budget for the next 3 years is only R14 million. This is the case even though South Africa has ideal year-round conditions for solar power, better than many countries with far higher levels of successful, government subsidised solar use. Davie also argues that RDP houses are worsening the energy

crisis, because they do not adhere to energy-efficient regulations such as insulation and north orientation. At the same time, electricity costs are rising, while renewable energy costs, driven by innovation, are coming down (Davie, K. 2006, p1-2).

The South African government seems to be avoiding the reality of the energy situation, partly because it is so focused on large-scale energy provision, which does not always yield the desired levels of energy supply. In addition, because these investments are so costly, macro-level energy generation provides energy which is unaffordable by the poor.

A policy document that has relevance to the two main case studies of this research; these being the Kuyasa Low-Income Urban Housing Energy Upgrade Project and the Oude Molen 'eco suburb' project; is the Sustainable Development Implementation Plan (SDIP) for the Western Cape, (SDIP, 2005).

Of the objectives which the document prioritises, the following relate to this study:

- "Encourage experimentation with alternative, environmentally sound technologies, designs and systems and encourage a real costing of such approaches and systems"
- " Providing incentives to promote sustainable practices...
- Strategically developing innovative technologies that promote sustainable development...
- Encouraging government to promote sustainability principles by developing and implementing a green procurement policy, through the design, construction, retrofitting and management of public buildings, and promoting environmentally sustainable practices within government administration (e.g. through waste minimisation and recycling practices)...
- Urgently address the unlocking of well located pieces of land, both public and private, across the province, for integrated housing development focusing on both greenfield and brownfield developments. Priority should be given to such sites as... Oude Molen... – these developments must be aimed at building socially mixed communities ... that meet the needs in particular of the urban poor and are designed in accordance with sustainability principles (such as energy saving, zero waste, re-use of water, recycling, densification, increased use of public transport, urban agriculture, and greening)...

- Setting challenging performance targets relating, inter alia, to the composition of the energy mix, the promotion of greater use of renewable energy sources and the increased adoption of energy efficiency measures...
- Provide an enabling environment that stimulates greater investment in renewable energy and that promotes energy efficiency in an integrated manner through all sectors, (SDIP, 2005).

The very concept of renewable energy provision alternatives can only be a success in policy and practice if policy makers understand that these systems need to be implemented on a micro, grassroots level. This does not mean that they must only occur in small, pilot project form as seems to have been the general case, but rather that, particularly for residential use, each household energy system should be seen as its own micro power station, providing energy for that household. If an interruption occurs in the energy generation process, it only affects one household, and may be repaired for a low cost.

Thus it appears that there is indeed a relatively substantial amount of policy surrounding the promotion of renewable energy supply in South Africa, but there are many inhibitors to the successful implementation of these policies, ranging from political agendas (including the desire to expand nuclear power generation) and political will to the affordability of current electricity supply.

3.2.2 – Housing

Housing policy has a role to play in the implementation of renewable energy, particularly for the large number of low cost houses that have yet to be built in South Africa. This section will assess the extent to which housing policy caters for and fulfills this role.

Energy efficient housing design is a critical part of effective energy efficiency. Standards in environmentally sound building set up by the Department of Housing in 2003 need to be integrated into regulations for the construction of South African subsidised housing. These design standards include the installation of insulation as well as a ceiling, usually omitted in RDP and other government housing projects. Other effective interventions include correct orientation, north-facing windows and an optimized roof overhang. Currently only approximately 0.5% of South African households have efficient thermal

design, but this statistic has the potential to increase dramatically with policy interventions such as subsidies, (Winkler et. al. 2006. pg 128-9).

Winkler et. al. suggest that: "An incremental housing subsidy for energy efficiency could be set to be equal to the initial incremental cost of the intervention, for the same end-uses covered under 'building codes' and 'appliance standards'. This measure could be implemented through existing housing legislation and programmes." (Winkler et. al. 2006. pg 129). Irurah and Boshoff also argue that there is significant scope for energy efficiency in low income housing in South Africa, particularly in harnessing funding through the Kyoto Protocol. However they admit that many pilot projects of this nature have not been sustainable, (Irurah, D. & Boshoff, 2003, p254-55).

Breaking New Ground

One of the major objectives of a new housing vision for South Africa, stated in 'Breaking New Ground' is to utilize "housing as an instrument for the development of sustainable human settlements, in support of spatial restructuring" (DOH, 2004, p7).

The Cabinet of the South African government is using the National Spatial Development Perspective (NSDP) to frame and inform allocation of infrastructure investment and development spending, in reaction to development programmes such as the housing programme which are not seen to be adequately fulfilling their mandate. The preparation of the Draft National Urban Strategy in 2004 by the Department of Provincial and Local Government (DPLG) included a vision of sustainable human settlements as:
"well-managed entities in which economic growth and social development are in balance with the carrying capacity of the natural systems on which they depend for their existence and result in sustainable development, wealth creation, poverty alleviation and equity" (DOH, 2004, p11). In order to effectively adhere to this definition of sustainable human settlements adopted by the South African government, the current low income housing product needs to be drastically altered.

Of the various contributions to spatial restructuring that will be made by the DPLG within the Draft National Urban Strategy, the one that is most relevant to this discussion is the enhancement of the housing product itself, which involves enhancing settlement and housing design and addressing housing quality. It is argued that this will be achieved

through the inclusion of design professionals and the adoption of standards and guidelines, 'to achieve sustainable and environmentally efficient settlements...; to enhance the traditional technologies and indigenous knowledge which are being used to construct housing in rural areas and to improve shelter, services and tenure' (DOH, 2004, p16).

Restructuring of the housing subsidy system was also prioritised in order to ensure that roll out can occur more effectively. As of April 2005 all households with an income below R3500 are able to access a uniform subsidy amount, rather than being allotted to one of the 3 subsidy levels. Households falling within the income category R3 501 to R7 000 per month are also now able to access a credit & savings-linked subsidy, which will allow a substantial number of additional households to access housing. It was also established that the subsidy needs to be adjusted to inflation to make it an effective housing delivery system, (DOH, 2004, 23-4).

The project of spatial restructuring and sustainable human settlements identified in 'Breaking New Ground' identifies a range of necessary interventions, including the promotion of "enhanced project design inputs and the promotion of alternative and indigenous building technologies to achieve better quality and more meaningful housing environments" (DOH, 2004, [2], p1) The project objective is to transcend the provision of "adequate housing" and attempt to achieve a broader concept of sustainable settlements as defined above, (DOH, 2004, [2], p1).

One of the key aspects of the Housing Land Strategy as identified in 'Breaking New Ground' that relates to this study to achieve quality housing environments is to support improved settlement design and the promote appropriate technology and construction methods. This will involve changing the current image of the "stereotyped subsidised 'RDP house'" by improving design, "promoting the use of alternative and indigenous technologies" in both urban and rural developments and improving access to new construction technologies, (DOH, 2004, [2], p3).

The design support strategy would involve the development of design guidelines and "investigating a role for the Department of Housing in the promotion and regulation of

alternative technologies". This places a large degree of responsibility in the hands of the Housing department, (DOH, 2004, [2], p4).

In terms of funding for the improvement of settlement design and appropriate technology, 'Breaking New Ground' states that money for improved design inputs and the promotion of appropriate technology remain at the feasibility stage. However, funds can be derived from "the existing housing subsidy scheme through the reprioritization of certain funding categories" If a need for capital grants for improving rural housing is identified, then these costs are to be offset against the rural housing subsidy. The capacity building programme will partly account for additional capacitation and recruitment costs, (DOH, 2004, [2], p6).

Within the institutional framework, the Department of Housing will create capacity to promote alternative and indigenous technologies and better residential design, with municipalities acting as developers with the assistance of Provinces. Social housing institutions will be responsible for a portion of housing projects, and social amenities may be run by NGOs or for profit companies. Local support organisations and professional bodies will also be involved in ensuring better settlement design, (DOH, 2004, [2], p7). The responsibility for developing capacity in this initiative will go to the Chief Directorate: Housing Sector Performance, and "feasibility studies around alternative technology support will be commissioned drawing on outside capacity" (DOH, 2004, [2], p8).

The timeframe for the support of the alternative technologies mechanism in 'Breaking New Ground' was identified as April 2006, but it is not clear if this has been achieved, (DOH, 2004, [2], p9).

3.3 - PRACTICAL APPLICATIONS OF RENEWABLE ENERGY IN LOW-COST HOUSING

While the process of drafting policies according to environmental, renewable energy and sustainable settlement principles is a relatively straightforward process, it is an altogether different procedure to put these principles and policies to practice. Environmental principles can often stand in opposition to the need to provide basic

housing for the poor, and issues of under-capacitiation in municipalities both in terms of finance and human resources make the consideration of new technologies virtually impossible.

Political pressure to roll out housing quickly and cheaply is one of the greatest challenges facing the Department of Housing, but, as the following section will show, it can be possible to implement a degree of energy efficiency and renewable energy systems in any housing development as long as sufficient research and planning goes into the process.

Literature has explored the challenge of energy efficient strategies for housing projects from the mid 1970s until the present day.

In an early but extensive and informative text; Alternative Natural Energy Sources in Building Design, (Davis, A. & Schubert, R. 1974, 170-182) outline the relationship of site to energy consumption, how best to conserve energy in buildings and a range of alternative energy systems, including, natural ventilation, water power, wind power, solar energy, integrated systems and most interestingly, organic fuels. The latter is most useful in this review as many other sources have little information on this subject. The authors argue that methane gas derived from digested waste could, potentially, substitute for conventional natural gasses used in energy production. The best uses for this gas would be in refrigeration and cooking and to an extent in lighting. Communities could derive energy from their vegetable waste, animal manure and particularly from their sewerage, making this system highly renewable, although conventional flush toilets use too much water for a digester and would have to be replaced by a system more similar to pit latrines. The byproduct after the gas has been collected also has the potential to be used as fertilizer.

This kind of technology would be highly appropriate for low-cost housing developments, as it combines the provision of sanitation with that of energy provision. It has an added advantage particularly in semi-rural areas, where the fertilizer by-product could be used for agricultural purposes, improving livelihood strategies. It may however, not be as socially acceptable as more conventional alternative energy sources such as solar or wind.

Passive solar strategies employed in the process of housing construction can be as effective as alternative energy systems that are installed after construction. The Energy Efficient Site Handbook, (Kay (et. al.), 1982) is the result of research conducted in New South Wales, Australia into energy efficiency in housing estates and subdivisions, making it particularly relevant to this discussion. The authors argue that, in the southern hemisphere, the main windows of a dwelling should face north to control the sun's radiation, correct landscaping can positively affect climate control, and that streets and services can be designed for maximum energy efficiency. Many factors regarding the site itself need to be considered in order to maximise energy efficiency, and passive solar design[1] (in this case distinct from passive solar water heating) as well as the use of vegetation surrounding the building, are crucial elements of energy efficient site design.

Mathews and Weggelaar argue that both Eskom and residents of low income households would greatly benefit from the installation of new insulating ceilings designed with polyminium as the consequent reduction of energy usage during peak hours is a goal of Eskom's demand side management programme, and residents would have reduced heating costs in winter, less chance of fire or negative health effects, and cooler summer temperatures. The authors propose that thus it may be to Eskom's advantage to invest in the installation of these ceilings. The ceilings cost R10.50/m², and are about 60% cheaper than currently available ceiling material, making them ideal for low-cost housing. (Mathews, E. H. & Weggelaar, S. 2006. pg 26)

The passive energy position is supported by Barton (et. al.) in Shaping Neighbourhoods, (Barton, H, Grant, M & Guise, R. 2003, 140-150) who also argue for energy efficiency through layout and careful site planning. Communal sources of alternative energy, such as small scale community wind farms, water turbines, waste, geothermal and biomass are all briefly discussed as possible options for neighbourhood supply. The authors stress the need for the formulation of a neighbourhood energy plan, prepared by the main development agent, the local council and the dominant local energy provider, which should assess the unique needs of the particular neighbourhood and formulate the best range of solutions for its energy requirements. Their argument focuses very

[1] Defined as where the structure of the building itself acts as a collector and storer of heat.

much around the community scale of renewable energy generation, and the importance of active user participation in the renewable energy process.
The research that was conducted for this dissertation (see chapter 4) delves more deeply into how the implementation of renewable energy provision for low income housing is possible and what form this implementation is taking in South Africa.

The following section looks at what case studies were to be found in the literature, both locally and internationally.

3.4 - CASE STUDIES OF RENEWABLE ENERGY PROJECTS

3.4.1 - International Cases:

Many case studies in the available literature are international ones. They range from individual household renewable energy strategies (implemented by mainly private, wealthy individuals) to government and NGO projects for usually rural but sometimes urban low cost housing energy projects.

International case studies in renewable independent living such as those in The Independent Home, by Michael Potts, (Potts, M. 1993, 54-61) are mostly rural based examples of individuals building and running their own independent homes, although there is also some discussion of the use of alternative energy systems in communities. One example in particular, that of Paul Gipe's (of the Kern Wind Energy Association) use of wind energy in California. Gipe argues that the approximately 5000 wind turbines in the Tehachapi Pass generate enough electrical power for the residential needs of 500 000 residents of California annually, although the turbines are not used to their full potential. He argues that wind turbines are ideal for meeting community energy needs, and can be installed in small clusters, as is common in Denmark, Germany and the Netherlands. Gipe estimates that wind energy could provide 20% of the electrical needs of the United States, if government and electricity suppliers were willing to support it. The ideal energy system, he argues, would entail a hybrid wind and solar system, that would compliment each other in different seasons.

It should be taken into consideration that, as in the United States, there are particular parts of South Africa that would be most suitable for wind as a renewable energy source because they have higher wind speeds and more suitable spaces to install turbines, and

thus wind energy systems must be prioritised for low cost housing developments in these areas, which include parts of the Karoo.

Solar photovoltaic (P.V.) energy systems have been tested and implemented within numerous housing programmes around the world. The Ladakah region in northern India has, since 2002, seen the installation and distribution of 10 000 solar energy home systems and 6 000 solar lanterns. (Van den Akker, J. & Takpa, J. 2003, p54-63)This region is mountainous, making installation of conventional electrical systems difficult, and as many of the residents are below the poverty line, they are unable to bear the costs of this installation. This project is in stark contrast to the individual initiatives above, and is a important example of the application of renewable energy in low cost housing developments.

The issues of waste management and energy supply can be resolved through interesting initiatives such as the following case study. The Integrated Waste Management Board in San Francisco, California, in meeting the city's 2020 target of zero waste in landfill sites, is researching the viability of using dog waste to produce methane gas, which can power all appliances that currently run on gas (Glaisler, D. 2006, p31) This is an appropriate use for dog waste, which makes up 4% of San Francisco's residential waste, can pollute the water supply and is unsuitable for composting. The methane digester takes only two weeks to convert the waste to gas, and then this is used for energy production. This project is only at a moderately small scale, but in theory, the generation of energy from the digestion of natural wastes could occur within communities all around developing countries such as South Africa.

3.4.2 - South African Cases:

The people who are to benefit from renewable energy strategies should understand the technology, and therefore many need to be provided with information on the advantages of and the options that exist for renewable energy systems. One such source of information is the GreenHouse People's Environmental Centre (Makgetia, T. 2006, 28) established in 1999 in Joubert Park in Johannesburg. This project operates as an inner city environmental resource centre, promoting and demonstrating environmentally sound development practices. Its main projects currently include a recycling centre employing 15 local people and a hotdog and popcorn stand powered by a solar panel. More centres

such as this need to be established if renewable energy is to gain popular support and a level of social acceptance.

Fiona Macleod and Gavin Smitsdorp (Macleod, F. 2006, p 5) have built a house near Nelspruit that is ecologically and economically sensible. Not only does it use a mix of power sources including passive solar water heating, gas and electricity, but they have also built it to be cool in summer and warm in winter through careful choice of position and orientation of the house, insulation in the ceiling and under the floor and cavity walls on the western side of the house to prevent damp.

Macleod also suggests several ways to minimise electricity consumption, including: Insulating an electric geyser and switching it off when away, use of more efficient gas hot water burners stoves and ovens, solar photovoltaic panels if one can afford them, management of airflow and sunshine and use of low-wattage fluorescent bulbs.

Cape Town is the site of the primary research in this study, and thus a brief description of its energy status follows.

The population of Cape Town is approximately 3 million, with 800 000 households, 40% percent of which are medium to high income and 60% of which are low-income households. Residential consumption of electricity in Cape Town is 14% of the total consumption. About 2% of households on formal sites are unelectrified, with the majority of unelectrified households being in informal settlements. Multiple fuels are used for different energy uses in most low income households, even those that have been electrified. The most common energy consumed after electricity is paraffin.(Winkler, H. Borchers et al. 2006. pg 29)

The city of Cape Town imports most of its power from coal fired power stations outside the city, with the local coal fired power station, Athlone, and the Koeberg nuclear power station providing a small proportion, and hydro generation also making a small contribution. (Winkler, H. Borchers et al. 2006. pg 31-2)

The Cape Town Energy Strategy policy has recommended the following policy interventions for the city that relate to this study: The residential implementation of:

- Solar water heaters – a 10 % penetration rate by 2010 and 15% by 2020
- Installation of ceilings – to reduce the need for space heating
- A comprehensive shift from incandescent lights to compact fluorescent lights (CFLs) – all households to shift from incandescent to CFLs by 2020.
- A target of 10% of electrical energy to be generated from renewable sources by 2020 for the city of Cape Town. (Winkler, H. Borchers et al. 2006. pg 33-4)

In order for Cape Town to avoid the expense of wind energy generation to achieve their 10% target by 2020, it is important for the city to explore the most cost effective combination of renewable energy options. (Winkler, H. Borchers et al. 2006. pg 39)

Ubushushu Bendalo

Ubushushu Bendalo is a trust established to pursue large-scale Solar Water Heater implementation in the Cape Town area and is comprised of key organisations involved in the energy sector in the City. The Trust aims to operate as an umbrella body, facilitating the implementation of solar water heater systems as well as funding, coordination, and providing expertise. It intends to eventually expand to energy efficiency and renewable energy implementation areas. (City of Cape Town, 2005, 17)

Kuyasa CDM Project

The City of Cape Town has subsidised the Kuyasa Low-Income Urban Housing Energy Upgrade Project, which was launched in 2002. (Pollack, M. 2003) Currently a pilot retrofit of renewable energy interventions in some of the homes has taken place. The purpose of this project is to demonstrate how energy-efficient technologies such as solar water heaters, insulated ceilings and compact fluorescent light bulbs can reduce carbon-dioxide emissions and other greenhouse gasses, and how these technologies are economically sound, can improve quality of life and have a positive effect on standards of health.

The Kuyasa project's next phase was due to start in 2006 and will retrofit 2 300 existing low-cost houses with passive energy-efficient features such as solar water heaters, insulated ceilings and energy saving light bulbs. (Pollack, M. 2003)

Oude Molen

The city of Cape Town and the Western Cape government have also initiated a comprehensive project at Oude Molen near Pinelands, 18ha site, in the form of an 'eco-suburb', where 600 homes are being constructed according to principles of sustainable living. (Merten, M. 2005) Two- and three-storey apartment buildings consisting of 600 low- and middle-income flats are part of this project, some specifically set aside for use with government housing subsidies.

The Oude Molen site is already inhabited by a community focused on 'alternative' environmentally friendly living, and home to professionals and artists, and a school, frail-care centre and organic farm already exist run by members of the community. The development will be mixed-use in nature, with workshops for crafters, retail space, a recycling centre and on-site sewerage treatment being added to the already diverse existing activities. (Merten, M. 2005)

Of importance to this study, energy requirements of Oude Molen will be minimised through efficient architectural design, and solar and gas energy supply will limit the development's dependence on the electricity grid. (Merten, M. 2005)

The renewable energy cases discussed above form a small percentage of the total projects occurring in South Africa. However, most of these projects are occurring in private middle to upper income homes, not funded by the government or donors, but by the people who own the properties. There are also several interventions occurring in rural parts of the country where it is not feasible to extend the grid.

3.5 - CONCLUSION

One of the most important conclusions to be drawn from this literature review, is the need for a smooth and effective transfer of environmental policy to housing development practice, particularly in South Africa, where the pressing need for low cost housing

delivery tends to result in the sidelining of the equally important renewable energy agenda.

The international cases show the success of large scale renewable energy interventions in California, Europe and India. In these cases, wind, solar photovoltaic and landfill gas have been successfully used to provide significant and location-appropriate renewable energy supply for residential and other uses. The scale of these interventions has also been large, which proves the possibility of the future implementation of appropriate large scale interventions in South Africa. In the San Francisco landfill gas case the project achieved two outcomes, that of reducing the dog waste and of providing energy, and was motivated by government policy. Much can be learned from cases such as these, both about creating sustainable settlements and about translating policy into practice.

The South African case studies focused on low income housing seem to be mainly situated in the Western Cape, and although, ideally this research should have a KwaZulu Natal focus, the case study analysis was forced to occur in Cape Town for this reason. This absence of local projects for renewable energy in low cost housing can itself be seen as an important statement of differing provincial priorities.

One of the most interesting cases was the GreenHouse People's Environmental Centre in Johannesburg, as this focuses on an aspect of renewable energy which is often sidelined, that of user education. If renewable energy is to be successfully implemented in South Africa, a significant amount of education and publicity needs to occur to ensure the acceptance of these new technologies particularly in low income communities.

Of the South African cases that were discussed above, the Kuyasa project is the one most relevant to the focus of this dissertation, as it is situated in a low income housing area and has already undergone a pilot. The efficacy of this pilot is discussed in chapter 4.

CHAPTER 4
RESEARCH FINDINGS

4.1 BACKGROUND

The primary research conducted for this dissertation predominantly took place in Cape Town and surrounding areas in June/July 2006, although one of the interviews was conducted in Durban in September 2006. The research, wherever possible, took the form of face to face interviews with individuals and representatives of organisations involved in renewable energy projects for low cost housing. The focus was on the experiences of professionals in this area, but one of the interviews was conducted with a community member residing in one of the projects and another with a representative from the city of Cape Town.

The aim of the research was to assess the nature and progress of renewable energy interventions for low income residential development, to explore the main drivers and funders of these interventions, and to extract some of the main problems and issues that surround these projects in Cape Town and surrounding areas.

The research findings below have been divided first into categories of respondents and then subdivided into responses to particular set questions. Where the interviews went beyond the set questions the issues have been discussed interview by interview.

The respondents were as follows:

Respondent 1- A representative from Sustainable Energy Africa, a strategic energy policy consultancy based in Tokai, near Cape Town.

Respondent 2 – A representative from AGAMA, an energy systems consultancy based at Lynedoch, near Cape Town, and also a middle income resident of a renewable energy residential development.

Respondent 3 – The Programme leader for Energy, Policy and Development at the Energy Research Centre (ERC) based at the University of Cape Town

Respondent 4 – Project Coordinator at the Sustainability Institute, in Lynedoch, near Cape Town.

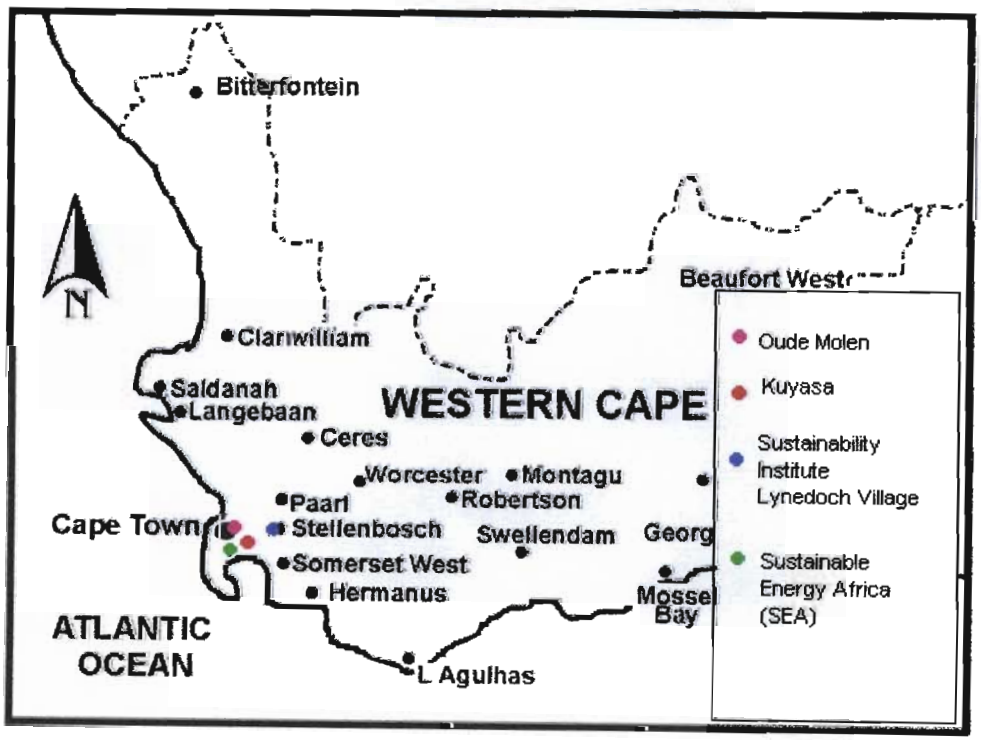
Respondent 5 – Managing Director of AGAMA Energy, in Lynedoch, near Cape Town.

Respondent 6 – Independent Architect and academic specializing in renewable energy systems and sustainable building based in Durban.

Respondent 7 – A resident of Oude Molen, one of the renewable energy sites in the planning stages.

Respondent 8 - Representative from the City of Cape Town's Environmental Resource Management Department

Fig. 1 – Contextual Map showing locations of Case Studies



4.2 FINDINGS

4.2.1 Observations

When in Cape Town conducting interviews I observed renewable energy interventions at the Lynedoch Village and at the buildings of both the Sustainability Institute and Sustainable Energy Africa (SEA).

Sustainable Offices

Both the Sustainability Institute and S.E.A. buildings provide proof of the success of energy efficient design. Oriented north, they make extensive use of natural light, thus requiring fewer light fittings, with those they have being energy efficient. Solar photovoltaic panels provide a good proportion of the electricity supply in both buildings which are designed with optimal yet cost effective insulation.

Despite the energy saving and renewable energy focus in the buildings, they have also been designed as aesthetically pleasing spaces, and not beyond the budget of a standard office building.

These buildings were not only designed with renewable energy and sustainability interventions integrated, but also each contain resource centres displaying pictures and information on these and other renewable energy, waste and water saving interventions. This information, often detailed and practically applicable, is freely available for individuals wanting to install their own systems.

Fig. 2 **Fig. 3**

The buildings for The Sustainability Institute (left) and Sustainable Energy Africa (right), both designed for energy efficiency and making use of renewable energy interventions

Lynedoch Village

The Lynedoch development, while only having 12 houses erected, and some of these in the last stages of completion, is nevertheless an informative case to have observed for the purposes of this research. The village is situated adjacent to the Sustainability Institute and approximately 500m from Lynedoch train station, two stops from Stellenbosch, just over an hour by train from Cape Town. It is also close to the main road between Cape Town and Stellenbosch making it well connected to two urban centres.

The biogas digester at Lynedoch was particularly useful from a research point of view, as I had never observed one before, only reading about them in the literature. A signboard describing the construction and functioning of biogas digesters had been erected nearby, and was highly informative. Unfortunately, the biogas digester was not in use, as the houses it served were unoccupied, and respondent 2 admitted that although it should have been installed in the main sewerage treatment system of the development, thus serving all the houses, this is not currently the case.

Fig. 4 **Fig. 5**

The waste receptacle (left) and the gas outlet (right) of the Lynedoch Biogas Digester

The exterior of the low income houses in the Lynedoch Village displayed the solar water heaters very clearly, however, in the photographs, it is clear that orientation of buildings was not fully considered in the design and layout, as many of the heaters have had to be erected on structures that orient them correctly, rather than directly on the roofs.

Fig. 6

Fig. 7

Some of the semi-detached energy efficient houses for low income residents at the Lynedoch Village

It is also clear from the photographs above that many of the houses are semi-detached and double storey, thus furthering the dual aim of aesthetic variation and increased density. This shows that low income dwelling need not be monotonous rows of identical single storey 30m² boxes.

Fig. 8

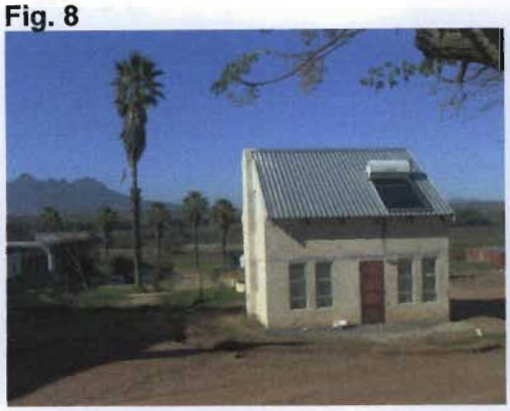


Fig. 9

Another low- income house (left) and the only middle-income house (right) at Lynedoch

The one middle-income house in the development differs only slightly from the others in its thatched roof and almost Cape Dutch style, but otherwise shows the same energy interventions.

The interior of the one semi-detached house still being completed is small and simple but pleasant. There are two bedrooms, one bathroom, a kitchen area, living area and a loft room, and most of the rooms were warm and light when I was in them despite the cool winter weather. The insulation in the ceiling is evident in Fig. 11 below.

Fig. 10

Fig. 11

Interior of one of the houses at Lynedoch, with the living area (left) and the loft room and insulated ceiling (right)

Some of the houses have built-in garages, obviously anticipating current or future car use by residents, although some of the residents I encountered in the village were still using a donkey and cart to move wood. The residents in the village are mainly retrenched workers and their families from surrounding farms.

Fig. 12

Residents at Lynedoch village using a donkey cart to transport wood

Oude Molen

Although I made a site visit to Oude Molen, the project is only in the planning stages and there was not much to see. I was able to examine the preliminary conceptual plans by the firm contracted to produce them, but was refused access on the basis of the

sensitive nature of the material. The design and layout of the housing is subject to change from the preliminary plans, and it will be interesting to see them when they are complete to assess to what extent renewable energy interventions have been incorporated.

It was evident from my visit to Oude Molen, however, that many of the residents, whether residing legally or illegally in the development, have made an attempt to engage in sustainable lifestyles. There are many vegetable gardens, some of which are communal, and there are a few renewable energy interventions such as makeshift solar water heaters, initiated by those residents with a little more money.

Respondent 7 lives in the Oude Molen Village in a 2 roomed shack with her 3 children and mother who suffers from a mental disorder and needs care. The shack is in a poor condition, has no ceiling and there are large gaps between the walls and the roof through which the elements enter. There is no toilet in the shack, only a toilet outside which respondent 7 has had to construct a shelter for. Electricity and water are connected illegally and shared between her and her neighbour. There is no geyser and water is heated in a kettle. Because this connection is overloaded it often trips and to reconnect power respondent 7 has to go next door. This happened while I was interviewing her.

Respondent 7 has her own vegetable garden and fish pond, but is by no means feeding herself and her family from the garden, and works part time as a children's entertainer to secure some income.

General Observations

I noticed that in Cape Town, on middle and upper income homes, there seem to be a far higher percentage of solar water heaters and photovoltaic panels than is evident in Durban. These percentages are not backed up by statistical evidence, but a possible reason for this comparatively high use of renewable energy for domestic applications may be a reaction to the power outages experienced in the Western Cape in 2005. Still, there appear to be problems with demand side management, and being in Cape Town during winter, when domestic electricity consumption is highest, I noticed a high level of

energy use awareness among the people I encountered, and a large number of media warnings to reduce domestic energy use.

I find this to be a strange consideration since the industrial sector is a far greater user of energy than the domestic sector, and reductions in energy use combined with more renewable energy technologies in the former area would go a lot further to preventing power outages in winter.

4.2.2 Respondent Category 1 - Interviews with renewable energy project leaders:
The interviews with renewable energy project leaders have been presented according to the question posed, as this is the most useful format for the later comparison and analysis of the responses.

4.2.2.1 Question 1
Kinds of renewable energy systems or strategies promoted or installed in low income housing by the organisation and the communities in which this is occurring.

Respondent 1: The organisation is a strategic energy policy consultancy so they are not directly involved in projects at the moment, although they used to be involved directly with communities, are now focusing on "strategy and capacity building...developers will come to us and ask us what should they do"
Their involvement in strategy includes work with the City of Cape Town Energy Strategy, and in this document, there is a section on residential, and specifically on low income households.

Respondent 2: This organisation (AGAMA) has moved from energy consulting to the supply of energy services, tackling issues such as provision and billing for hot water, warm homes in winter and cool homes in summer, an Liquid Petroleum Gas (LPG) gas cooking.

They have been contracted by the Sustainability Institute to work on the Lynedoch pilot project, a mixed income and racial eco-village with a sustainable focus including renewable energy. It has reached the stage where the low cost homes in the development (11 out of 42 in total) have been built and the residents have taken

occupation, which took place between March and July 2006. The development includes renewable energy aspects such as solar water heaters, LPG gas cooking, and energy efficiency compact fluorescent light bulbs.

AGAMA is trying to package these energy services in a complete system in an attempt to reduce the cost of the renewable energy technology (or at least manage it) for the benefit of the low income residents. "...the capital cost of all of the renewable energy technology is the big problem. If you can overcome that, then you're ok, because if you look at the cost over 20 years, or 10 years, even, you'll find that using your solar water heater is actually cheaper than the electric heater."

AGAMA has attempted to reduce costs by attempting to find financing for the solar water heaters and then charge for the water itself, or the energy service itself, in order to move "...closer to the actual energy services: hot water, cooked food, a house at 21 degrees Celsius" They have implemented pre-paid electricity meters in the homes, and inflating Eskom's tariff to cover the equipment costs. Respondent 2 argues that this is not ideal solution, but part of the process he is involved with includes finding better ways of managing this process.

A major impediment to energy efficiency has emerged with the construction of the Lynedoch first phase of development, in that "the houses themselves aren't energy efficient." The houses were built with unfired adobe brick, which is a sustainable material, but the thermal properties of the walls are very inefficient, being "a single layer of adobe so there's no cavity, and from experience... it's a fridge in winter."

Respondent 2 also relates that the size and orientation of the plots is a problem in ensuring energy efficiency, as they are not north facing. He argues that the problem occurred in the planning stage of development 3-4 years before, and that "it would be crucial for these kinds of issues to be a part of the planning process"

Respondent 3: The Energy Research Centre, being a university based research centre, is more involved with policy than project implementation, however Respondent 3 explained that they advise on implementation and that they are also involved in looking for and promoting renewable energy systems, including "solar home systems...biodiesel,

[and] we're looking at solar water heaters" He argues that there is a lot of potential for job creation in renewable technologies "especially the biodiesel and solar water heaters".

The Energy Research Centre (ERC) has set up solar home photovoltaic systems, and is involved in the monitoring and evaluation of these systems. This project has been commissioned by the government, and involves the ERC monitoring and evaluating two out of five concessionaires, which are "those companies that have been allocated certain areas or parts of the country... remote rural areas, and... are responsible for the distribution, maintenance of these solar systems."
These two are located in KwaZulu Natal and the Eastern Cape, with the former being moderately successful and the latter not functional.

Respondent 4: The Sustainability Institute was involved specifically with Oude Molen. This is a project specifically driven by the City of Cape Town, and suffers from "significant challenges that are both historical and site specific." One of the major challenges has been conflict, both within the community and between the community and the City.
The Oude Molen site is "owned by the city and essentially linked to the old Valkenberg mental hospital", however many tenants have moved in, and the city has not effectively delivered services , and the residents responded by not paying. There are, additionally, "a number of illegal residents who have capitalized on that and have moved onto the site, but, having said that... there's a strong sense of community."

Respondent 4 argues that there are problems with some inhabitants acting as land barons and taking advantage of the current instability surrounding the site. These individuals are acting as "gatekeepers who are trying to control it, mobilizing things, trying to undermine, [and making] accusations of intimidation."

In order to negotiate these problems, certain social processes have occurred. Respondent 4 explains that, at the time of the interview, agreements had just been made and leases were about to be issued by the city. He argued that the outstanding rental payments had also been successfully negotiated, and that the city of Cape Town is about to issue legally binding leases.

Respondent 4 explained that the project had reached the stage where interventions were viable. A number of drawings in the form of spatial plans were completed by Mokeka Design Laboratory, not detailing very much, but with some suggestions of energy activities and interventions and an overview of the way the site would look. The renewable energy aspect has not yet been clearly formulated, but technologies such as electricity generation from photovoltaic, solar water heaters, north orientation of new buildings and a possible use of biogas digesters because of the urban agriculture aspect of the project. Wind generation would be limited because of space constraints, but the site may become a user of electricity produced by Cape Town wind generation. One of the major objectives of the project is to "have as few as possible inputs coming in, but virtually no inputs leaving the site."

The very new technology of photo voltaic (PV) cells embedded in roof tiles, and added to homes in the construction phase have been considered as an option to test in the Oude Molen site. Respondent 4 argues that this is a South African made technology, exclusive to one S.A. based company (Lomotech), making it appropriate to use in a project with a sustainability focus.

Eskom has shown an interest in supporting this initiative, with the thinking that a standard low income house "...if they had a solar hot water system, and were not using an electric stove, would probably generate from their roof system... on the average, probably one and a half times the amount of energy required by that house." This is regardless of orientation and based on having these tiles on the entire roof, and the energy would be fed back into the grid, and "any housing development could become a net generator of energy, and negate the need for additional power stations." Respondent 4 argues that this project would make financial sense to Eskom, and ensure a renewable supply of energy to the Oude Molen residents, although the process of implementing this technology will probably take two or three years.

Challenges with the Oude Molen site include the incorrect orientation of many of the existing historic buildings, but Respondent 4 is hopeful that the city of Cape Town will release funding to allow for "a more intense investigation into ...the best possible options."

The Sustainability Institute is also deeply involved in the Lynedoch development, but this was not discussed as it had been part of interview 2.

Philipi is another project in which the Sustainability Institute (SI) was involved. Respondent 4 argues that this is a unique case as it is an existing factory with huge silos on site. "One of the ideas was to utilize the large silos ... as a pump storage system." This would mean that energy that was generated during the day would possibly be able to be stored for demand side management. The feasibility of this project has not been calculated, but the site remains interesting because of its location in the centre of a very low cost area giving the developers an opportunity to use it as a showcase of best practice.

This is an important issue for the SI, as "quite often, communities are inclined to feel they're getting a second class product, they're not being given the normal plug-in to electricity." The Philipi project might act to showcase the benefits of renewable energy technologies and inspire a measure of aspiration and acceptance for communities, and a desire to replicate this project.

The Sustainability Institute has followed this principle before, when setting up their own building and the Lynedoch development, which received some funding from the neighbouring Spier wine farm. A clubhouse for a tennis match between Anna Kornakova and Amanda Coetzer was built at Spier with the same technologies that were to be applied at Lynedoch. Once it was an accepted project at Spier it was applied at Lynedoch. Respondent 4 argues that "we try to use that in our roll-out in a lot of the new technologies. Put it in governmental buildings, in signature projects and things like that... so its seen as something that is good enough for the best project in the community". The theory is that this results in increased buy-in and acceptance of renewable energy technologies.

Professor Swilling developed this concept based on research conducted in Cape Town which found that "the intervention of sustainability is not only about reducing the ecological footprint, but it's also about finding ways to increase the footprint of those in poverty." Respondent 4 argues that although this is a contradiction it works to increase the service balance between the wealthy and the poor in a sustainable way.

The other project that Respondent 4 is directly involved in is the Sustainable Communities Pilot in Grabow, one of six sites around the country, some rural and some urban. This pilot has led to the development of 3 models, an urban model, a rural-urban model and a scattered rural settlement model. All of these sites have waste removal and sanitation problems, and the project leaders are discussing the application of technologies such as biogas digesters and localized waste treatment plants. One of the major objectives is "how to protect, really very poor residents against the shocks that will emerge from the increase in costs of resources."

Investigation of the Grabow site has uncovered that the very poor living in large households are "sometimes only using electricity for 5 days of the month." This may be because of the large size of households or the way energy is used, but as they are only using the portion of electricity that is subsidized, the installation and infrastructure costs are not being covered. This brings up the issue of the economic viability of this provision for Eskom, "and the conflict between that and meeting political goals." Respondent 4 argues that this makes the investigation of renewable energy streams for these sites a potentially cost effective and viable alternative.

In the Grabow site wealthy sites will be created with an increased rate base to cross-subsidize poorer residents. Wealthy residents will be subject to "strict zoning and by-law conditions relating to sustainable initiatives", including paying for any extra electricity capacity installation, with only the bare minimum supplied and renewable technology mandatory. Substantial wind flow exists, so wind energy options are also being investigated. Overloaded sewerage systems can benefit from biogas generation possibly "owned by a separate company that sells the energy that they create back to the municipality to run all the municipal services, such as street lights."

Respondent 4 also explains that sites such as ba Palaborwa, where the town of Palaborwa and 3 other settlements are about 10 kilometers from each other, suffer from over-extended infrastructure systems, making the provision of extensions very costly, and because of the distances these services can't be run by a single infrastructure provider. The idea of a thermal energy system is in discussion, suitable "because it's fairly overcast in the lowveldt, but its very hot...you're looking at an agricultural based

greenhouse idea" that can be used in the existing mine which will be closing fairly soon, and which has long chimneys suitable for retrofitting.

Respondent 4 made the point that "the social process is a key element in the... roll-out, and the acceptance and the use of it." He used the example of the non-occupation of the N2 Gateway, due partly to a lack of engagement with social processes. He stressed the need for communities to establish what they need, and to be part of the implementation for a project to be successful. "There is a paradigm to do with delivery which is starting to show its flaws. And the kind of social consequences of that are... going to be quite a challenge."

Respondent 5: This interview dealt specifically with Kuyasa, in Khayalietsha, an RDP type housing development of 2309 houses of 30 meters squared. The Project was based on a 10 household pilot, which the organisation "equipped with solar water heaters, with insulated ceilings and with lamps, and which were monitored together with the adjacent 10 houses" which didn't have these interventions. This was done in order to quantify the benefits of renewable energy interventions, and measure the "actual temperature differences in houses with a ceiling, and a water heater and so on." This is a validated methodology for calculating the benefits of these interventions, which went together with a socio-economic study on residents responses to the technology.

Respondent 5 explained that Kuyasa a retrofit of existing low income houses, limiting the renewable energy services they could be fitted with. However, he argued that this is an important case, as there are many existing houses that should be retrofitted. The nature of the project means that is "increasing access to energy services, and at the same time providing that increased access in a way which addresses or acknowledges the energy dimensions of climate change." Both of the above issues are important in a broad context, as they were identified as "millennium development goals in terms of access and poverty ... and in terms of the environmental impacts of energy."

The Kuyasa project is characterised by 3 interventions: solar water heaters, thermally insulated ceilings, and energy efficient lamps. Respondent 5 explains that these interventions have been quantified to mean energy savings to the householder of a few hundred rand a year, and as it is possibly the largest implementation of renewable

energy strategies to date, with 2309 households, the impact will be significant. The current status is that "the project now needs to be implemented for the remaining 2299 houses. And that's at the stage of the business plan being developed by us with money from DEET."

The Kuyasa project has been approved, but full funding has not yet been secured, and there is some discussion as to who (householders, local or national government or climate change funding) should bear the costs and how this should happen.
Respondent 5 discussed the differences between a Greenfield housing development where "the critical issues of urban design and site layout, and orientation of buildings, and materials of construction, and... fenestration" could be addressed, and the Kuyasa project, where house orientation is different, meaning that they are able to use the 10 pilot houses to "show the difference between 2 houses of exactly the same floor plan and window layout" where one is facing north and the other south. These issues are potentially beneficial for policy formation, but need to be translated from their current form to one that can be used for policy making.

Philipi is an approximately 11ha site in Cape Town being promoted as a sustainable neighbourhood and aimed at the gap market, which respondent 5 defines as "people who just don't qualify for housing subsidies and can't get into the market."
It is situated at the site of a disused cement factory and will be upgraded to have 4 kinds of facilities. These include about 350 middle income bond-financed housing units, run as "a sustainable commercial development". Urban agriculture, commercial office accommodation, and "a seriously large shed, 30 meters wide, 30 meters high and 200 meters long" which may become cinemas and gyms.

The types of renewable energy technology have not been finalised because of the uncertainty of funding and respondent 5 identified the problem of the percentage that should be borne by households versus by the service provider.

Another Project that Respondent 5 is involved with is Lwandle "essentially a hostels to homes conversion project which was implemented in '96/'97". In this project the households made the decision to acquire solar water heating with a portion of their pooled housing subsidy. Lwandle was a hostel catering for migrant workers and over

time was occupied by about 1000 low income families who "employed a project manager and a consulting engineer" to oversee the provision of infrastructure and the construction, conversion and refurbishment of buildings.

Some advisors from SEED were involved in facilitating the process, and the community made a decision to allocate a portion of their housing subsidies, "then money was borrowed from the development bank, by the local authority...with the loan [being] repaid by a fixed [amount] in their rent." Despite the Respondent's initial suggestion that the money should be paid for on a fee for service basis, the residents have been successfully sharing the communal hot water showers even though hot water is limited, and they are paying a fixed fee. Respondent 5 described the Lwandle project as "the biggest solar water heating project in South Africa by a long chalk."

The project has also been successful for around 10 years, which is surprising because of the fact that the hot water is shared, and because the residents decided against connecting up a backup electrical water heating system. This means that although the geysers have elements built in to them, they haven't been used, and "very interestingly, people are happy with the fact that on some days in winter they're not going to get hot water. And I think that's really interesting too, that people often talk about this kind of issue of is it reliable, and what happens if the sun doesn't shine and whatever. And I think its actually an overstated... kind of issue... We all know, when the sun doesn't shine we're not going to have hot water, and by the way, that's completely fine then. Then you do something else."

Respondent 5 argues that this situation is predictable in its unpredictability, unlike during the power blackouts in the Western Cape in December 2005, where households, workplaces and industry were so reliant on grid electricity that blackouts meant that the whole economy came to a standstill.
The Lwandle example is an interesting case study to learn from and improve on "because its kind of 95% or 80% working... socially and technically."

Funding may not be a major problem either, since the Development Bank provided funding very easily even though they were not entirely aware that they were funding a significant solar water heating project.

Respondent 6: As an architect working on designing renewable energy for housing, interviewee 6 argued that the most important energy interventions he is involved in are orientation, passive heating and insulated ceilings. He aims for 60% of all buildings in the projects he designs to be north facing, "because it's not even a consideration in town planning schemes now, passive heating."

Respondent 6 observed while teaching in Pretoria that tin houses in Shoshonguwe are so energy inefficient that at the coldest times of day it is colder inside the house than outside, leading to a high level of chest problems among residents. He argues that this comes from "silo thinking, that housing is just housing, and health is just health and education is just education" and these issues are not addressed in an integrated and holistic way. Linked to this is the reluctance of government departments such as the Department of Housing to consider life-cycle costs, and rather focus on initial costs, meaning they will be reluctant to spend an additional 12%.

In the case of the upliftment of Nduma School, a nearby well had a solar panel and water tank placed above it, solar panels pumped water into the tank and all over the school, and "there was a solar heater for heating the water, and there was light for the teachers to wash." However, these were all stolen within 2 weeks, and the funder refused to replace the intervention, with the argument that "the community must know where it is." The result was that the school had no water, heat and light for about 16 years.

Synthesis of Question 1

Both respondent 1 and 3 work for organisations that are more involved with policy than project implementation. Respondent 1's organisation, Sustainable Energy Africa is involved with strategy, capacity building and advising the government and developers on renewable energy options. Their involvement has extended to the City of Cape Town's Energy Strategy. Respondent 3's organisation, the Energy Research Centre advise as far as implementation is concerned, and are also involved in researching and promoting renewable energy systems. These include solar home systems, solar water heaters, biodiesel, and solar home photovoltaic systems, and the ERC is involved in the monitoring and evaluation of these systems.

Respondents 2 and 5 work for AGAMA, which has moved from a position of energy advising and consulting to the supply of energy services for residential and commercial applications. Respondent 2 described these as including solar water heaters, LPG gas cooking, and energy efficiency measures such as compact fluorescent light bulbs. AGAMA is also in the process of trying to package these interventions as a bundle of energy services. Respondent 5 discussed Kuyasa, which was a retrofit project with solar water heaters, thermally insulated ceilings and more energy efficient lamps to replace incandescent lamps. Lwandle, an earlier project, was a hostels to homes conversion, and the biggest solar water heating project in South Africa.

Respondent 4's organisation, the Sustainability Institute, works with technologies such as photovoltaic, solar water heaters, north orientation of new buildings and use of biogas digesters. It is also exploring the very new technology of pv cells embedded in roof tiles, and have considered these as an option in the Oude Molen project. In the Philipi project they are investigating the use of a pump storage system, where energy that was generated during the day would be able to be stored for demand side management. They adhere to the principle of installing renewable energy interventions in government buildings and high profile signature projects so they are seen as desirable, which theoretically increases buy-in and acceptance by poorer communities. In Grabow, as with other projects, wealthy sites have been created, and rates are increased to cross-subsidize renewable energy interventions for the poor. Strict zoning and by-law conditions relating to sustainable initiatives are also enforced.

The Sustainability Institute are also investigating wind energy options, and have found that overloaded sewerage systems can benefit from biogas generation which could be used to run municipal services, such as street lights. In Palaborwa the use of a thermal energy system is in discussion, suitable for overcast and hot conditions.

Respondent 6 works mainly with orientation, passive heating and insulated ceilings.
The most common interventions among the respondents are solar water heaters, insulated ceilings, CFLs, and orientation/passive heating.

4.2.2.2 – Question 2

Community access to renewable energy pilot projects

Respondent 1:

Respondent 1 explained that he thinks of the issue of access in relation to each particular intervention which has its own set of barriers and need particular approaches, and that efficient lighting, solar water heaters, ceilings, hot boxes, and efficient cookers are all different from each other. He argues that the energy efficient building aspect is the most important for broad community access. An approach of Sustainable Energy Africa is to "focus on middle and high income... They are the big consumers, really. And they've also got the money to invest in something which will pay itself back", whereas poorer households have more difficulty in coming up with the capital costs.

Respondent 1 explains that low income interventions including the one at Kuyasa are informative but not self sustaining, because they have access to various support systems. It is much easier to give communities access when it is economically self-supporting.

Respondent 2: Lynedoch is making use of a homeowners association to manage municipal functions such as waste processing on site. They have a grid electricity connection and don't collect much of their own water, but all houses use a dual water supply of clean water for drinking and grey water to flush toilets. There is a degree of engagement with the Stellenbosch Municipality with regards to rates negotiations. Respondent 2 argues that the issue of "paying rates, and paying for the services that you need versus those that you don't need" has come up as one of the main discussion points. So far the negotiation is at the stage where the municipality has some functions, but may "employ the homeowner's association as the people who actually do things on site."

Planning processes in Lynedoch have contributed to the problem of poor site layout, because zoning regulations demanded the upfront zoning of between 100-150 sites, even though the intention was only to have 42 plots. The zoning and poor layout were originally done for a low income housing development "to accommodate people who were being shoved off the farms... Lynedoch development realized this, but ... to go

through the whole planning process again, and then to re-orientate the sites, just would have been far too much, so we're left with this legacy of poor layout. "

Respondent 3:The members of the households don't own the solar systems installed for them by the concessionaires who are also responsible for maintenance. The households pay a monthly "fee for service and system... [and] government pays the concessionaire R3500 [per household] as a once-off payment for the installation of the solar system."

Because of the remote rural nature of most of these projects, traditional land tenure is also a major factor in who has access to the solar systems, as when the land belongs to a tribe, the chief becomes the allocater of land. These projects are justified for rural areas where it is seen as too costly to extend the grid, not in urban areas where between 80-85% of households are electrified.

Respondent 4: In Oude Molen the current residents and new ones will benefit from the renewable energy interventions. One of the conditions of the upgrade is that low cost residents will be included as the site is in a central position and this is "part of meeting national... densification and integration requirement concepts."
The poor will deliberately be involved.

Respondent 5: In Kuyasa part of the selection criteria was that it was a "newly developed area in Khayalietsha, and I have an idea it was selected by the city of Cape Town themselves."

Respondent 6: Respondent 6 argued that in general, poor communities do not have access to renewable energy technologies or even passive heating strategies, despite recommendations having been made to the housing board.

Synthesis of Question 2

All respondents answered this question differently.
Respondent 1 explained that people's access to these technologies is dependant on in the context of each particular intervention which has its own set of barriers and appropriate approaches.

Respondent 2 - Lynedoch is making use of a homeowners association to manage municipal functions, and that current residents are low income recipients of the housing subsidy.

In respondent 3's project households pay a monthly amount for service and system, while government pays the service provider R3500 per household as a once-off installation payment. Traditional land tenure systems affect rural peoples access to renewable energy interventions. Renewable energy projects are only justified for rural areas where it is seen as too costly to extend the grid.

In Oude Molen respondent 4 explained that current residents have first choice on condition that the City of Cape Town can provide homes for low cost residents in the village.

Respondent 5 indicated that Kuyasa was selected as an already existing residential site for the intervention by the city of Cape Town.

Respondent 6 reacted to the question by stating that poor communities do not usually have any access to renewable energy technologies or even passive heating strategies.

The renewable energy interventions being conducted by the respondents all have different ways of including people in them. However, a general trend seems to be a measure of government intervention in deciding which communities have access.

4.2.2.3- Question 3

Source of funding for renewable energy interventions

Respondent 1: In the Western Cape the housing subsidy has been increased to support the inclusion of a ceiling, however, this was motivated by health reasons, specifically to lower the incidences of TB in the Western Cape's cold and damp winters.

This is a positive step, however, as "a ceiling changes energy efficiency hugely."
Respondent 1 argues that funding for additional renewable energy of efficiency interventions are unlikely to come from the housing subsidy, despite strong economic

arguments in favour of them. This may be because the housing department would rather build more houses than spend more money per house, adopting a short rather than long term view.

Respondent 2: The developers of Lynedoch are Lynedoch Development, with a portion of the funding coming from Spier, who accessed funding from the skills development levy, "so whilst they were building they ran a kind of a learnership... the workers were actually learners, and hence funds from the skills development levy could be used to pay the workers [although] I think questions can be asked about the quality of the learning programme." What this means is that the project is not financially replicable. The motivation was partly political on the part of the Sustainability Institute, who run a masters programme and needed a visible case.

Respondent 2 argues that despite the problems Professor Mark Swilling, one of the people behind Lynedoch "will admit that ...its not a failure, because... you've got 11 families who lived in tiny little houses" and who now live in far better homes. Respondent 2 also argues that it provided several good learning points, although he believes that more time should have been spent making the project work before moving on to new projects, which is what happened. "it probably would have been better to take a step back, take things a little bit slower, and really make this place work."
The government is not involved in funding this project.

Respondent 3: Respondent 3 argues that the government is more eager provide funding for rural rather than urban renewable energy projects due to the cost of extending the grid. This strategy is "part of the government's national electrification programme... which was started in the early '90's," and funded from the national electricity fund. The only solar systems that receive funding from this programme are off-grid systems, and some of these receive funding from GTZ (the German Development Bank) and some from private firms, making it a public/private sector partnership.

The Energy Research Centre "advised government on the national electrification programme" as well as evaluating and making recommendations on it. The ERC was particularly influential in the formation of the free basic electricity policy (Electricity Basic Services Support Tariff), which ensured that the poor would not only have an electricity

connection, but also be able to afford to use it. This is "where government gives each poor household that qualifies for it 50 kilowatt hours free per month."

The ERC were also involved "the piloting of this free basic electricity (FBE) in KwaZulu Natal, in the Eastern Cape and in the Free State" and made feasibility recommendations to government. These stated that FBE was feasible while government is able to afford it, no time frame has been calculated for this or for the length of the FBE policy. The theory is that as the economy grows, and people's living standard improves, they will use more than the 150 kilowatt hours per month that qualifies them for FBE, and the government will pay for less and less subsidized electricity.

The interesting thing about the FBE, argues respondent 3, is that, in theory, it may be used to reward users of renewable energy of all income groups as long as they can prove use of less than 150 kilowatt hours per month. "its possible, if you can reduce your electricity use to a level below 150, then you can qualify" for FBE.

Respondent 4: Oude Molen receives external funding as well as funding from the City of Cape Town. One of the possible funders coming through is the Moore Foundation, which has allocated large amounts to "looking at sustainable and renewable energy in cities in the developing world". Of the 2 locations in Africa, Dar es Salaam is confirmed, and Cape Town is still to be confirmed. This is the same foundation which advised California's implementation of "the million solar homes."
There are also other types of funding such as funding from the Clean Development Mechanism (CDM) and Tradable Renewable Electricity Coupons (TRECs).

The Development Bank is another potential funder for sustainable communities pilots and possibly "the municipal infrastructure grant and the provincial infrastructure grant."

Funding comes from various levels of government, however the funding takes a long time to access. The Development Bank has had a change in mandate and are providing the bridging finance until the government funding is released "and then [the DBSA] re-coup the money " from the correct source.

Cross-subsidisation, is a funding model where the wealthy in a sustainable/renewable energy development essentially support the intervention costs of the poorer residents and is what has "happened here at Lynedoch, ...in Franschoek, and ...in Grabow." The bridging finance is often all that is needed, just to get the development up and running.

Respondent 5: The funding for the Kuyasa intervention has not yet been secured, but Respondent 5 is confident that it will be found with the right amount of prioritization. He argues that: "it's a bit like the decision on smoking in this country. At some point, somebody just said on some day we're just going to have a law to ban smoking... people didn't even think it was possible, they thought it was crazy and not viable... I just think its political will."

A portion of the funding may come from DEET, although those funds are allocated for poverty alleviation and they are unsure of meeting all the criteria. Respondent 5 argues, however, that there is a provisional idea that some of the costs should be borne by the residents. "There's a notional idea that they'll each contribute R500 somehow", but it isn't clear if this will be an initial or recurrent cost.

Respondent 5 argues that there should be an amount in the housing subsidy set aside for renewable energy and energy efficient interventions. The argument for serious infrastructure investments is supported by the case of post-war Europe, where "the world bank effectively financed rural electrification". This was the result of a government decision that economic growth demands electricity, and "it might be appropriate for the South African government to say, at some point, people need a basic level of hot water." A capital subsidy would then be provided for solar heating, absolving the household of a portion of recurrent costs, and providing "better health, better hygiene and ...better quality of life."

Respondent 6: Respondent 6 argues that funding for renewable energy and energy efficient interventions are "actually cheap at the price" compared to the cost of not doing them. There are also cheap interventions such as cardboard box or egg crate ceiling insulation.

He was involved in a survey in 2002 of all housing in South Africa, and found that "only 6% of the new, state houses had ceilings." In areas that have cold winter temperatures this means a significantly lower temperature.

A development outside Mooi River, has houses built on steel frames manufactured in Durban, thereby not contributing to local skills development, and which don't even have the capacity for ceiling installation. This exposes some of the problems within housing policy.

Respondent 6 argues that not only should a portion of housing subsidies be used for energy efficient strategies, but if the design of the house doesn't fit energy efficient specifications, then it shouldn't get funding. He believes this is the best way to ensure sustainability compliance.

Synthesis of Question 3

Respondent 1 reported that in the Western Cape the housing subsidy has been increased to include a ceiling, but no other renewable energy interventions.

Respondent 2 explained that the Lynedoch Village was funded primarily by Lynedoch Development, with a portion of the funding coming from Spier through accessing skills development levy funds.

Respondent 3 named the most significant funders for renewable energy as the government's national electrification programme, the German Development Bank (GTZ) and the Electricity Basic Services Support Tariff.

Respondent 4 explained that Oude Molen receives funding from the City of Cape Town, funding from CDM and tradable renewable electricity coupons (TRECs). Potential funders include the Moore Foundation, the Development Bank and possibly the municipal infrastructure grant and the provincial infrastructure grant. The funding that comes from various levels of government takes a long time to access, so an option is cross-subsidisation, a funding model where the wealthy in a sustainable/renewable energy development support the intervention costs of the poorer residents.

Respondent 5 explained that funding for the Kuyasa intervention has not yet been secure, but a portion of the funding may come from DEET and there is a provisional idea that some of the costs may be borne by the residents. He argues that there should be an amount in the housing subsidy set aside for renewable energy and energy efficient interventions.

Respondent 6 argued that funding could come from residents or government as cheap interventions such as cardboard box or egg crate ceiling insulation exist, and not only should a portion of housing subsidies be used for energy efficient strategies, but if the design of the house doesn't fit energy efficient specifications, then it shouldn't get funding.

The general consensus seems to be that funding is most likely to come from government departments or large international funding organisations. However, the funding from government is limited and slow to process, and interventions are often required from institutions such as the Development Bank to speed these processes up. Other funding options for renewable energy interventions that are often under utilised include local big businesses and the residents themselves, whether this be directly from all residents, or cross-subsidised from wealthier residents.

4.2.2.4 – Question 4

The most appropriate or effective form of renewable energy provision for low cost housing

Respondent 1 : Respondent 1 answered that solar water heaters were second most economically viable, but preceded by general house efficiency which "starts with building the houses... so they don't need as much heating and cooling... Must put in a ceiling as a part of that package." This is an intervention beginning to occur in Cape Town, but nowhere else in South Africa.

He stresses that the real difference with solar water heating occurs in middle/high income households, where it pays itself back over a few years, "but in a low income house you don't use as much energy to heat water... it's actually not worth it financially, so you have to approach it from another angle, a sort of welfare angle."

A calculation needs to be made as to whether it is better for low income households to install a solar water heater "and it'll have to be subsidised, or is it better for government, or Eskom... to build a big solar generation plant in Upington, and put that renewable energy into the grid?"

Respondent 2: Respondent 2 argues that in South Africa solar interventions make the most sense, because of an abundance of sunlight "whether it's solar thermal for heating water or p.v." Unfortunately the costs are currently the problem.

Respondent 2 also argues that "there's huge potential for integrating your energy with your sanitation, with biogas." Biogas can be extracted both from household waste and sewerage, making everyday waste products useful.

Respondent 3: Respondent 3 is involved in research for his PhD on the suitability of renewable energy technology for poverty alleviation, and investigating which technologies will be most appropriate for poverty alleviation. From what he has discovered so far, solar water heaters and biodiesel can help poverty alleviation through job creation and "there's a lot of potential for job creation and skills development. This makes these technologies suitable twice over, as renewable energy and as part of economic development.
Gel fuel, used in conjunction with other technologies may also have the potential to create jobs, while simultaneously being safer than paraffin.

Urban poor electrified households tend to "use electricity mostly for lighting and for entertainment... and charging cell phones". Cooking and water heating, however, are carried out using paraffin and other fuels. This is where gel fuel can step in, "and will make it ...less hazardous and will improve people's quality of life."

The energy strategy for Cape Town promotes solar water heaters, housing insulation and compact fluorescent lighting as the best energy strategies for low cost housing.

Other renewable energy technology face stiff competition with grid electricity supply, as electricity in South Africa "is probably the second cheapest in the world after New

Zealand... so that makes the entry for renewables very, very difficult." The only way to successfully implement these strategies is to have "an enabling sort of policy environment for renewables" otherwise they are "definitely not an option."

Respondent 4: Respondent 4 argues that efficient energy use is one of the most critical energy interventions, and many countries have "been able to manage the growth through efficient resource use ...and I don't think we're there yet."
He argues that the increasing introduction of renewable energy technologies will increase energy saving.
Biogas digestion is critical, "it deals with the key principle of sustainability, because it allows for the integration and mixed use in a variety of different challenges, the waste streams, agriculture" and other issues. There is a cultural barrier about cooking off it, and he projects that this will not be a primary use, rather "...heating and electricity generation through small, localized generators".

Respondent 4 argues that there are also "opportunities along the west coast ...for wind, and ...opportunities in the middle of the Karoo for solar" integration into the grid. He warns against nuclear energy, as he sees it as "far more dangerous than anything else."

He also argues for situational appropriateness of renewable energy technology in the same way that there is with materials for building. Renewable energy can be inappropriate, for example, "if you've got a huge sewerage line and its running to an under utilized sewerage plant, don't go to the expense of biogas, use it....I think its about resource use and what funds you have available to make the best intervention."

His suggestions are for solar heating and cooking and ablution facilities that are communal, meaning that houses can be larger. This idea is based on an Indian model. The cultural perceptions of biogas may also change. He argues that "in China if they hadn't used biogas ...we would already be in an ecological meltdown, not that we aren't already, but it would be far worse."

Respondent 5: Respondent 5 argues that the "very first thing is proper housing... just properly designed houses", rather than having to retrofit, as the costs of this process are very high. This design would include "proper layout of sites, proper orientation of

buildings on sites, and then proper design of the buildings, so they've got the right roof overhangs, the right number of windows in the right places, and decent materials, proper insulation in the ceilings." Good urban design and town planning are also a large part of this.

He argues that "once you've got an essentially good building, then you can talk about ...solar water heating ... and other forms of renewable energy."

Wastewater treatment, coupled with a biogas digester is another technology that Respondent 5 recommends, as it deals with a few issues simultaneously. Although existing sewerage infrastructure may be an impediment, he argues that it all comes down to proper decision making and the right political will. Once you have this, "funding will follow."

He argues that present housing and infrastructure design is "only being done [in that way] because that's how it's been done in the past", and this was inherited from more developed countries. He argues that is should just be done better, than the present course of "trying to adapt systems which are ill suited to how people earn money and how people live, and what the immediate socio-economic situation in the country is."

Respondent 6: Respondent 6 argues that one solution is to conduct "an investigation into what impacts a South facing room with a big picture window, that hits the rain and the bad weather, has on a family compared to a north facing window." The results will be very informative.
For more active interventions, he recommends woodlots, as many people still use wood for cooking, even in peri-urban areas. Although wood smoke may be polluting, "it is a renewable energy source."

Electricity control systems for public buildings are also effective, and save a lot of energy annually. However this is useless without a consideration of the amount of embodied energy contained in materials used in a house.

Respondent 6 sees biogas as a problem because "the Zulus have a total taboo about anything to do with excrement". He argues in other countries such as Ghana, villages

collect all their "sewerage and cow dung and weeds and everything" and from that manage to supply "street lighting in the whole village and cooking." However he argues that biogas also has the disadvantage of being explosive, and difficult to detect with smell.

The biggest problem, he argues are the "social hazards... poor people who can't take social risks." Renewable technologies are often seen as inappropriate or second-class. His experience with non use of solar cookers had this problem.

Respondent 6 agrees that it is important to work with upper and middle income groups, to make renewable energy more socially acceptable. He argues that he has worked on all kinds of alternative housing types including "mud buildings and cob buildings... but I've never built for [anyone] but a millionaire or an architect."

He considers this to be a serious constraint to the future of renewable energy technologies, particularly since the opportunities for them in South Africa are so great, with the extent of sunshine that occurs. "we just waste this resource all the time." Respondent 6 sees large scale solar generation as "the secret potential of this country" particularly in any settlement "that's more than 18 kilometers from the grid."

In urban areas, solar generation is suitable for providing light. "And I think light equals homework, equals education [and] extension of daylight hours." It is an application that could also be used on streetlights, and with the new embedded solar roof tiles. Interviewee 6 argues that this is beneficial because of the major problem that occurs with theft of solar panels, such as occurred in the case of Nduma School.

Synthesis of Question 4

Respondent 1 named the most appropriate interventions as general house efficiency and solar water heaters. He was unsure whether it is better for low income households to install a solar water heater or have government, or Eskom build large solar generation plants and transfer renewable energy into the grid.

Respondent 2 prioritised solar interventions and described the huge potential for integrating energy with sanitation by using biogas systems.

Respondent 3 argued that solar water heaters and biodiesel may result in poverty alleviation through job creation. He also named gel fuel, solar water heaters, housing insulation and compact fluorescent lighting as important renewable energy interventions for low income households.

Respondent 4 prioritised efficient energy use, followed by biogas digestion. He also made the case for the harnessing of wind energy in the west coast and solar generation in the middle of the Karoo, which could be integrated into the grid. Other options include solar heating and communal cooking and ablution facilities.
Respondent 5 made the case for the correct layout of sites, the proper orientation of buildings on sites, and energy efficient house design. Thereafter, solar water heating would be appropriate, as would wastewater treatment, coupled with a biogas digester.

Respondent 6 argued first for orientation followed by woodlots to cater for people using biomass. Another renewable energy intervention is electricity control systems for public buildings. He sees biogas as a problem because it is explosive. He argues that it is important to work with upper and middle income groups, and sees large scale solar generation as having great potential particularly in remote settlements. In urban areas he argues that solar generation is suitable for providing light.

The respondents mostly argued that site orientation, ceiling insulation and energy efficient house design were the priority renewable energy interventions that should be applied for low income housing. Solar water heating followed this in order of appropriateness, with biogass, CFLs and then large scale solar collection in descending order of importance. Wind generation, gel fuel and biomass were also mentioned.

4.2.2.5 – Question 5

Other issues raised by respondents when asked

Respondent 1: Respondent 1 stressed that, taking into consideration the financial and environmental aspects of renewable energy, there should be a focus on middle and high income residential development. However the problem with this is that its "very unfashionable... people wont approve projects in those areas, even if they'll actually pay

for themselves." Resources are allocated for low income interventions, even though they are more difficult to justify from an economic standpoint.
Respondent 1 sees this as a lost opportunity, and that middle and high income should not be ignored, as this is where the "biggest environmental footprint" exists, "and it's financially feasible to sort them out."

Respondent 1 suggests the introduction of various legislation for middle and upper income developments such as "a solar water heater bylaw, and an electricity bylaw, and a tariff that rises sharply above a certain consumption" level. Low income households should focus on efficiency and move on to solar water heaters.

Respondent 3: Respondent 3 also agues that the "focus needs to shift from low cost housing to medium and upper income development in terms of renewable energy strategies", because low income consumers tend to use less electricity.
In South Africa, the reduction of electricity use by high income groups will "make an impact with... carbon emissions."

In order to make a positive impact on low income households' quality of life, interventions such as insulation mean a reduction in the use of paraffin, and the use of CFL's provide "the same sort of luminosity and light and use less electricity."
Solar water heaters provide a cost saving for low income households, and are being actively promoted by many interests including the city of Cape Town, which is "working with companies to reduce the cost of solar water heaters... compared to ordinary electricity heaters."

Respondent 5: Respondent 5 argues that in implementing more sustainable energy, there should be a "focus on the service, the light... [its better to] put a window in this wall rather than put an artificial light, maybe from a wind generator."
AGAMA is more focused on "the light, or the hot coffee, not really worried about whether it came from a solar cooker"

The second point he makes is that all of the "more sustainable energy systems, have a characteristic of mostly a fixed cost energy service." This is perceived as a higher cost, and it might be, but the advantage is that the "future costs of the hot water that come

from that system are predictable, and fixed, today." This means that the consumer will know what his or her hot water costs will be for the next 10 years, or as long as the technology lasts. The "predictability of the future costs of the energy service from renewables is ...an insurance policy, really." Although many people know this, it is overlooked as the biggest benefit of renewable energy.
This is particularly clear when it is argued that "nobody can predict what the cost of electricity is going to be in ...18 months time, or 3 years time.... [whereas] As long as the sun shines, you're going to have hot water, and that's predictable."

Respondent 5 argues that even though Eskom is providing consumers with gas heaters and cookers, it is giving low income households future expenses they can't afford. "Whereas, if the government, or Eskom had spent this same money, made some more sustainable energy service, ...that would have been a more sensible thing to do." It provides individuals and organisations with a fixed cost that they can budget for.

"*in my view, there's no future in these unpredictable, variable costs in energy technologies, which means carbon based, nuclear based technologies, because we don't know, nobody, not even the IEA or anybody can really tell you what these costs are going to look like. So its actually quite a risky investment to go down that route, and there might be impacts of renewables that they know... Renewable energy systems or sustainable energy systems inspire more confidence.*"

Respondent 6: Respondent 6 argues that renewable energy interventions can't be seen as an issue that is different or special. They have to be integrated from the beginning of development. "Just like... you don't know who has AIDS, so all housing has to be sympathetic to AIDS, so all water must be collected off roofs" and all housing developments should have renewable energy standard. During the World Summit on Sustainable Development, there were renewable energy "show houses in Soweto and East Rand... but I don't even know what's happened to those things now", they were pilot projects that got no further.

These ideas have a lot to do with different cultural conceptions of future and planning ahead. "There isn't a Zulu word for the future except uksasa which means tomorrow, but

there's a profound respect for the past. And this is I think what leads to the sort of ad-hoc-ism and not looking at future things"

Respondent 6 argues that renewable energy implementation is frustrating from this viewpoint, and that although he has been working on it for 30 years, he hasn't seen much progress. A significant cataclysmic event is what will cause change.

Synthesis of Question 5

Respondent 1 made the point that although it is more important to focus on renewable energy strategies in middle and high income residential development projects are not approved in those areas, as low income development is prioritised. He suggests the introduction of various legislation such as a solar water heater bylaw, an electricity bylaw, and a tariff that rises sharply above a certain consumption.

Respondent 3 argued that the focus needs to shift from low cost housing to medium and upper income development in terms of renewable energy, and that low income households need interventions such as insulation, CFL's and after these, solar water heaters.

Respondent 5 argued that, in implementing more sustainable energy, the focus should be on the service of light, or heat, and that it shouldn't be important where it came from. He also makes the point that the predictability of the future costs of the energy service from renewables is overlooked as the biggest benefit of renewable energy.

Respondent 6 raised the point that renewable energy interventions can't be seen as an issue that is different or special. They have to be integrated from the first phases of development.

Two of the respondents made the strong point that renewable energy interventions need to be aimed at middle and upper income developments if they are to be effective and feasible. The focus should be on the service rather than where the energy came from, and renewable energy should be integrated fully into the development process.

4.2.2.6 - Question 6

Other issues that arose during previous questions

Respondent 1: The Green Building, in which Sustainable energy Africa is based, uses renewable energy systems such as electric and solar water heating as well as a grey water system. The building was built by "three individuals, some of which are with this organisation, and I'm one of them." It was informed by what they already knew about renewable energy systems as professionals working in the area for a long time, "we know all the renewable and efficiency options... it was really just putting a fair bit of that into practice." There was a degree of learning in the process also.

Respondent 1 argues that only recently have private developers of gated communities and large, upper income housing estates begun to consult with SEA. Part of the reason for this is an increase in the perceived demand for middle and upper income housing with a sustainable focus, and "if you've got a house which is built properly, with solar water heaters and that sort of thing, its financially a better bet than a run of the mill house."

There are not many developments that are seriously implementing these interventions. However, "there are a couple around the country where they are taking it seriously. Group Five is just starting to take it seriously. And there's a suburb up in Clanwilliam, a solar suburb or something."

Respondent 1 argues that Cape Town is only ahead of other parts of the country in renewable energy interventions because of the 2005 power outages. "So basically people were seriously inconvenienced, and so they were motivated to do something about it... It takes a crisis for people to do anything, no matter how strong the economic motivation is, no matter how sensible it is, for government or individuals to do anything, it just doesn't happen."

Eskom itself is releasing figures that admit that it is cheaper to implement energy efficiency than to build more power stations. However, "Eskom is good at building generation plants, not good at energy efficiency", so these interventions have not

occurred. "You should never try and leave energy efficiency up to people who want to sell energy."

Respondent 1 explains that this slowness of action despite all the evidence in favour of renewables is very disappointing. Cape Town's goal of 10% of households to have solar water heaters by 2010 is "becoming increasingly unrealistic as nothing happens, year after year."

The same goal exists for Cape Town on a broader scale, with the aim of a 10% renewable energy supply by 2020, which Interviewee 1 argues is a more realistic goal. It may be achievable with a mix of renewable energy sources such as solar water heaters, wind energy, biodiesel and landfill gas. "It's not clear, but it's possible... But it requires... quite a clear political will within the city." Restructuring and political issues are a significant barrier, however.

Respondent 3: Funding for renewable energy interventions from carbon credits has only occurred in the case of "the Kuyasa project, in Khayalietsha but not in remote rural areas." There needs to be a significant amount of carbon funded to make the trading worthwhile to the countries involved, and rural areas will never consume enough to make it worthwhile.

Respondent 6: Respondent 6 argued that a possible suggestion for policy formation in terms of renewable energy would be to adapt the housing code to include the "thermal transmission of the roof" and perhaps other energy specifications.

The 'red book' also needs to be adapted, as it contains "nothing about the inside of a house at all."

Synthesis of Question 6

Respondent 1 raised the point that only recently have private developers of gated communities and large, upper income housing estates begun to show interest in renewable energy and that there is an increase in the perceived demand for middle and upper income housing with a sustainable focus. However, there are only a couple of developers in South Africa taking it seriously, including Group Five.

He argues that Cape Town is only ahead of other parts of the country in renewable energy interventions because of the 2005 power outages, proving that it takes a crisis for people to do anything.
Another point he makes is that Eskom is good at building generation plants, not good at energy efficiency, which has resulted in interventions not occurring. Thus Cape Town's goal of 10% of households to have solar water heaters by 2010 is viewed as increasingly unrealistic and renewable energy goals generally may be achievable with a mix of renewable energy sources. However to achieve this requires a clear political will to do so.

Respondent 3 explained that funding for renewable energy interventions from carbon credits can only occur in cities as rural areas have too low a rate of consumption.

Respondent 6 argued that there is a need to adapt the housing code to include the "thermal transmission of the roof" and perhaps other energy specifications and that the red book needs to detail insides of houses to be an effective reference.

The responses seem to indicate that although the move towards renewable energy application in middle and upper income developments is an important one, it is occurring slowly. Energy crises are a good catalyst for renewable energy adoption, but relying on a profit driven service provider for this is a problem. A clear political will is necessary to achieve Cape Town's renewable energy targets for 2010. Funding from carbon credits for urban interventions is a possibility, and housing standards need to include renewable energy specifications.

4.2.3 – Respondent Category 2 - A resident of Oude Molen:

4.2.3.1 Background of Resident

Respondent 7 has been living in Oude Molen village for 2 years. When she arrived, she began making enquiries about who she should pay to. "We bumped into a government official, a lady, and she said don't pay to anyone because the money is not getting through to government. And so she told quite a few people and quite a few people stopped paying."

Respondent 7 chose to move to Oude Molen because she had heard it was an eco-village, and she was accustomed to staying in similar places. "So I looked for an open space, and this place had been abandoned. I first stayed in a bus, actually... then I found this place open, and it was ...an abandoned shack. And I didn't have something so nice, so I moved in." Approximately 3 months later the owner returned and wanted his shack back, so Respondent 7 made a deal with him where she bought him a wendy house and she could remain in his house.

Corruption and subletting of houses in Oude Molen was very common. Landlords "would rent a place to you in the eco-village, but then they'd rent out a place to your neighbour, who is like a drug dealer, and who's got all the young tik-heads or crack-heads, and then they would just constantly rob you. So you've not no ways to improve your lifestyle, because you're just getting robbed all the time." Crime in the Oude Molen Village is a huge issue, and one that has worsened since she moved there.

Respondent 7 is a single mother with 3 children to support, and when she first moved into Oude Molen did so out of an urgency for a place to stay. She had also just experienced financial problems: "I'd moved to Cape Town, I had a job ...and then my finances didn't work out and I didn't have something stable all of a sudden.... Well, I don't mind, I'll just move everyone in the car till things make sense again. So I did, I put them all in the car and found something."
Her next priority was to set up a decent standard of living, which she defines as: "not nessicarily so much how much you've got, as how much energy and time you spend educating your kids... because even if you've got hardly anything but you've got... a lot of love for your family, and time... then your children aren't going to end up on the streets." She argues that poor parents only have their time to offer their children, but a good standard of living can be achieved if paying a very low rental. This explains the popularity of squatting in South Africa

4.2.3.2 Conditions of the shack/Amount being paid

Respondent 7 has been told that to continue to live in the shack she helped build in Oude Molen, excluding the land around it, she will have to pay R580 per month.

"firstly, for me to live in this space already, is already quite a thing, you know what I mean?" The shack has no insulation, no ceiling, and interviewee 7 reports that it is very cold at night in winter.
The R580 per month does not even cover "fixing electrical wiring... or fixing the plumbing, or the piping, none of that... They don't do any garden services."

Respondent 7 will also have to pay arrears of about R300 per month for the two years she was living in the shack illegally. "And now we're being charged arrears when we were told not to pay... And we've been called irresponsible because we didn't pay, when, in the meantime we were told not to pay."

In total, with the land she needs to set up a nursery she will have to pay R1200 "and they haven't come up with a plan for security... I've had to put up all the fencing"
Respondent 7 argues that she is "paying to be moved anytime, the fact that I moved here as a squatter is completely not counted." Many of the people in Oude Molen moved in as squatters, and many of them have not signed leases with the event of the upgrade.

4.2.3.3 Electrical connections
The electricity supply in the shack comes via her neighbour on an extension cord. "It comes into my place, and then I have to split it up into to cooking and stuff, and I can't overload it otherwise it trips out". Respondent 7 is nervous that faults in the electrical connection may cause a fire.

The connection is currently an illegal one and although she is not currently paying for electricity, she was paying at some point, "the people were paying money to somebody over there who was paying to the government, apparently." She describes this as similar to co-opted electricity. She will have to pay after the intervention takes place, not only for the connection and the supply, but she will also have to "buy my own electric box and have it put in, and my own earth leakage thing, and then somehow I'll get connected up."

4.2.3.4 Respondent 7's knowledge of interventions
Respondent 7 has been given an 18 month lease, and has not been informed that a ceiling or insulation will be put in her shack. When the lease was provided she asked the project leaders (presumably representatives from the sustainability institute) "have I got

first options to buy a house, or are you guys going to replace this house?", and she was told she would not have access to either.

Respondent 7 has not been told about renewable energy interventions of any kind, only "that any time during the 18 months they can come along and say you have to move, and then they allocate me another piece of ground somewhere and I must move my shack there." The rent she will be paying will remain the same during this time, and she will not be allocated a new home.

When respondent 7 brought up the issue of security, "they made out like, well each person must take responsibility for their own security and people must start thinking about security." Respondent 7 argues that prior to the intervention these sorts of issues were dealt with communally. "Like if one person's place got robbed, then the community would start keeping a look out, everyone would warn each other."

4.2.3.5 Way forward

Respondent 7 will not remain in Oude Molen to see the completion of the intervention. "I gave my whole place away, because I couldn't deal with the pressure. I gave it to my sister .... I'm gonna pay them [Sustainability Institute] like R200 a month or something just to store stuff." She has not yet finalized where she will move to, but is adamant that she does not want to remain and be subjected to the kind of treatment she has been receiving.

She maintains that the Sustainability Institute and the City of Cape Town "aren't bettering anyone's standard of living, they're just piling a huge amount of debt on everyone's heads, and saying... if you don't like it, leave. And then we don't even get first options to buy, because there's going to be units up for sale" in the 'improved' Oude Molen.

Synthesis of Interview 7

The experience that respondent 7 has had with renewable energy residential development is not positive. She arrived in the original Oude Molen Village with her children and mother, in the face of financial problems, hoping to be able to live in a sustainable community. She moved into a half-completed shack that had been

abandoned by its owner, and when he returned, negotiated to remain in the shack, which she repaired as best she could and to which she added a vegetable garden. Respondent 7 argues that she was willing to pay rent, but was informed that the money was being misappropriated and she was within her rights to refuse to pay. She has lived as a squatter in Oude Molen for 2 years, and had to contend with the serious problem of crime in the village.

When the City of Cape Town identified Oude Molen as a site for a renewable energy residential upgrade, and appointed the Sustainability Institute to manage this project, many of the residents that had been living there illegally, including respondent 7, were made to feel unwelcome. Partly this was due to the City's demand of the payment of arrears and the enforcement of leases in return for their right to remain in the village, but also because they were not informed about any renewable energy interventions that would directly benefit them, and because many of them, including respondent 7, felt that they were treated like naughty children and disrespected because of their non-payment.

Respondent 7 also noted that the Sustainability Institute was dismissive when she brought up the issue of crime, and instead of supporting the idea of a community based solution, told her that it was an issue to be dealt with by each individual.

The end result of respondent 7's experience with the Oude Molen renewable energy upgrade is that she will be moving elsewhere and leaving her shack with her sister.

4.2.4 Respondent Category 3 - Representative from City of Cape Town's Environmental Resource Management Department

4.2.4.1 Location of the concept of 'renewable energy' in policies or plans for the city of Cape Town

The Respondent provided an outline of the policy and strategies in all spheres of government relating to renewable energy from Local to National Government, which has been summarised below:

Local Government Level – City of Cape Town

Renewable Energy in the Integrated Development Plan (IDP)

In terms of the high level outcome to be achieved over the long term, Cape Town must be positioned as a leading African city in meeting its energy needs through sustainable means.

Outputs that must be achieved over the next year:

i. Purchase renewable energy
ii. Facilitate the implementation of the Energy and Climate Change strategy
iii. Facilitate the development of the Biofuels industry and market
iv. Explore the opportunity to extract methane from landfill sites
v. 10% (83 800 houses) of households to have solar heaters by 2010
vi. 10% of city-owned housing to have solar heaters by 2010

The council outputs and resources that will be required and allocated to achieve the above outputs:

i. Facilitate the development of the Biofuels industry and market
ii. Strategic partnerships with PGWC, DEAT and Independent Power Producers
iii. Investigate the opportunity to extract methane from landfills
iv. Introduction of effective legislation, monitoring and enforcement for air quality management
v. Legislation and incentives to stimulate the use of solar heaters

Draft Energy and Climate Change Strategy

Africa's first local authority Energy and Climate Change Strategy is expected to be adopted by the City of Cape Town in mid 2006. This strategy contains a number of programmes and projects aimed at reducing the City's contribution to climate change, mainly through the promotion of a more sustainable use of energy, and by minimising the impacts of climate change on communities and ecosystems most vulnerable to it. The strategy also identifies targets for energy efficiency and improvement of energy management and supply, including Cape Town's national and international energy and climate change commitments.

The City of Cape Town is the first African city to prepare an Energy and Climate Change Strategy, based on the state of energy use in the metropolitan area. The draft strategy stems from the Integrated Metropolitan Environmental Policy (IMEP) and sets out a vision for the delivery of more sustainable, environmentally sound energy to the population of the metropolitan area. This will be achieved through the promotion of sustainable development in all core functions of the City within a framework that provides a clear vision and direction for the City as a whole, and specifically the energy sector.

The strategy identifies five core energy sectors (transport, electricity supply, residential, government industrial and commercial), with specific targets for 2010, working towards broadening the sources of energy and efficiencies in each of these sectors. Apart from attempts at greater energy efficiency and the use of renewable energy alternatives, the strategy also explores measures aimed at preparing and reducing the anticipated impacts of climate change on communities, the natural and built environments, as well as the economy.

Transport

One of the key strategies by the Transport Directorate is renewable energy and it forms part of a long term goal to support cleaner fuel and renewable energy sources for domestic, transport and industrial use.

The city identified the following key focus areas:

i. Promote alternative and more efficient modes of transport
ii. Reduce the usage and dependence on private vehicle trips
iii. Promote the use of alternative and cleaner energy sources such as bio-diesel and LPG, amongst others

Transportation impacts on sustainability:

i. Human health impacts,
ii. air and water pollution,
iii. depletion of non renewable resources

Transport is one of the biggest energy uses and consequently one of the biggest emitters of carbon dioxide. There is a strong focus on more sustainable transport which encompasses the use of alternative fuels notably Biofuels such as biodiesel.

The Provincial Government of the Western Cape (PGWC)

The PGWC is in the process of developing an Integrated Energy Strategy. This document is *yet* to be released.

National Government Level

The White Paper: *The Promotion of Renewable Energy and Clean Energy Development*, Part one – Promotion of Renewable Energy
August 2002.
This document makes reference to all forms of renewable energy such as wind, biomass, hydro, solar, wave energy, ocean currents, and energy from waste

The White Paper *on the Energy Policy of the Republic of South Africa*, December 1998 is a Department of Minerals and Energy Paper which also makes reference to Renewable energy.

4.2.4.2 Past or current alternative energy projects funded and initiated by local government that exist within the City of Cape Town's low-cost housing programme.

A Low Cost Housing Project in Kuyasa, Khayelitsha

The City of Cape Town and South-South North, a non-profit developmental organisation has initiated the first Clean Development Mechanism (CDM) project in Africa. The Kuyasa project has been designed as a CDM project under the Kyoto Protocol, which gives it access to carbon finance through the international carbon market. The Kuyasa project received international recognition in 2004 as the first to qualify for the WWF's CDM Gold standard.

The Kuyasa project was launched in June 2003 after over one year of planning, design and baseline development. It involved the retrofitting of 10 low cost houses with energy efficient and renewable energy technologies. The ten houses were selected under strict

criteria which allowed the inclusion of houses where a variety of living conditions are experienced. The pilot facilitated the monitoring of energy use and emission reduction, as this was required for the project's final Project Design Document which was submitted to Executive Board of the United Nations Framework Convention on Climate Change. Ten houses thus far have been retrofitted with compact fluorescent light bulbs, insulated ceilings and solar water heaters, whilst the potential exists to retrofit 2300 houses. Finances would be acquired from carbon income (15-20% of project cost, based on current carbon prices) and community contributions (approximately 15% of the project costs. The total cost to retrofit 2300 houses is estimated to cost R109 978 and the projected carbon income is estimated at R2.5 million over a 21 year period. Emission reductions per household are estimated at 2.8 tonnes CO_2 per house/year, which is to generate R2.5million carbon income.

Results from technical research and social monitoring show that a 5% temperature increase in winter and a 5% temperature decrease in summer can be expected in retrofitted households. The retrofitted households can enjoy a 40% reduction on their electricity bills through less energy demand and consumption. This is important for poorer households who spend 10%-20% of their income on energy (Cape Town Energy Strategy, 2003). The Kuyasa project is not only a renewable project but a poverty alleviation initiative as well. The project therefore has the opportunity to be replicated nation wide with over 1.5million low cost houses. Grant funding is thus able to come from a number of sources as the project can be eligible for: poverty alleviation, employment creation, and health and energy sustainability.

The Kuyasa project has, and will continue to have, positive impacts on the environment through emission reductions and reducing the City of Cape Town's contribution to climate change.

In addition to job creation, another positive socio-economic impact of the project is the savings on energy experienced by each household, which is particularly significant among low-income households.

N2 Gateway Housing Development (low cost housing development)

The N2 Gateway development *may* be fitted with solar water heaters. Currently a proposal is being considered. The outcome is still pending.

4.2.4.3 Other applications in which alternative energy systems are being utilized or explored within the City of Cape Town

City of Cape Town: Energy Efficiency and Renewable Energy Initiatives: Tygerberg Administration Buildings (Parow) Energy Audit and Retrofit

As a part of the Cities for Climate Programme CCP programme, Cape Town has embarked on various projects to reduce the city's carbon footprint. One such is being undertaken by Sustainable Energy Africa - Energy retrofit of the Tygerberg Administration buildings. CO2 savings of around 160 tons/year are anticipated as a result of implementation.

Council Fleet

The second measure involves the conversion of two council vehicles (as a pilot project) to run on liquefied petroleum gas (LPG). The city's fleet of 7 700 cars account for 15% of the CCT emissions.

Solar Water Heater by-law

A Solar water heater by-law is in the process of being developed by the City. This will ensure that all new houses are fitted with a solar water heater.

Methane Gas Harvesting

The Bellville South landfill site, which is due to be closed in 2006, has been proposed for a pilot project in which methane will be taken from the landfill and used for energy earning carbon credits under the Kyoto Protocol. It was found that the site could generate 20 500 tons of landfill gas - half of which is methane gas - each year for the next 10 years. This has not started as yet.

Demand Side Management

The City of Cape Town has also been part of Eskom's Demand Side Management (DSM) and this involved the distribution of the energy efficient light bulbs known as compact fluorescent light bulbs (CFLs)

4.2.4.4 The influence of central government renewable energy policies on the role and type of energy provision in the City of Cape Town

The City of Cape Town is leading the way in renewable energy and energy efficiency policy/strategy in South Africa. National policies are considered in local policies and strategies and these include:

The White Paper: *The Promotion of Renewable Energy and Clean Energy Development*, Part one – Promotion of Renewable Energy and

The **White Paper** *on the Energy Policy of the Republic of South Africa*, December 1998

National Policies are not an enforcing mechanism but rather a guiding document and Local strategies are aligned with National Policies as far as possible.

Synthesis of Interview 8

In terms of renewable energy in policies or plans for the city of Cape Town respondent 8 divided this into 3 spheres: local, provincial and national government.

At local government level, the City of Cape Town has renewable energy identified in its IDP (Integrated Development Plan) as a priority in positioning it as a leading African city in meeting its energy needs through sustainable means. The Draft Energy and Climate Change Strategy, which was expected to be adopted in 2006, sets out a vision for the delivery of more sustainable, environmentally sound energy to the population of the metropolitan area.

Transport plans have also identified Cape Town's long term goal to support cleaner fuel and renewable energy sources for domestic, transport and industrial use.

At Provincial Government level, the Western Cape is in the process of developing an Integrated Energy Strategy, which has not yet been released.

At National Government Level, The White Paper *The Promotion of Renewable Energy and Clean Energy Development* and The White Paper *on the Energy Policy of the Republic of South Africa*, are both established pieces of legislation endorsing renewable energy policy.

With regard to past or current alternative energy projects funded and initiated by local government, respondent 8 identified the Kuyasa project, discussed earlier in this chapter, and the N2 Gateway Housing Development may adopt the use of solar water heaters depending on the outcome of a proposal.

With regard to other applications in which alternative energy systems are being utilized within the municipality, the City of Cape Town is implementing the following energy efficiency and renewable energy initiatives:

- The Tygerberg Administration Buildings (Parow) Energy Audit and Retrofit
- Council Fleet pilot project, where 2 vehicles will be tested to for the suitability of running on LPG gas
- Solar Water Heater by-law, being developed to ensure that all new houses are fitted with a solar water heater
- Methane Gas Harvesting pilot at the Bellville South landfill site
- Demand Side Management, together with Eskom, the city distributed energy efficient light bulbs (CFLs)
-

With regards to how central government alternative energy policies have influenced the role and type of energy use in Cape Town, the White Paper *The Promotion of Renewable Energy and Clean Energy Development* and The White Paper *on the Energy Policy of the Republic of South Africa*, have both been referred to by the City, however, respondent 8 stressed that national policies are not an enforcing mechanism but rather a guiding document and Local strategies are aligned with National Policies as far as possible.

4.3 CONCLUSION

The above chapter has attempted to present the findings of the research conducted in Cape Town in June/July 2006 and in Durban in September in as clear and systematic

way as possible, in order to lead into an assessment of these findings and an analysis as to how they impact on renewable energy provision for low income housing in South Africa, which will be presented in the following chapter.

CHAPTER 5 - ANALYSIS AND CONCLUSIONS

5.1 KEY THEMES

From the research, 7 key themes relevant to renewable energy interventions for low income housing emerged:

i. **Advantages and disadvantages of the various technologies for housing application**
ii. **Funding availability and limitations**
iii. **Issues around government support and policy**
iv. **Low income versus upper income application**
v. **Issues of access to systems involving Government, developers and residents**
vi. **Social Attitudes, Processes and Problems**
vii. **Possible strategies to improve the provision of renewable energy interventions for low income housing**

Advantages and disadvantages of the various technologies for housing

This discussion includes the advantages and disadvantages of active technologies such as solar water heaters, solar pv cells, energy efficiency compact fluorescent light bulbs, biogas, large scale solar collection, wind generation, gel fuel, LPG gas cooking and biomass. It also includes passive strategies such as site orientation, ceiling insulation and energy efficient house design.

Although the review of literature already identified the best renewable energy systems for a South African context, an assessment and comparison drawn from the interviews is important to understand the perspectives (based on experience) of practitioners in the field regarding the grassroots applicability of these technologies.

Disadvantages:

The capital cost of all of the renewable energy technology listed above is seen to be the biggest problem, particularly for low income households without the means to make the initial investment.

Wind generation can be of limited use in high density urban landscapes because of space constraints and perceived high noise levels.

While the new pv cells embedded in roof tiles are effective, cutting edge technology, the process of implementing this in any development will probably take two or three years, and to make more widely accessible to housing construction, even longer.

A major problem exists with incorrect orientation of existing and new buildings (if they are not north facing). Town planning schemes tend to see passive heating as a non-issue and when site layout is completed without addressing correct orientation, it is often too costly to go through the layout process again.
Renewable technology in low income developments often runs the risk of being stolen and in many cases by members of the same community, making developers reluctant to initiate renewable energy projects.

Energy policies often dictate that renewable energy projects occur in rural areas where it is more costly to extend the grid, rather than in urban areas where a large percentage of households are already electrified.

Advantages:
These technologies have a dual role of increasing access to energy services, and simultaneously providing access in a way which addresses global issues of climate change.

Through the Kuyasa pilot, solar water heaters, thermally insulated ceilings, and energy efficient lamps have proved to equal energy savings of a few hundred rand a year per household.

Passive heating has been found to be effective and achievable if a target of 60% or more of all buildings in a development are laid out facing north.

Job creation is a positive and proven advantage to the promotion of renewable technologies particularly in the manufacture of biodiesel and solar water heaters.

Pv cells embedded in roof tiles are a new and very advantageous renewable energy technology, which is South African made, making it appropriate to use in projects due to sustainability. They have also been proved to potentially generate, an average of around one and a half times the amount of energy required by a house, meaning that any housing development could become a net generator of energy, and sell it back to Eskom.

An advantage of renewable energy technology is that it can reuse existing or disused structures to create or store energy. In Palaborwa a project is in discussion to utilize large disused silos as a pump storage system, meaning that energy generated during the day could be stored for demand side management.

Systems such as biogas digesters are advantageous for new and upgraded settlements because they are ideally combined with localized waste treatment plants. The outcomes of energy provision and waste management for low income settlements can be simultaneously addressed.

In parts of the country that are overcast but hot, such as many parts of the Lowveldt, a thermal energy system is applicable. This can work on an agricultural based greenhouse concept that can be installed, for example, in disused mines if they have long chimneys. This means that not only can these systems extract energy in overcast weather, but they can be part of a process of revitalizing the economies of small towns in decline.

The case of the Lwandle hostels to home conversion has proved that large scale low income solar water heating projects can be successful in the long term, as the project has been running without major problems for over 10 years. This case also indicates the possible social acceptance of renewable energy technology that can occur if the community is allowed agency in the project.

Greenfield housing development has been identified as an area where critical issues of urban design, site layout, orientation of buildings, materials of construction, and positioning of windows can negate the need for extensive installation of active renewable energy technologies in low income housing.

One of the most important and overlooked benefits of renewable energy technology for use by low income households is the inherent predictability of the future costs of the energy service. This means that households are able to plan their limited finances around at least one fixed and reliable cost.

Low income housing is best served by the renewable energy applications of site orientation, ceiling insulation and energy efficient house design, and these have the advantage of comparatively low capital costs for the state in comparison with active renewable energy technologies. Another finding that makes financial sense to the state and Eskom, is that it is cheaper to implement energy efficiency in South African households than to build more power stations

Funding availability and limitations

To successfully implement renewable energy interventions for low income housing, as with all development projects, money needs to be made available. Because electricity provision is not as fundamental as water, sanitation or housing itself, and because the concept of renewable energy is not yet fully endorsed by government policy and practice, nor competitive in the private sector, the acquisition of funding for these kinds of interventions is difficult and slow.

Uncertainty of funding can result in slowness of roll-out and indecision on the level of renewable energy technologies that can be applied to the development. This occurred in Philipi, and is one of the issues in the Oude Molen project.

Another issue that has come up in several of the cases is indecision over the percentage of the project cost that should be borne by households and the percentage that should be borne by the service provider.

Lwandle can be viewed as a good example of a financial solution to the provision of renewable energy for a low income housing upgrade. In this case a community decision was made to allocate a portion of their housing subsidies to installing solar water heaters for communal showers. This led to money being borrowed from the development bank by the local authority, which was repaid by a fixed sum in community members rent. It is

interesting that the Development Bank provided funding for a significant solar water heating project without being aware of its implications. It also offers hope for future projects to be funded in this way, primarily because the intervention has been successful for over 10 years.

There were various sources of funding that are or may be available for renewable energy interventions identified by the respondents. These include:

- Private funding from various corporate and donor organisations;
- Accessing funds from the skills development levy;
- The National Electrification Programme;
- The German Development Bank (GTZ);
- The Electricity Basic Services Support Tariff;
- The Development Bank;

A problem that arises in the roll out of the intervention is that government granted funding takes a long time to be made available, although this can be managed to some extent through the assistance of the Development Bank.

A refocus from a few macro level projects to a multitude of micro level interventions in the implementation of renewable energy, as was discussed in chapter 3 could also contribute to the financial sustainability and replicability of these systems in low income households.

Support from government and policy for renewable energy interventions for low income housing

Renewable energy interventions have been identified as a priority by the City of Cape Town in its IDP (Integrated Development Plan), and the city has produced the Draft Energy and Climate Change Strategy as well as being in the process of developing a Solar Water Heater by-law

The Western Cape Province is also currently developing an Integrated Energy Strategy, and National Government has *The White Paper on the Promotion of Renewable Energy*

and Clean Energy Development and The White Paper *on the Energy Policy of the Republic of South Africa* to inform renewable energy policy.

In addition, the City of Cape Town is currently implementing 2 major renewable energy interventions specifically for low income housing, namely Kuyasa and the N2 gateway and has put in place 4 additional renewable energy interventions not directly to do with low income housing.

Within the various spheres of government, however, there appears to be a kind of 'silo' mentality, where different areas such as housing, health, poverty and energy provision are addressed separately and not in an integrated and holistic way. Life-cycle costs of housing or energy technology are also not effectively considered, with a focus rather on initial costs. This may seem cost effective if finances are considered on an annual basis, but in a mid to longer term view of 10 to 50 years this is economically inefficient.

Another issue is that in the Western Cape the housing subsidy has been increased to include a ceiling, ignoring the importance of other energy efficient or renewable energy interventions. This becomes a problem when a consideration is made of the Provinces contribution to energy efficiency as it becomes tempting to describe this inclusion as being sufficient, where it is only really a very small increase in the housing subsidy.

Several of the respondents argued, and this author agrees that there should be an amount in the housing subsidy set aside for renewable energy and energy efficient interventions for low income housing development. It would also be very simple yet very effective to implement a housing clause that demands the compliance of house design with energy efficient specifications, or a withholding of funds.

One of the respondents argued that governments and individuals tend to only implement serious changes in policy or practice after a major crisis has occurred, no matter how strong the economic motivation may be. This is a trend which can and should be reversed through thorough and long-term planning practices, particularly in the field of renewable energy implementation in low income housing developments. Unless this occurs in Cape Town, the city's goal of 10% of households with solar water heaters by 2010 will not be achieved, nor will similar goals in other cities in South Africa.

Low income versus upper income

Sustainable practices involve reducing the ecological footprint of the wealthy, and sustainably increasing the footprint of the poor. This will increase the service balance between these economic groups while making positive steps towards cutting carbon emissions. Very poor living in large households use very little electricity and make almost no impact on increasing these emissions.

In sites such as the one in Grabow, the cross-subsidisation of poor sites by those of the wealthy through an increased rate base is one of the ways that a balance can be achieved while pursuing the aim of economic integration. The strict sustainability based zoning and by-law conditions to which the wealthy in this model are subjected, include the installation of additional electricity capacity and the mandatory use of renewable technology.

Renewable energy interventions in low income development are usually given first priority, despite extensive evidence and recommendations that these strategies in middle and high income residential development projects will be easier to achieve and more effective in reducing coal fired electricity consumption and positively impacting on social acceptance of these technologies.

It has also been argued that it is important to focus on middle and high income renewable energy interventions as they have access to capital to invest in technologies which will pay themselves back, whereas poorer households have difficulty in raising this money and rely on grants. This means that low income interventions such as at Kuyasa are informative and important showcases but not self sustaining.

It has therefore been argued by most of the respondents that the governmental focus on renewable energy provision should shift from low cost housing to medium and upper income development, and that the renewable energy focus for low income households should be on interventions such as insulation, CFL's and where possible, solar water heaters.

The broad interest in and use of renewable energy technologies by private developers of gated communities and large scale, upper income housing estates has only recently

begun to occur. This process needs to speed up in the City of Cape Town in order to successfully achieve the goals set for 2010.

Issues of access to systems involving Government, developers and residents

In order to ensure broad community access and maximum benefit from energy efficiency initiatives, energy efficient building design should be the renewable energy system most widely implemented in low income housing developments.

It has generally been found that poor communities have exceptionally limited access to renewable energy technologies or even the most basic passive heating strategies. This is despite recommendations having been made to the housing board, and seems to have occurred primarily because it is much easier to give communities access when it is economically sustainable, which cannot occur in this sector.

The City of Cape Town was the major decider of recipients for most of the residential renewable energy interventions.

In general, low income households do not have ownership of the solar or other renewable energy systems installed in their houses or communities. The general practice seems to be for the government or developer to assign concessionaires who install the systems and are also responsible for maintenance. The government or developer will pay a single installation fee for the system, whereafter the households are usually required to pay a monthly amount for service and system.

In rural interventions, traditional land tenure is also a major factor in who has access to the solar systems, since when the land is under tribal ownership, the chief becomes the primary allocater of land. This adds an extra level and a different form of community consultation and participation to the process of installing renewable energy systems in rural households.

In centrally located urban developments such as Oude Molen it becomes important to ensure that previously disadvantaged low income residents are included in allocation of dwellings and facilities as this becomes part of meeting national urban densification and integration requirements, in addition to the achievement of renewable energy goals.

Social Attitudes, Processes and Problems

In the research, it emerged quite strongly that many low income communities feel as though they are recipients of second class products when they are provided with renewable energy systems rather than standard electricity supply from the grid.

Interventions such as those at Philipi, Kuyasa, and Oude Molen could be used to showcase renewable energy technologies for low income residential application and inspire a measure of aspiration and acceptance for both communities and governmental housing finance providers, and work towards inspiring replications of these projects.

A process to inspire community and general social acceptance occurred at Spier and Lynedoch, where the renewable technologies to be used in the Lynedoch village were first used for the tennis facilities and hotel at the neighbouring Spier wine farm, which became the site of an international tennis tournament. This created an international level of exposure for the facilities, and made their application in a mixed income housing development easy from an acceptance aspect.

This international level of exposure is difficult to replicate, but more modest attempts to profile renewable energy could also occur in governmental buildings, and signature projects with a high level of media and community interest. The 2010 FIFA world cup would be another large-scale opportunity to gain such exposure and community buy-in, particularly in the next year or two while many facilities are still in planning and construction phases. These technologies need to be seen as good enough for the best project in the community or even the country, and not a second-rate or cheaper option.

Education of communities about the benefits of renewable energy systems, as is occurring in the GreenHouse People's Environmental Centre in Johannesburg (discussed in chapter 3) is one of the ways in which communities could be made aware and receptive to these technologies.

The example of the non-occupation of the N2 Gateway project was raised in the interviews, and this was attributed in part to a lack of engagement with social processes and community perceptions. It emerged that there is a need for communities to voice

their needs and concerns, and play an active role in the implementation for a project to be successful. This is applicable equally to projects with a renewable energy focus.

The intervention in Lwandle proved that community needs and acceptance of particular situations can be very different to what the developers expect. In this case the hot water is a shared resource, with the residents themselves rejecting the need for a backup electrical water heating system. The community is satisfied with communal access to hot showers and the fact that they will not always have a supply of hot water when the weather is not suitable. This was a huge surprise to rather cynical developers but has proved after more than 10 years to be a system that is a success in terms of community buy-in.

One of the major community based problems that occurs in relation to renewable energy systems for low income development as identified in the research is that of theft of these systems taking place soon after installation, particularly in the case of PV panels. This has hampered many new developments from receiving funding for this technology and many communities which have had systems stolen have been rendered without the energy services they require, and reluctance from donors to replace the stolen systems.

The development in Oude Molen has been experiencing social problems including non payment of rent and service fees, and the self-appointment of some residents as leaders and land barons, taking advantage of the current instability. In order to deal with these issues, particular social processes were implemented to negotiate community acceptance of and a degree of participation in the changes that were going to occur. This process was identified as a success by the developer and as being full of problems by the resident interviewed, but the outcome was the settlement of agreements and outstanding rental payments and the issuing of leases by the city.

The resident's perception of these processes was mainly that the city of Cape Town and the Sustainability Institute made many of the residents that had been residing illegally feel unwelcome and treated them with significant disrespect. This seemed to be due to the City's demand for the payment of arrears and signing of leases and because information was badly transmitted to them about the changes that were to occur in the village.

Possible strategies to improve the provision of renewable energy interventions for low income housing

It seems that many of the projects including those in Kuyasa, Lwandle and Lynedoch are potentially beneficial to inform policy formulation, but the best practices emerging from these projects need to be translated from their current report form to one that can be used for policy making.

The introduction of various legislation such as the draft solar water heater bylaw that is to be introduced in the City of Cape Town, an electricity bylaw, and a tariff that rises sharply above a certain consumption needs to be implemented in a speedy fashion and in all urban areas in South Africa to be really effective.

Another important change that needs to be made regarding the implementation of more sustainable energy is a shift in perceptions away from placing significance on the energy source and towards the service of light or heat that is provided for the residents of a community. The origin is only important in that it be sustainable from an economic and environmental perspective.

Additionally, renewable energy interventions can no longer be viewed or treated as technology that is different or special from other components of layout and design of housing. Nor must they be an afterthought in the creation of settlements. They have to form an integral part of the development process from the early conceptual stages if renewable energy interventions are to achieve a measure of success.

Town planning professionals and educational institutions need to recognize the importance of implementing energy efficient site orientation and house design in all housing developments, but particularly for low income housing, in order to reduce the need for excessive energy consumption and retrofitting of renewable energy systems in developments where these are unaffordable.

Broad National, Provincial and Local Government renewable energy goals are generally possible to achieve with the implementation of a combination of renewable energy sources, and an investment of financial and human resources. However to achieve this

goal in the challenging South African low income housing environment will require a clear and certain political will.

The South African housing code also needs to be adapted to include the necessary renewable energy specifications to guide this development and the 'red book' needs to also make an active contribution to this process, as merely stating the requirements for renewable energy standards without providing detailed reference material for developers will prove a major obstacle in achieving renewable energy goals.

5.2 RECOMMENDATIONS FOR POLICY AND PRACTICE

- That architecture and town planning professionals and institutions automatically include energy efficient house design, layout and orientation in all housing developments, but particularly in low income housing. This would have benefited developments such as Lynedoch Village and Kuyasa, both of which have had to negotiate the absence of these processes in their implementation of renewable energy systems.

- That policy and regulations in all levels of government be drafted to ensure that the above occurs and that all the relevant government spheres and departments take responsibility for the enforcement of these regulations and follow them in the projects for which they are responsible. If the Department of Housing and various local and district municipalities were as committed to residential renewable energy implementation as is the City of Cape Town, the achievement of a sustainable settlements goal would be more realistic.

- That more focus on the practical, deliverable aspects of renewable energy provision occur within government and education institutions, and that the existing reference and standards documents for low income housing be updated to include the most relevant energy efficient standards and renewable energy interventions, and that these be used as the standards to which all housing must conform in order to be built. Too many low, middle and upper income housing developments do not implement energy efficiency, to the detriment of the people who occupy the houses as well as the environment.

- That a policy is formulated and pursued to encourage and promote renewable energy interventions for all new middle and upper income houses, and that these requirements are enforced through municipal by-laws. The research has indicated that middle and upper income households use the most energy, and are able to pay for their own interventions, making this the most financially sustainable of these recommendations.

- That social engagement processes education on renewable energy and community consultation is undertaken in order to inform communities on the range of renewable energy interventions that can be installed to provide their houses with energy, as well as the funding streams and payment options. It is also important to allow communities to consult with developers and indicate their preferred kinds of energy systems and funding streams. This process was most successful in Lwandle, and this case should be upheld as best practice in this regard.

- That the housing subsidy be expanded to accommodate the inclusion of renewable energy interventions for low income households, specifically solar water heaters. This may expand the government's initial housing costs, but in terms of long term energy costs and quality of life for low income residents, the savings are massive.

- That to ensure the financial sustainability and replicability of renewable energy interventions, a shift occur that sees more small scale projects occur in community low income housing developments. This will also build community confidence and increase acceptance and buy-in to renewable energy systems.

- That funding be sought from the Municipal Infrastructure Grant (MIG) and the Provincial Infrastructure Grant and the concept be researched that some renewable energy costs should be borne by the recipients, whether it be an initial or recurrent cost. This could occur in the form of cross-subsidisation, where the wealthy support the intervention costs of the poorer residents.

- That larger-scale renewable energy generation strategies such as landfill gas extraction, biogas coupled with sewerage management and large scale solar and wind farms also be more actively investigated as ways to supplement grid electricity supply in regions where they are appropriate. These have been shown to be exceptionally successful internationally.

- That revolutionary technology such as the solar roof tiles be encouraged and supported by government for use in housing and government facilities, and that the development and roll-out of this technology is speeded up as much as possible.

- That energy efficiency and renewable energy interventions be seen as an integral part of all sustainability efforts in development and treated as being as important as all other facets of building and development. Only in this way will the concept of 'Sustainable Human Settlements' truly be achievable.

5.3 CONCLUSION

All of the issues that were raised during the interviews are potentially resolvable, and the literature identifies many similar issues that constrain renewable energy provision for low income housing. Three of the most striking conclusions that have emerged during the analysis are firstly that renewable energy interventions can effectively be implemented in low income housing if the correct political actors display enough political will. Secondly, that to ensure a significant impact on community acceptance and environmental benefit, middle and high income housing developments should be targeted as users of renewable energy systems, and thirdly that town planning can play a crucial role in ensuring that low income housing is designed and oriented correctly to be energy efficient and negate the need for additional renewable energy systems to be retrofitted.

In the context of this dissertation being prepared to fulfill the requirements of a town planning masters degree, it seems appropriate that South African town planners in both the public and private sector engage with the concepts underpinning sustainable development, and therefore apply energy efficient and renewable energy applications to all kinds of developments, but particularly housing for low, middle and upper income residents.

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ANNEXURE A – INTERVIEW QUESTIONS

A) Interviews with the Alternative Energy Consultants and Project Leaders:

1) What kinds of alternative energy systems/strategies is your organisation actively involved in promoting and/or installing in low cost housing projects, and in which communities is this occurring?

2) How do these communities get access to these systems?

3) What is the source of funding for this initiative?

4) What kind of energy standard are being used in these projects? (e.g. the voltage/wattage deemed appropriate for each household)

5) What kind of support do you receive from, or links do you have to, national, provincial or local government departments?

B) Interviews with the Community Representatives/Leaders (2-4):

1) Please explain what you understand by the concept of 'alternative energy'?

2) What alternative energy systems in use by groups or individuals in your community are you aware of?

3) Which groups (from the government, the private sector or NGOs) have attempted or expressed interest in installing alternative energy systems in your community? What kind of systems are these?

4) What level of awareness of the option of alternative energy do the members of your community have, and what is your perception of their opinions of these systems?

5) What kind of strategies to the residents of your community use to save energy?

C) Interview with the City of Cape Town Municipality Housing/Electricity and infrastructure representative:

1) Please explain how and where the concept of 'alternative energy' is present in any policies or plans for your municipality?

2) Please describe any past or current alternative energy projects that exist within your low-cost housing programme.

3) What other applications exist in which alternative energy systems are being utilized or explored within the municipality? (e.g. for street lighting, schools, hospitals, civic buildings etc.)

4) Please explain how central government alternative energy policies have at all influenced the role and type of energy use in your municipality?

D) Interview with a Representative from Eskom:

1) Electricity provision in the Cape Town area has become a highly contentious issue in the past year. How is Eskom managing the high demand for electricity supply?

2) What measures to promote energy efficiency is Eskom undertaking?

3) What kind of alternative energy strategies or projects, particularly for low cost housing, is the company involved in?

4) Explain your position on alternative energy as a possible competitive threat to conventional Eskom electricity provision?