SUSTAINABLE ENERGY AND POLICY DESIGN ON THE ENERGY TRANSITION TO RENEWABLE ENERGY SYSTEMS IN STELLENBOSCH, CASE STUDY: STELLENBOSCH SOLAR WATER HEATER BY-LAW

By Thumakele Gosa

This thesis is presented in fulfilment of the requirements for the degree of Master of Philosophy in Sustainable Development Planning and Management in the Faculty of Economic Management and Sciences through the School of Public Leadership (SPL) at Stellenbosch University (SU)

Supervisor: Prof Mark Swilling
Faculty of Economic and Management Sciences
Department of School of Public Leadership

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DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University (SU) will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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ABSTRACT
South Africa is plagued by poverty, unemployment, high demand for housing and increasing demand for reliable energy services to reduce the existing levels of such challenges, which Stellenbosch Municipality (SM) is also struggling to overcome. Currently, the need for sustainable energy has become an increasingly prominent subject of discussion and catalyst of action ever since South Africa first encountered its energy crisis. In May 2008, South Africa was engulfed by severe energy crisis, literally rolling blackouts, industries stopping business, much accusations, frustration and plenty of opportunities. Eskom, which generates 96% of South Africa's electricity, is one of the largest monopolistic energy utilities globally. The country was ranked as the least efficient electricity consumer out of 13 developing nations globally, its inefficiency was compared to that of countries such as Brazil more than twice as efficient, with Hungary three times and Mexico four times more efficient than South Africa. The 2008 energy crisis has compelled the government to take energy-efficient measures to reduce electricity consumption, while inducing the consumers to achieve financial savings through the implementation of massive national solar water heater (SWH) programmes. South Africa’s national SWH programmes included Eskom’s and the Department of Energy’s (DOE) short-term to medium-term targets, being the installation of 1 million SWHs by 2014 and another 5.6 million SWHs by 2020. Such targets have been factored into the promising development policy engines such as South Africa’s second Industrial Policy Action Plan and the New Growth Path (NGP) Strategy to put interventions to stimulate local manufacturing sector, SWH market demand and skills development.

The current study will attempt to show that the SM has a higher population growth and also higher housing backlogs than before, which both have serious implications for energy demand and for improving the quality of life of poor communities, arresting joblessness and reducing inequalities. It describes an investigation into sustainable energy policy designs crafted to enforce SWH systems within SM. It also seeks to establish the impact of SWH on improving the quality of life for the poor, the exaggeration of SWH benefits and problems in contextualising SWHs to enhance local economic development. It examines whether or not SWH can improve quality of life. The SM population is expected nearly to double by 2017 and its energy supply remains constrained by the limited Western Cape energy capacity. The present study drew lessons from local to international sustainable energy studies and relevant sustainable development literature. It argues that if sincerely empowered and resourced, mayors and local governments globally have the potential to lead emission mitigations to ensure high global greenhouse gas emissions cuts targets are realised. However, most municipality revenue is derived from electricity sales, so using SWHs could really compromise and reduce this revenue source. The tangible SWH benefits are diluted by baseless overrating such as radical improvement of quality of life for target poor communities, overlooking the cultural context and languages spoken by beneficiaries of such SWH Projects, inadequate understanding of the actual electricity and financial savings. More research is required to contextualize, and enable incorporation of SWHs in culture.

The research methodology used is qualitative interviews and sustainable energy literature review, journals and grey literature. The chapters cover: (1) sustainable energy systems problems in South Africa, (2) sustainable energy literature review, (3) Stellenbosch Renaissance, (4) research findings, and (5) research findings analysis and recommendations.

OPSOMMING

Suid-Afrika gaan gebuk onder armoede, werkloosheid, ŉ enorme behoefte aan behuising, en ŉ toenemende vraag na betroubare energiedienste. Sedert Suid-Afrika die eerste keer die gevolge van ŉ energiekrisis begin ervaar het, is die behoefte aan volhoubare energie die onderwerp van al hoe meer gesprekke en ŉ katalisator vir optrede. In Mei 2008 het Sarah Ward gesê: "Suid-Afrika is in die greep van ŉ ernstige energiekrisis, kompleet met beurtkrag, nywerhede wat hul bedrywighede moet staak, baie beskuldigings en frustrasies, en volop geleenthede". Eskom, wat 96% van Suid-Afrika se energie opwek, is een van die grootste monopolistiese energienutsmaatskappye wêreldwyd. Uit 13 lande oor die wêreld heen word Suid-Afrika as die ondoeltreffendste elektrisiteitsverbruiker beskou: Die land se energie-ondoeltreffendheid is glo vergelykbaar met die van ontwikkelende lande soos Brasilië, Hongarye en Meksiko. Die energiekrisis het die regering genoop om energiedoeltreffendheidsmaatreëls in te stel om elektrisiteitsverbruik te verminder en boonop geldbesparings teweeg te bring deur die inwerkingstelling van ŉ massiewe nasionale sonwaterverhitter- (SWV-) program. Die nasionale SWV-intervensies sluit in Eskom en die Departement van Energie (DOE) se teikens op kort en mediumtermyn, synde die installasie van ŉ miljoen SWV's teen 2014 en nog 5,6 miljoen SWV's teen 2020. Dié teikens is ingesluit by belowende ontwikkelingsbeleidsenjins, soos Suid-Afrika se tweede Aksieplan vir Nywerheidsbeleid en die Nuwe Groeipad- (NGP) strategie, om die plaaslike vervaardigingsektor, -mark en -vaardighede te ontwikkel.

Wat voormelde uitdagings betref, is Stellenbosch Munisipaliteit (SM) geen uitsondering nie. Hierdie tesis toon dat SM se bevolkingsgroeikoers sowel as behuisingsagterstande drasties toegeneem het, wat ernstige implikasies inhou vir die vraag na energie, die verbetering van arm gemeenskappe se lewensgehalte, die werkloosheidsyfer en erge ongelykhede. Die studie beskryf ŉ ondersoek na volhoubare energiebeleidsontwerpe wat daarop gemik is om SWV-stelsels binne die SM-regsgebied in werking te stel, die impak te bepaal van SWV-stelsels op die verbetering van arm gemeenskappe se lewensgehalte, en die kontekstualisering van SWV's vir begunstigdes om aan plaaslike ekonomiese ontwikkeling stukrag te bied. Hiervoor word daar ondersoek of SWV's wél lewensgehalte verbeter. Die SM-bevolking sal na verwagting teen 2017 verdubbel het. SM-elektrisiteitsverskaffing bly onder druk weens die uiters beperkte Wes-Kaapse energievoorraad. Hierdie studie put uit vorige ervarings van plaaslike én internasionale volhoubare energiestudies sowel as tersaaklike literatuur oor volhoubare ontwikkeling. Daar word aangevoer dat "indien burgemeesters en plaaslike regerings die wêreld oor behoorlik bemagtig en van hulpbronne voorsien word, hulle die potensiaal het om die leiding te bied om vrystellings te verminder en te verseker dat hoë wêreldwye teikens vir die vermindering van kweekhuisgasvrystellings verwesenlik word". Die vermindering van fossielbrandstofgebaseerde waterverhitting lewer ŉ skamele bydrae tot plaaslike $C0_2$-temperingspogings. Tog verdien SM die meeste van sy munisipale inkomste uit elektrisiteitsverkope, en sou die inwerkingstelling van SWV's hierdie inkomstebron in gevaar stel en laat krimp. Verdere navorsing oor SWV-inwerkingstellingsopsies word vereis vir die hantering van die gevolglike spanning sowel as die kwessie van SWV-besparings en die beskikbaarstelling van inligting oor sodanige besparings in alle plaaslik gesproke tale.

Die navorsingsmetodologie wat vir hierdie studie ingespan is, was enkele kwalitatiewe onderhoude en ŉ literatuuroorsig, ook sogenaamde 'grys literatuur', oor volhoubare energie vir relevante, volhoubare ontwikkeling. Die hoofstukke dek onderskeidelik (1) probleme met volhoubare energiestelsels in Suid-Afrika; (2) ŉ oorsig van literatuur oor volhoubare energie; (3) die Stellenbosch-Renaissance; (4) die navorsingsbevindinge; en (5) ŉ ontleding van die navorsingsbevindinge sowel as aanbevelings.

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The present study demonstrates that South Africa's energy crisis has opened up opportunities to enhance the transition to sustainable energy systems. Globally, studies have shown that the SWH by-law is an effective policy mechanism for putting energy transition into motion and for leading to the creation of SWH market demand, green job opportunities and the mitigation of climate change. Sustainable energy systems fall outside my academic background, which consisted of adult basic education training, which afforded me an opportunity to upgrade my education level from Standard Five to matriculation in 1999. In 2000, I enrolled to read, and later graduated with, a Bachelor of Theology from SU in December 2004. From 2005 to 2007, I practised the Christian ministry under the auspices of the Uniting Presbyterian Church in Southern Africa in Graaff-Reinet. At the end of 2007, I was awarded a bursary by the Centre for Renewable and Sustainable Energy Studies (CRSES) from SU to study renewable energy systems at the Sustainability Institute (SI), Lynedoch. Since early 2008, the journey has been very challenging, eye-opening and enriching in many ways. The truth is, I was unaware of renewable energy systems before I joined the course. As a study of this nature requires the researcher to have grounding in technology, the end-product will largely reflect my limited technical expertise. However, that I have been able to conclude my investigation up until this point has been due to the professional support and academic guidance that I have received from lecturers, fellow students, and supervisors. Thanks to the editorial services of the Language Centre (SU), and Jennifer Saunders respectively.

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GLOSSARY OF TERMS

AMEU........................ Association of Municipal Electrical Undertakings
ANC........................... African National Congress
CCT........................... City of Cape Town
CDM.......................... Clean development mechanism
CEF............................ Central Energy Fund
CFLs............................ Compact Fluorescent Lights
$C0_2$.............................. Carbon dioxide
CSIR.......................... Council for Scientific and Industrial Research
DA.............................. Democratic Alliance
DME.......................... Department of Minerals and Energy
DoE........................... Department of Energy (newly established sector of DME)
DSM...........................demand-side management
DTI............................. Department of Trade and Industry
EMM.......................... Ekurhuleni Metropolitan Municipality
GW............................. Gigawatt (1 billion watts, 1 million kilowatts or 1 thousand megawatts)
GWh........................... Gigawatt hour (1 billion watts per hour)
IDPs........................... integrated development plan
IPP........................... independent power producer
KWh.......................... kilowatt hour (1 thousand watts operating within an hour's time)
LED........................... local economic development
MDGs........................ Millennium Development Goals
MFMA...................... Municipal Finance Management Act
MSA.......................... Municipal Systems Act
MW........................... Megawatt (1 million watts)
MYPD....................... multi-year price determination
NEMA........................ National Environmental Management Act
Nersa........................... National Energy Regulator of South Africa
NMBM....................... Nelson Mandela Bay Municipality
OECD........................ Organisation for Economic Cooperation and Development
RDP........................... Reconstruction and Development Programme
REEEP...................... Renewable Energy and Energy Efficiency Partnership
RES............................ Renewable Energy Systems
RSBS.......................... Research on the Scientific Basis for Sustainability
SABS.......................... South African Bureau of Standards
SESSA........................ Sustainable Energy Society of Southern Africa
SI................................ Sustainability Institute
SI & PREFE .... Sustainability Institute (SI) & Probitas Real Estate Finance Education CC (PREFE)
SM.............................. Stellenbosch Municipality
SU.............................. Stellenbosch University
SWH..........................solar water heater
UN.............................. United Nations
UNDP......................... United Nations Development Programme
UNFCCC................... United Nations Framework Convention on Climate Change
Watts.......................... Measurement of total electrical power. Volts × amps = watts
WBGU …………….. German Advisory Council on Global Change
WSSD......................... World Summit on Sustainable Development

CHAPTER 1 SUSTAINABLE ENERGY SYSTEM PROBLEMS IN SOUTH AFRICA

1.1 INTRODUCTION TO THE STUDY

The South African White Paper on Renewable Energy Policy, 2003 stated that sustainable energy that is generated from sustainable natural resources supports sustainable development. When bulk of energy sources are local and naturally available, security of energy supply will be enhanced and thus minimize disruption by international crises or limited supplies. However, the sustainable energy system problems in South Africa are largely blamed on the fact that South Africa's economy was dominated by a monopoly of fossil-fuelled energy supply during the apartheid years leading to the first democratic government after 1994 with highest carbon dioxide ($C0_2$) emissions (DME, 2003: x, 3). Pursuant to the adoption of Agenda 21 by the 1992 Earth Summit hosted by Brazil, ten years after South Africa hosted the World Summit on Sustainable Development (WSSD) on August 26 –September 4, 2002 in Johannesburg that amongst many things encouraged adoption of all renewable energy and energy efficiency systems to enhance sustainable development (NGLS Roundup 96, 2002: 5). The present study highlights problem areas in the South African energy portfolio starting from section 1.3 including dominance of coal-fired energy as shown in section 1.3.1 The thesis reflects on the energy policy design and impetus to drive sustainable energy after the 2008 energy crisis. It also makes links to international challenges of poverty, inequalities and climate change mitigations. The problem facing South Africa and the world is that fossil fuels, which have been blamed for causing global warming and devastating effects are unsustainable. South Africa started to regard the solar water heater systems (SWHs) seriously and is currently promoting them. The literature review will highlight the main driving factors behind embarking on sustainable energy consumption, and showing that adoption of the best international practised policy frameworks enhanced SWH rollout. It exposes such tendencies as disregard of culture and local languages in SWH projects as requiring more consideration.

1.2 MAIN RESEARCH QUESTIONS

In the Western Cape, Eastern Cape and Gauteng Provinces, SWH installation projects have been done and three specific initiatives will be mentioned in advancing the discussion of this main research question. Does the installation of sustainable energy systems in the form of integrated interventions such as SWHs, ceilings and CFLs contribute to improving the quality of life in poor households? It is argued that sustainable energy policy designs have enhanced sustainable energy transition, support energy efficiency and energy security. "Important drivers for policy interest in SWH as it is for most renewable energy technologies include energy security concerns, fuel mix diversification, climate change mitigation effects, and industrial and economic development opportunities" (Ackom et al, 2011: 4). NGLS Roundup 96, (2002: 5 - 6) noted poor access to sustainable, affordable and stable energy constrained human, social and economic development to achieve Millennium Development Goals (MDGs). Sustainable energy services can reduce poverty, advance social equity and environmental safety. Energy services have a huge impact on economic productivity, health, education, climate change, food and water security, and communication services. "Transition pathways for increasing the share of each RE technology through integration of should aim to facilitate a smoother integration with energy supply systems, but depend on specific sector, technology and region. Multiple benefits for energy users must be the ultimate aim" (Bhuyan et al, 2012: 616). After the oil crises of 1970s & 1980s Israel was the very first country globally to approve a solar ordinance to enforce the installation and usage of solar thermal systems in all new and renovated buildings (Kaufmann, & Milton, 2005). The background on sustainable energy and literature review will help to discuss the questions below.

1 What policy measures are required to enforce the SWH installation to improve quality of life for all?
2 How can SWH use growth help in enhancing local economic development (LED) to reduce poverty?
3 How can SWH market demand, skills and green jobs be created without exaggerating SWH benefits such as making claims of radical health status improvement, and without overlooking cultural context?

1.3 PROBLEM STATEMENT

Between October 2007 and February 2008 Eskom faced energy shortages and required 10% reduced energy consumption to manage energy shortages in South Africa from January 2008 onwards[1]. The present thesis topic is sustainable energy and the impact of policy design on the energy transition to renewable energy systems in Stellenbosch. It was primarily premised on undertaking Stellenbosch SWH by-law case study to investigate possibilities to enforce SWHs in new buildings and extensions to reduce consumption. Things changed as new building regulations were approved in 2011 to enforce efficient resource use including the SWHs and building designs (Schefferlie, 2012). Energy is virtually the key driver of economic growth with a major influence on the development of improved socio-economic living conditions (Winkler et al, 2005: 27). South African Constitution of 1996 embraced the United Nations sustainable development approach, Agenda 21 as attested in section, 1.3.2 (DME 203: 6). "Agenda 21 was unveiled in 1992 during the United Nations Conference on Environment and Development (UNCED), commonly known as the Rio Earth Summit, where more than 178 nations adopted Agenda 21 and pledged to evaluate progress made in implementing the plan every five years thereafter"[2]. Among many critical things Agenda 21 induces actions to enhance the adoption of sustainable energy systems to achieve sustainable development. However, South Africa has neglected to invest in sustainable energy policy implementation due to Eskom's monopoly and availability of cheap coal-fired electricity. Eskom is energy generator since 1923 and partial distributor of energy in partnership with 187 municipalities nationwide **(**Hallowes, 2009: 27; Kohler, 2008: 30).

1.3.1 Energy generation and major energy consumers

South Africa is faced with a challenge of overcoming poverty, and is required to improve the quality of life of its citizens to reduce huge inequalities that tend to dominate the economic landscape, with energy being a critical component in the enhancement of development.

Table 1.1: Energy generation and major energy consumers			
Energy generation portfolio		Major energy consumers	
Coal-fired plants	88.0%	Industrial sector	41.0%
Nuclear energy plant	6.5%	Transport sector	28.0%
Coal–to–liquid fuels (oil)	10.0%	Residential sector	17.0%
Small hydropower plants	2.0%	Grant Total	86.0%
Gas turbine facilities	2.0%		

Source: South Africa Yearbook, 2008/09: 409-410; Kohler, 2008: 41.

[1]Eskom Annual Report, 2008: 46, 48.
[2]Freedom 21 Santa Cruz.

Table 1.1 above shows that Eskom generates 95% of electricity supply mainly derived from the coal-fired plants (88%), nuclear energy (6.5%), small hydropower (2.3%), gas turbine facilities (2%), and 10% of coal–to–liquid fuel (Kohler, 2008: 3, 41; South Africa Yearbook, 2008/09: 409-410). The energy sector contributes 15% to the gross domestic product (GDP) and employees 250 000 in South Africa (South Africa Yearbook, 2010/11: 173). The three key energy consumers are industry, 41%, transport, 28% and the residential households, 17%. The supply of energy is an essential need for both individual and joint economic development operations, and for domestic activity. Energy resources help people to meet their daily needs in regards to pumping, transporting, and managing to carry out residential tasks, including producing and storing food, preparing food, keeping warm or cooling down, and heating water. The provision of energy enhances opportunities for people to become educated, to engage in income generative programmes to improve their quality of life and to strive for improved security (Clark & Drimie, 2002: 1). For Germans, the introduction of technological innovations helped to reduce the energy and material intensity of many products. However, the increased volumes of consumption of goods outweighed the gains made in this respect. Household energy consumption accounts for nearly 30% of total final energy consumption in Germany, which is more than South Africa's 17%, and, after transport, is the second most rapidly expanding area of energy use in the country (ZEW, 2009: 2).

1.3.2 Severe energy crisis

The White Paper on Energy Policy of 1998 indicated that investment in new energy capacity was required in 1999 to escape energy crisis that South Africa (SA) encountered from the end of 2007 to early 2008 as if it was not forewarned at all. Table 1.1 above gives a summary of Eskom total energy supply. Eskom is responsible for about 26 energy plants in South Africa with a total capacity of 42 618 MW on March 2008, of which 37 698 MW was available from 13 coal-fired power plants. Eskom also generate 929 MW from about four gas and liquid fuel turbines 661 MW from 6 small hydropower plants, and 1400 MW from two pumped-storage schemes and 1930 MW from one Koeberg nuclear power plant (Kohler, 2008: 7-9, 44-45). Eskom's reserve margin was estimated at 25% in 2000 and sharply declined to from 10% to 5% in 2008. One needs to keep in mind that a safe reserve margin should be between 15% and 20%. The independent power producers (IPPs) were to be enabled to generate 30% extra energy supply. The severe energy crisis occurred due to dwindling infrastructure systems, poor planning, rapid economic growth of more than 4%, delayed new investments and outdated Eskom infrastructure (Kohler, 2008: 3, 7-9, 38, 41).

The energy shortage in South Africa halted the Constitutional mandate and the ability of the country to enhance the quality of life of its citizens. The New Constitution of South Africa guarantees equality for all and empowers all government organs to advance an energy policy that has, as its chief mandate, to dispense reliable energy for all citizens. The Constitution is a primary motivator of the striving to enhance the quality of life for all South Africans. The Department of Minerals and Energy (DME, 2003: 6) stated that "The production and distribution of energy should be sustainable and lead to an improvement in the standards of living of citizens. The Bill of Rights provides that everyone has the right (a) to an environment that is not harmful to their health or well-being, and (b) to have the environment protected for the benefit of present and future generations through reasonable legislative and other measures that (i) prevent pollution and ecological degradation, (ii) promote conservation, and (iii) secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development." In addition to its severe energy crisis, South Africa recognises that the production of coal-fired energy releases carbon dioxide ($C0_2$) emissions, which are globally regarded as the leading greenhouse gas emissions, that are responsible for climate change, with attendant international policy imperatives to cut down their amount (DME, 2003: 3, 10). In essence the "current methods of producing and using energy have environmental, and health effects that increasingly endanger welfare and the key challenge is to move to cleaner energy supply and more efficient use, while continuing to extend affordable access to modern energy services, in particular for poor rural and urban communities" (Winkler, 2005: 27). South Africa faces high poverty, joblessness, rising population numbers and the growing electricity demand.

1.3.3 Extended electricity access

Since 1994, in efforts to meet the historically unmet electricity demand, the African National Congress (ANC) led government extended electricity access to the majority of South Africa citizens. Electricity access improved from 36% in 1994 to more than 70% in 2002, increasing to 76% in 2009 and to 84% in 2010 (ANC, 2011: 2; Bukula, 2009; Prasad, 2007: 3). The energy crisis resulted in a painful and yet inevitable increase in electricity prices. Former South African President Thabo Mbeki (2008) stated that "this situation has precipitated the inevitable realisation that the era of very cheap and abundant electricity has come to an end". "The price of electricity in South Africa was unsustainably low and does not reflect the true cost of producing, transporting and distributing electricity" (Eskom, 2008: 11).

1.3.4 Electricity prices

In 2006, the NUS Consulting research listed South Africa as a supplier of one of the cheapest forms of electricity out of 14 nations worldwide namely Denmark; Italy; Germany; Belgium; Netherlands; Spain; the United States; the United Kingdom; France; Finland; Canada; Sweden; and Australia. This research showed that the South African electricity tariff was just US4.05c per kWh, with Australia as the next cheapest electricity price 31% more expensive than South Africa and Denmark 231% more expensive than South Africa (Kohler, 2008: 36).

TABLE 1.2: ELECTRICITY PRICE COMPARISON
ELECTRICITY PRICE COMPARISON FOR 14 COUNTRIES

2006 RANK	2005 RANK	COUNTRY	COST 2006, US CENTS PER kWh
1.	2	Denmark	13, 41
2.	1	Italy	13, 24
3.	8	UK	11,03
4.	5	The Netherlands	11,01
5.	9	France	10, 53
6.	4	Belgium	10, 50
7.	3	Germany	10, 33
8.	6	Spain	9, 30
9.	7	US	8,82
10.	10	Finland	8, 09
11.	13	Sweden	6, 96
12.	11	Canada	5, 87
13.	12	Australia	5,29
14.	14	South Africa	4,05

The survey is based on prices as of April 2006 for the supply of 1000 kW for an organisation with a monthly usage of 450 000 kWh. All prices are in US cents a kilowatt hour and excluded VAT (Kohler, 2008: 36). Table 1.2 gives 14 nations electricity prices. The National

Energy Regulator of South Africa (Nersa) among other matters is mandated to regulate and approve Eskom's electricity tariffs (EIA, 2010: 3). In December 2007, Eskom was granted 14.2% electricity tariff increases by Nersa. The multi-year price determination (MYPD) enabled the authorities to increase electricity tariffs for three consecutive years, since 2006 (Kohler, 2008: 37). Nersa granted Eskom a 27% electricity hike in 2008 and 31.3% in 2009 (Reuters, 2009). Nersa approved a 24.8% tariff increments from 1 April 2010, a 25.8% increase for 2011/12, and s further 25.9% increase for 2012/13. The electricity price will increase to more than 41.5c/kWh for 2010/11, 52c/kWh for 2011/12 and more than 65c/kWh in 2012/13 (Nersa, 2010).

During the 2012 National Address President Gedleyihlekisa, Jacob Zuma told the nation, South Africa: "There is an ongoing concern from business and communities about high electricity costs" (Zuma, 2012). Furthermore the President has said: "I have asked Eskom to seek options on how the price increase requirement may be reduced over the next few years, in support of economic growth and job creation and give me proposals for consideration. We need an electricity price path which will ensure that Eskom and the industry remain financially viable and sustainable, but which remains affordable especially for the poor" (Zuma, 2012). In response to President Zuma's call Nersa has subsequently reduced electricity tariffs increments. "The National Energy Regulator of South Africa (Nersa) has revised Eskom's power tariff increases for the period April 1, 2012, to March 31, 2013, from the 25.9% approved previously to 16%" (Creamer, 2012).

1.3.5 Electricity generation capital

Eskom's electricity generation capital has increased from R84 bn to more R500bn in 2011 for energy generation capital, mainly to complete two new coal-fired power plants, Kusile (4800 MW), at a cost of R140.7bn, and Medupi (4800 MW), at a cost of R125 bn (Creamer Media and Kohler, 2011: 10). Eskom will retrofit Medupi power plant with a clean technology such as flue gas desulphurisation (FGD) to reduce nearly 90% of $C0_2$ emissions. Kusile coal-fired power plant will be equipped with FGD technology from the start. "The FGD investment is a requirement of a loan package agreement for this project from the World Bank" (Marokane, 2010). South Africa realized that attaining sustainable energy and efficiency will help reduce its high $C0_2$ emissions. The one million SWHs rollout could reduce 587 GWh of electricity demand from Eskom a year, avoid building of 2000MW power plant with savings of 3,1 million litres of water, 1,2 million tonnes of coal and 2, 320 billion tonnes of $C0_2$ emissions from avoided combustion of coal (Frost & Sullivan, 2011: 5).

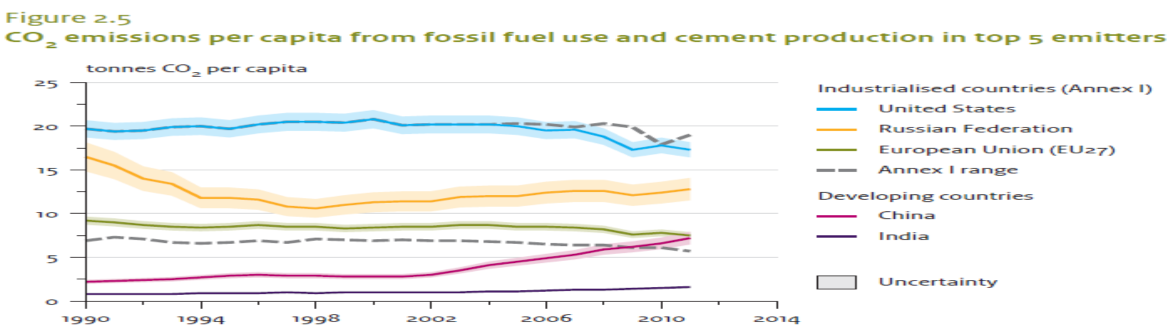
Eskom sought to double its energy generation capacity from over 40 000MW to 80 000MW by 2025 with solar energy and wind energy. The ministers of the Department of Public Enterprises and the Department of Energy (DOE) supported Eskom to obtain the World Bank loan of US$3.75bn (R27.7bn) in order to strengthen its electricity baseload capacity. The South African reality is that the nation's coal-fired energy supply will be used for the foreseeable future as acknowledged by the World Bank (Marokane, 2010; Kohler, 2008: 11).

The above stated electricity price increment happened during the time when Eskom supported by the government was asking the World Bank loan to complete these new coal-fired plants, Kusile and Medupi. In this heated coal-fired debate Professor Mark Swilling advanced a view that focused the national argument on starting to seriously invest on sustainable energy systems. "In reality, this decision should not be about carbon or the environment at all, but should be a purely economic decision, i.e what will best incentivise innovation, job creation, investments and global competitiveness? Investing in mature capital-intensive technologies creates fewer jobs than investments in new decentralised technologies that are not captured by monopolistic value chains. South Africa needs to harness its entrepreneurial energies to drive returns on innovation and not just rely on the same old SA story-cheap resources and labour exploitation" (Swilling, 2010). The World Bank loan granted to Eskom recognized the need stabilize South Africa's electricity supply to meet its obligations to improve lives and sustainable electricity supply locally and in the Southern Africa. Building stable electricity supply after 2008 energy crisis is very costly after forced week long industrial closure early January 2008 and loss of R50bn to the GDP, which induced South Africa's attention to energy efficiency and renewed electricity capacity plans (Hallowes, 2009: 10, 12).

1.3.6 Worldwide carbon dioxide emissions

Worldwide carbon dioxide (CO_2) emissions which are the major cause for global warming has increased by 3% in 2011 and reached high growth of 34 billion tonnes in 2011. In 2011 the average Chinese per capita CO_2 emissions also expanded by about 9% to 7.2 tonnes CO_2. "Taking into account an uncertainty margin of 10%, this is similar to the per capita emissions in the European Union of 7.5 tonnes in 2011, the year in which the European Union saw a decrease in emissions of 3%. China, the world's most populous country, is now well within the 6 to 19 tonnes/person range spanned by the major industrialised countries. In comparison, in 2011, the United States was still one of the largest emitters of CO_2 with 17.3 tonnes in per capita emissions, after a steep decline mainly caused by the recession in 2008–2009, high oil prices compared to low fuel taxes and an increased share of natural gas" (European Commission and PBL Netherlands Environmental Assessment Agency, 2012: 6). In 2012, the UN head has declared commitments to his "Sustainable Energy For All" initiative during Rio+20 review of UN development conference in Brazil (see section 1.3.9), the first public pledges made to the program since its launch in September 2011 to double sustainable energy share and reduce $C0_2$ emissions responsible for climate change (Reuters, 2012).

Figure 1.1: CO_2 emissions per capita from fuel use

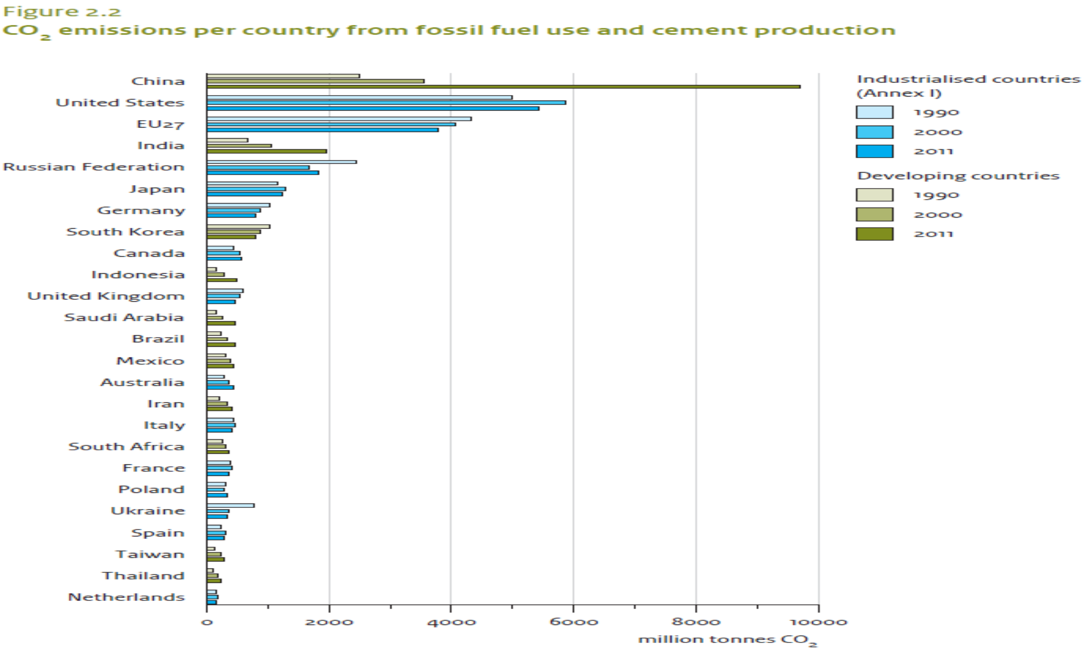


Source: European Commission and PBL Netherlands Environmental Assessment Agency, 2012:15

Sustainable energy is invoked to reduce $C0_2$ emissions trends. "The trends in CO_2 emissions per inhabitant of the top 5 emitting countries are shown in Figure 2.5. These trends reflect a number of factors including the large economic development in China, structural changes in national and global economies, the impacts of major economic downturns in the Russian Federation in the early 1990s and in the United States in 2008 and 2009, and the impact of climate and energy policies" (European Commission and PBL Netherlands Environmental Assessment Agency, 2012: 15). As from 1990, China's CO_2 emissions per person expanded from 2.2 to 7.2 tonnes in 2011 while the EU27 $C0_2$ decreased from 9.2 to 7.5 tonnes per person and in the US from 19.7 to 17.3 tonnes per person during the same period (European

Commission and PBL Netherlands Environmental Assessment Agency, 2012: 13). The "CO_2 emissions are generated by carbonate oxidation in the cement clinker production process, the main constituent of cement and the largest of non-combustion sources of CO_2 from industrial manufacturing, contributing about 4% to total global emissions. Fuel combustion emissions of CO_2 related to cement production are of the approximate same level, so, in total, cement production accounts for roughly 8% of global CO_2 emissions …" (European Commission & PBL Netherlands Environmental Assessment Agency, 2012:16-17).

FIGURE 1.2: $C0_2$ EMISSIONS PER COUNTRY FROM FOSSIL FUEL USE



Source: European Commission & PBL Netherlands Environmental Assessment Agency, 2012:14).

Figure 1.2 features South Africa among the top 20 countries $C0_2$ emitters. The 3% increase in worldwide CO_2 emissions in 2011 is above the past decade's average yearly increase of 2.7% slightly shrinked in 2008 and surge of 5% in 2010. Top emitters contributing to the 34 billion tonnes of CO_2 spewed globally in 2011 are China (29%), the United States (16%), European Union (11%), India (6%), the Russian Federation (5%) and was 4% in Japan (Watts, 2012).

1.3.7 Effects of global climate change

Africa is one of the poorest continents globally, suffering the adverse effects of global climate change, to which it only contributes 3% to 4% in total global $C0_2$ emissions. The continent is struggling to cope with a poor quality of life, concerning itself with poverty alleviation efforts and with enhancing its adaptation capability. As stated earlier in subsection 1.3.2 (DME, 2003: 3, 10; Winkler et al, 2005: 27), South Africa needed to embark on a sustainable energy paradigm shift to be low carbon intensive rather than to rely, as it has in the past, mainly on fossil fuels (Davidson et al, 2007: 3; Engineering News, 2011).

According to Reuters (2009), "the U.N. Climate Panel projects that up to 250 million people in Africa could face greater stress on water supplies by 2020 and that yields from rain-fed agriculture could fall by up to 50 percent by 2020 in some African nations". Some of the "developments are often built on green field sites, cutting down trees and other foliage for these developments reduces the capacity of the natural environment to absorb carbon dioxide" (Joburg, 2009). The natural system absorbs a fraction of $C0_2$ emissions from the atmosphere, of which 20% of emitted gas remains in the air for at least a millennium and, in turn, continues to cause global warming long after the emissions are reduced. “The thermal inertia of the oceans also plays a part: the large mass of ocean water on the planet is delaying the rate of climate warming today because most of it is lagging behind the changes in surface temperature. Once it has warmed it will retard the Earth's cooling after emissions cease” (Monastersky et al, 2009). Climate change compromises quality of life and living conditions.

In Glad et al n. d: 103-104 it is stated that the IPCC (2007) reports that temperature increase is projected to be from 1°C to 2°C, with an increase in precipitation of 20% for the 2020 to 2029 scenarios relative to 1980 to 1999. For the long-term scenario until 2090 to 2099, the projections are in the form of 4°C to 5°C. Impacts like this should be incorporated in the analysis of future energy systems and design criteria, since they will serve to reduce heat demand and to enhance the risk of overheating in buildings. The previous century witnessed an increase in the average temperature of the Earth’s surface of by 0.6°C, with the sea level increasing by between 10 and 20 cm, glaciers retreating nearly everywhere in significant proportions, the intensity of cyclones escalating in the North Atlantic and weather phenomena, in the form of storms, floods and droughts, becoming extreme. Even if carbon emissions were to be halted today or tomorrow, worldwide temperatures are likely to increase by at least another half a degree Celsius and sea levels to escalate by another 11 cm by the end of the 21^{st} century. Significant reduction in carbon emissions is necessary if a less than 2ºC temperature increase is to be averted (Ashley et al, 2011: 8).

1.3.8 Inequality trends

The inequality trends in South Africa are a reflection of inequality trends and global poverty. The United Nations Food and Agricultural Organisation (FAO) in 2009 reported that nearly 1.2 billion of people globally had a poor quality of life, including from the developed nations, with poverty affecting about 15 million people; the Near East and North Africa (42 million); the Latin America and Caribbean (53 million); Southern Africa (265 million); the Asia and Pacific (642 million). Most of the affected global citizens are from developing nations in Asia and the Pacific, Southern Africa, Latin American and the Caribbean regions (World Hunger Education Service, 2010). The 2011 Global Wealth Report states that to be counted amongst the world’s rich people an adult must have US$4200 in assets without debts, and US$82 000 enable the adult to be counted amongst the top 10% richest global citizens. “In sharp contrast the richest 10% own 84% of the world’s wealth, with 1% alone accounting for 44% of global assets” (Research Institute, 2011: 09-10).

Tables 1.3 to 1.5 present inequalities pertaining to a global energy consumption of countries. In essence the energy consumption imbalances reflected below shows South Africa with high patterns of electricity consumption per capita per annum while China’s remains low. Figure 1.1 and Figure 1.2 above have already shown that China, Japan, US, UK and most EU27 are burning fossil fuels and spew highest $C0_2$ missions responsible for climate change globally. Crane & Swilling (2007: 2) stated that “we live in a highly unequal world, urbanized world connected to rapidly degrading eco-system services, with looming threats triggered by climate change, high oil prices and food insecurities”. Poverty, unemployment and inequality still remain deep chronic scar in the collective consciences of all people of goodwill globally. The National Planning Commission of South Africa understood these problematic challenges as this is demonstrated by the opening words of its National Development Plan Vision 2030. “No political democracy can survive and flourish if the mass of our people remain in poverty without land, without tangible prospects for a better life. Attacking poverty and deprivation must therefore be the first priority of a democratic government” – The Reconstruction and

Development Programme, 1994 (National Planning Commission, 2011: 1). Energy usage evidently shows worldwide discrepancies with the developed countries consuming huge amounts of energy. Table 1.3 below shows Canada compared with 19 other countries.

TABLE 1.3: 20 COUNTRIES ENERGY CONSUMPTION kWh/CAPITA PER YEAR			
Country name	2007	2008	2009
Australia	11,149	11,182	11,113
Botswana	1,533	1,568	1,503
Brazil	**2,175**	**2,237**	**2,206**
Canada	**16,846**	**16,449**	**15,471**
China	**2,329**	**2,457**	**2,631**
Germany	7,184	7,149	6,779
Ghana	247	267	265
Kenya	149	149	147
India	539	564	571
Italy	5,713	5,661	5,271
Japan	**8,490**	**8,091**	**7,819**
Libya	3,965	4,001	4,170
Nigeria	138	127	121
Russian Federation	6,317	6,435	6,133
South Africa	**4,938**	**4,759**	**4,532**
Spain	6,335	6,393	6,006
Ukraine	3,529	3,534	3,200
United Arab Emirates	**13,050**	**12,206**	**11,464**
United Kingdom	6,152	6,055	5,692
United States	**13,657**	**13,663**	**12,914**
Source: World Bank, 2012			

Table 1.3 captures a typical average picture of 20 countries energy consumption, kWh per capita per country, with South Africa demonstrating very high levels of average energy consumption ranging between 4,938 kWh in 2007, 4,759 kWh in 2008 and 4,532 kWh in

2009 per capita. South Africa's average energy consumption is almost doubled that of China, which was 2,329 kWh in 2007, 2,457 kWh in 2008 and 2,631 kWh in 2009, whereas it doubled Brazilians average energy consumption which was 2 175 kWh in 2007, 2 237 kWh in 2008 and 2206 kWh in 2009. South Africa still grapples with apartheid inherited inequalities. Our planers argued that inequality could be reduced if the Gini co-efficient falls from present level of 0.7 to 0.6 by 2030 (National Planning Commission, 2011: 3).

Table 1:4 Energy consumption per kWh covering six countries 1980-2009									
Country	**1980**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**
China	**282**	**511**	**770**	**993**	**1783**	**2,041**	**2,329**	**2,457**	**2,631**
France	4,426	5,974	6,631	7,255	7,677	7,558	7,541	7,683	7,488
Germany	5,796	6,640	6,331	6,636	7,113	7,174	7,184	7,149	6,779
Japan	4,718	6,486	7,365	7,974	8,213	8,253	8,490	8,091	7,819
UK	4,684	5,357	5,576	6,115	6,289	6,226	6,152	6,055	5,692
US	9862	11713	12660	13671	13694	13574	13642	13651	12904
Source: Yao and Luo, 2012: 6-7									

Tables 1.3-1.5 in many ways capture the international patterns of energy use as informed by varying per person usages. Worldwide, per capita incomes, broader indicators such as the Human Development Index are favourably correlated with per person energy consumption, and economic growth can be viewed as the most relevant factor driving increasing energy consumption in the previous years. As economic functions expands and diversifies, demands for advanced sophisticated and flexible energy systems arise.

TABLE 1:5 PER CAPITA ENERGY CONSUMPTION PER kWh FOR VARIOUS REGIONS									
	1980	1990	1995	2000	2005	2006	2007	2008	2009
World	**1,586**	**2,123**	**2,200**	**2,392**	**2,675**	**2,756**	**2,851**	**2,877**	**2,826**
Euro area	4,205	5,340	5,637	6,321	6,839	6,930	6,930	6,934	6,592
High income	4,203	5,185	5,329	5,855	6,305	6,385	6,391	6,387	6,066
Middle income	375	945	959	1,067	1,387	1,498	1,612	1660	1,693
Low income	135	221	181	174	214	224	224	228	230
OECD	5,361	6,669	7,213	7,957	8,308	8,315	8,397	8,368	7,984
Source: Yao and Luo, 2012: 6									

1.3.9 Global economic crisis and fuel prices effects

The South African energy crisis of late 2007 and early 2008 was followed by an international economic crisis of 2008 with negative effects on improving quality of life due to job losses. Prior the financial crisis world population proportion living in abject poverty was viewed to be shrinking, forecasts indicated that by 2015 there will still be almost 1 billion people living on under US$1 a day and nearly 3 billion living on under US$2 a day (Barbier, 2009: 21). Sustainable energy is key to reducing global poverty and efficiency. Ashley et al (2011: 3) argued that "the impact of the global economic crisis on South Africa was severe. The South African economy contracted, especially in the manufacturing sector, exports plunged, and more than a million jobs were lost between October 2008 and the first quarter of 2010. Even after the South African economy started to grow again, jobs continued to be shed in both the formal and informal economy". Increases of fuel prices result to increased transport and agricultural sector costs, and in food security for the poor being compromised. The "prices for food traded internationally increased almost 60 per cent during the first half of 2008 with basic staples such as grains and oilseeds showing the largest increases" (Barbier, 2009: 22). The global economic crisis and high fuel prices are symptomatic of a rapidly growing global population whose highly manipulative economic systems and growth have subjected many to chronic poverty, while elevating a scant few to a state of abundant wealth (10%). The global population climbed to 7 billion on 31 October 2011. The extreme global population growth currently experienced is a relatively new phenomenon. Two thousand years ago, the global population was 300 million. It took more than 1 600 years for the number of global citizens to double to 600 million. The rapid global population growth rate commenced in 1950, due to reduced mortality rates being experienced in the developing countries, which resulted in the presence of an estimated 6.1 billion people in 2000 on the planet, which was almost two-and-a-half times the 1950 global population size. In 2050, the world population is projected to reach between 9.3 billion and 10.6 billion, and it is likely to be more than 15 billion in 2100 (UNFPA, 2011: 5-7). When narrowing down the global citizen figures to those areas that are closer to home, the African population can be seen to be growing rapidly. The Sustainable Water Conference that was hosted by the University of Nairobi in Kenya from 26 to 29 August 2009, and which was sponsored by the Royal Society of Chemistry and Syngenta, noted this trend. In 2009, Africa had exceeded 1 billion in population, with an increase of 2.4% per year, of which 341 million had no access to clean drinking water and 589 million had no access to adequate sanitation (PACN, 2010: 7). Such crises have the potential to arrest South Africa's progress to achieve the Millennium Development Goals (MDGs) of halving poverty and joblessness by 2015 (UN, 2010: 8-12). In June 2012, the UN secretary general Ban Ki-moon stated that more than 50 governments launched new energy mechanisms, while private investors have pledged over $50-billion to help carry out his goal to double the share of global sustainable energy and energy efficiency improvement by 2030 (Reuters, 2012).

1.4 SOUTH AFRICAN SOCIO-ECONOMIC DEMOGRAPHICS

Sustainable energy is about the people, environmental safety and relation to the wholeness of life. South African socio-economic demographics are marked by a population increase from 40 million in 1994 to an estimated 47.9 million in 2007, and to 50.59 million people in July 2011. The increase in the number of households has occurred more rapidly than that of the population itself, with associated demands being made for various resources and bulk infrastructure development (Chikulo, 2011: 6; Statistics South Africa, 2011: 6, 12).

Now the CENSUS 2011 outcomes of South Africa's population trends shows a rapid growth from about 40 583 572 million in 1996 to 44 819 777 million in 2001, and 51 770 560 million in 2011 (Statistics South Africa, 2012: 15). "In terms of income, huge disparities still exist with the highest average household income R156 000 in Gauteng and the lowest in Limpopo at R56000. The average household income for black South Africans was R60 000 and for whites R365 000" (Nicholson, 2012). Bulk of the above stated population needs jobs. All means of addressing increasing inequalities must be explored. Creating new employment opportunities is viewed as a very positive long-term effect of RE both in the developed and developing nations and was stressed in most national green-growth strategies. The policymakers embraced the development of local markets for RE as a means to gain competitive advantage in providing international Markets (Yamba et al, 2012: 191). The possibility and potential for sustainable green jobs in sustainable energy industry is shown under section 2.9.1, Table 2.1, and under section 2.9.6, Chinese sustainable energy industry.

The experience of poverty remains stubbornly highest amongst the African blacks (54.8%), followed by African Coloureds (34.2%), African Indians (7.1%), and African Whites (0.4%). This trend reflects the perpetual consequences of the legacy of apartheid, with poverty not only being deep-rooted, but with the economic structure locking the majority of the people into the poverty in which they were subsequently born and raised. Hence, poorer households, mostly those of African blacks, still have unsatisfactory access to such basic services as clean water, decent housing, energy, good health care, and education (Chikulo, 2011: 6). Table 1.6 reflects South Africa's poverty rate (Chikulo, 2011: 6). This deprives many people freedom.

Table 1.6: South African poverty rate, population share and poverty share by population group

Group population	**Poverty rate of individuals Percentage shares**	**Population of poor individuals percentage shares**	
African Blacks	54.8	80.1	93.3
African Coloureds	34.2	8.7	6.3
African Indians	7.1	2.5	0.4
African Whites	0.4	8.6	0.1
Grand Total	47.1	100.0	100.0
Source: Chikulo, 2011: 6			

1.4.1 Unemployment rate

In South Africa, during the first quarter of 2011 unemployment rate was at 25,0%, in the fourth quarter of 2011 it decreased to 23.9% and in the first quarter 2012 the total rate of joblessness was 25.2%, which amounted to 4.5 million in real figures. The jobless rate of white people ranged from 5.9% in the first quarter of 2011, 6.7% in the fourth quarter of 2011 and 6.1% in the first quarter of 2012. The jobless rate of black Africans was 29.0% and 27.7%, Coloureds 22.6% and 21.1%, and Asians, 11.7% and 8.5% in the first quarter to the fourth quarter of 2011 respectively (Statistics South Africa, 2012: 17). Census 2011 results have shown that unemployment rate has increasingly deteriorated from the above stated estimated 25% during the first quarter of 2011 to 29.8%, which was almost 6% higher than 23.9% finding recorded by the 2011 fourth quarter labour force survey (QLFS). Expanded 40% joblessness figure includes people who have given up looking for employment during the time of census 2011 compared with 35.4% recorded by the labour force survey. Western Cape Province population has rapidly grown from 3 956 875 in 1996 to 4 524 335 in 2001 and 5 882 734 in 2011 (Statistics South Africa n. d: 3). The Western Cape is counted amongst the three provinces with a relatively low joblessness rate below the national average, with the other two provinces being KwaZulu-Natal (20.3%) and Limpopo (19.3%), with that of the latter having increased by more than 4% from 17.8% in the first quarter of 2008 to 22.2% during the first quarter of 2011. During 2011, joblessness rate of black Africans was 32%, that of Coloured Africans 21.9% and that of African white people 5.6% in the Western Cape region (Provincial Treasury, 2011: 88, 108-109, 125). Stellenbosch Municipality (SM) is a crucial part of the Cape Winelands District Municipality (CWDM), which includes the following local municipalities: Breede Valley (139 940), Drakenstein (217 746), Langeberg (81 679), Stellenbosch (188 601) and Witzenberg (77 921), with an estimated total population of 711 498 in 2010, accounting for 13.6% of the total Western Cape Province population and for about 1.4% of the South African population (CWDM, 2011: 26). The unemployment rate was 19% in the CWDM, which was low in comparison to the 22.2% of the Western Cape Province, and to the more than 25.7% national average (Aroun, n. d: 9). Stellenbosch unemployment was estimated at 17% in 2011, which was higher compared to Langeberg (14%) and Witzenberg (15%), and lower than the Breede Valley (23%) and Drakenstein (23%) respectively (CWDM, 2011: 41). Joblessness mainly affects youth aged between 15 to 35 years with more than three million of them being jobless (Department of Labour, 2010: 4). South Africa is committed to achieving the MDGs of halving the current joblessness and poverty rate by 2015. In 2005, South Africa experienced numerous service delivery protests against poor service delivery, nepotism, the irregular administration of tenders, housing demand, and corruption, with not all of the protests being exclusively directed at the municipalities (Muller, 2006; Reuters, 2011). From August 2008 onwards the global economic crisis halted all forms of economic growth and worsened joblessness, which many countries worldwide tried very hard to escape. In the third quarter of 2010, the Republic of Korea had a 3.5% unemployment. China, specifically in Hong Kong had 4.6% joblessness in September 2010. During the same period in Brazil, six metropolitan areas had 6.2% unemployment and in 2011 the United States grappled with over 9% unemployment (ILO, 2011: 28, 35, 39; Provincial Treasury, 2011: 14).[3]

1.4.2 Effects

The above stated unemployment rate figures have had serious implications in terms of ordinary people's buying power, and have entangled many people in a perpetually poor quality of life. The United Nations (2010: 12) stated that "prices of staple foods remained high in 2009 after the initial food crisis of 2008. At the same time, the incomes of poor households diminished because of higher unemployment following the economic downturn. Both crises contributed to a considerable reduction in the effective purchasing power of poor consumers who spend substantial share of their income on basic foodstuffs." The definition of poverty below is one among many others and was advanced by the World Bank in 2009. "Poverty is hunger. Poverty is lack of shelter. Poverty is being sick and not being able to see a doctor. Poverty is not being able to go to school and not knowing how to read. Poverty is not having a job, is fear for the future, living one day at a time. Poverty is losing a child to illness brought about by unclean water. Poverty is powerlessness, lack of representation and freedom" (Cristib and Morósa n. d: 4). Our world is defined along poverty lines.

For very poor nations and poor developing nations the measurement of poverty is often US$1.25 and US$2 per day respectively compared to rich nations measurements already alluded to in section 1.3.9. For instance, Japan, United Kingdom and United States measure their poverty line by US$14 or US$26.19 per day (Nyasulu, 2010: 149). In South Africa, a country grappling with poverty in 1999, Eve Annecke and Prof Mark Swilling founded the Lynedoch green village, located in the Western Cape 12 km away from the historic town of Stellenbosch not far from Cape Town. "This south-western tip of Africa is where the Indian and Atlantic oceans notionally meet and it is the home of fynbos which is the smallest and most diverse of Earth's six biomes. As the first hinterland outpost of the Dutch colonial settlement in the mid-1600s in what is now Cape Town, Stellenbosch is often regarded as the intellectual birthplace of apartheid. This legacy is reflected in the harsh inequalities in wealth and land ownership that still characterise this rich agricultural region. We started building the Lynedoch EcoVillage in 1999 with a group that included a local housing activist, landless farmers, the local school principal and two architects who were prepared to figure out what it means to design for sustainability" (Annecke & Swilling, 2012).

[3]ILO. 2011. Global employment trends 2011: The challenge of a jobs recovery.

1.4.3 Housing conditions

See sections 1.6 and 3.1.2 for more details of Lynedoch case. The housing condition is a key determinant of the living conditions of any community. Having a bearing on human health and labour-force productivity, the condition is dictated by economic conditions and especially by income and housing costs. Currently lack of access to housing is characterized by inequalities inherited from apartheid in South Africa. After 1994, the country followed a policy of building millions of Reconstruction and Development Programme (RDP) houses with less regard for quality, overlooking poor energy efficiency, ceiling insulation and thermal performance needs to address the apartheid legacy. The roofing was placed directly upon solid wall structure resulting in the poor thermal performance of RDP houses (CURES, 2009: 11). In 2007, the housing backlog was estimated at 7 million (14.5%) as being the total number of citizens living in shacks (Rangasami, 2011). Since then, the housing backlog has not been substantially improved instead the backlog has escalated.

In 2010, when South Africa was reportedly facing a housing shortage of 2.1 million (12 million people), R16bn was allocated to building low-income houses in the 2010/11 fiscal year, having increased from R9bn in the 2008/09 fiscal year (Cross, 2008: 3; Van Wyk, 2010: 177). In the light of the political history of apartheid that led to the exclusion of the majority of South Africans from improving their quality of life, the new inclusive political rhetoric asserted the right of quality of life for all. After 1994, the delivery of RDP housing became one of the top priorities of the ANC-led government, which built more than 2 million homes in their striving to realise their 'better life for all' vision (Muller, 2006). CASE (2006: 14) states that "quality of life depends on your life circumstances: whether you are employed, where you live, your gender, class and culture". During cold and rainy winter days, poor households living in either informal or RDP houses tend to use dangerous raw coal and paraffin heaters for space and water heating. The result is that smoke that is inhaled indoors endangers the quality of life of those concerned (CURES, 2009: 7). CURES, with reference to Ward (2002: 66), also states that the orientation and layout of houses, as well as the building materials chosen, could be utilised more efficiently (CURES, 2009: 11).

1.4.4 Housing in the Western Cape Province

In 2010, the housing backlog of the Western Cape was 426 711 units. In essence the household income level provides insight into the economic behaviour and buying capacity of the community concerned. The housing backlog of CWDM region was estimated at 75 764, of which Stellenbosch Municipality (SM) accounted for 16 643 (CWDM, 2011: 32; Provincial Treasury, 2011: 137-138). Sustainable energy signals were contained in the document entitled Stellenbosch 2017 Housing Strategy 2008. The strategy sought to introduce some sustainable ways of dealing with housing inequalities, with a projected budget of R9bn to reduce housing backlog of 20 000 housing units by 2017 and to mitigate the increasing energy demand as well. The strategists concerned envisage that 68% of the project could be delivered in partnership with the private sector (CWDM, 2010: 23). Winkler (2006: 4) has stated that "energy is understood as necessary, but not sufficient for development". Energy is key to a better life quality. The CWDM (2011: 22) has shown a high regard for, and listed quality of life among its key local economic development (LED) growth drivers. It views quality of life "as an all-encompassing driver with specific programmes in the Expanded Public Works Programme aimed at improved infrastructure, overcoming backlogs in service delivery, providing education, health and safety services and so on".

1.4.5 Renewable energy policy

Improving the quality of life for the above-stated poor population segment is a priority. The present study has established the broader context within which the above complex problem statement, starting from section 1.3 to 1.3.1 up to subsection 1.4.4, should be understood. The White Paper on Energy Policy, 1998 has promised diversification of energy portfolio. The White Paper on Renewable Energy Policy, 2003 envisaged to produce 10 000 GWh from renewable energy systems by 2013, and SWHs were to contribute 23% of the total target (Fakir & Nicol, 2008: 22; Winkler et al, 2010: 6). After 2008 energy crisis, South Africa has seen more clean energy targets emerging as attested by its renewable energy policy design.

Since March 2011 sustainable energy systems were designated to contributing 42% of new electricity generation, while 23% would come from nuclear energy, and about 15% would be derived from coal-fired electricity by 2030. The South African 20 Year Energy Master Plan which is an integrated resource plan 2010 (IRP 2010) was approved by the Cabinet (Manyi, 2011). South Africa has voluntarily committed itself to achieving 34% $C0_2$ reduction by 2020 and 42% $C0_2$ reduction by 2025. In terms of the Long-Term Mitigation Scenario (LTMS), local emissions are to peak from 2020 to 2025 and decline thereafter (Winkler et al, 2010: 2).

- The Energy Efficiency Strategy was published in 2005 is aimed at cutting demand and consumption, enabling a 12% energy savings in 2015 (DME, 2003: 25-26; DME, 2005: 2). The Electricity Regulation Act 4 of 2006 provides a strong legal basis for the operation and mandate of Nersa. The Energy Act of 2008 provides the basis for integrated energy planning in the form of the Renewable Energy and Energy Efficiency Partnership (REEEP). Eskom generation capacity is set to double to 80 000 MW by 2025 at R1.3 trillion capital, if the South African economy grows by 6% per year. Eskom requested 10% reduction usage countrywide (Hallowes, 2009: 13, 19).

- Eskom embarked on a massive demand-side management (DSM) exercise to arrest the energy crisis, for which it required R4bn, but instead received only R2bn from Nersa to drive 925 000 to a 1 million SWH rollout. If the installation of a SWH is correctly done, the household energy consumption will be cut by 60%, with a 30% to 40% savings per month (DME, 2009: 8; Mangena, 2007; Eskom & Nano, 2008: 4-5). The Eskom SWH rebate to induce consumers to switch to embracing the SWHs was more than doubled since early 2010 from R2bn to R5.4bn (Van der Merwe, 2010a)[4].

- The Department of Trade and Industry (DTI) released the Industrial Policy Action Plan 2010 (IPAP, 2010) in April 2010 with specific targets set at enhancing green economic markets. In conjunction with the Department of Energy (DOE) and the Department of Public Enterprise (DPE), the DTI has acknowledged that the DoE plans to roll out 1 million SWH by 2014, and that it is committed to contributing to a 5.6 million SWH rollout by 2020 (IPAP2, 2010).
- The Economic Development Department (EDD) has proposed a New Growth Path that is premised on a target to create 5 million jobs over a ten-year period in South Africa. The reduction of unemployment from 25% to 15% over the same period has a special focus on green economic development such as entering the solar energy and wind

[4]Christine Van der Merwe, 2010a. SOLAR WATER HEATING, Higher rebates spur interest in solar water heating – Eskom, released on October 06, 2010, Engineering News Online.

energy markets. EDD plans to provide 300 000 green jobs by 2020 and 400 000 green jobs by 2030. The Industrial Development Corporation (IDC) was allocated R25bn to support the green economy over five years (Maseko, 2010; Smit, 2011). The above-stated new energy policy portfolio shift can potentially contribute to improving the quality of life, social equity and grant alternative income generative opportunities.

1.5 RESEARCH PROBLEM

The South African renewable energy policy envisages significantly promising shifts, in which SWHs have assumed a centre stage. The research problem for the current thesis is threefold:
(1) Stellenbosch Municipality (SM) has done little to embrace SWHs through enforcing solar ordinance or SWH by-law as international best policy to enhance SWH market and highlight overrated SWH savings.
(2) Identifying some of the promising examples of South African energy policy design shifts.
(3) Understanding impacts of SWH in improving the quality of life while stating overlooked necessity to ground SWH projects on community contexts, cultures and local languages. The first enforced SWH rollout through the solar ordinance or SWH by-law was pioneered by Israel in the 1980s and followed a decade later by Barcelona, Spain. When Cape Town was busy drafting its SWH before it was cancelled in 2011 because South Africa has since passed newly amended national building codes to enforce SWHs, Prasad stated this. "The history of the SWH by-law in Cape Town is interesting because it was inspired by the corresponding ordinance in Barcelona, another one of the case studies in the Create Acceptance Project. The technology transfer from north to south began in 2003 when the deputy mayor of Barcelona was invited to speak about their experiences at a workshop in Cape Town" (Prasad, 2007: 3). Some SWH promoters advance exaggerated accounts of the benefits to be gained from SWH, claiming that such heating offers a 35% to 40% savings (DME, 2009: 9, 13) on the heating obtained from more conventional sources, or cutting of costs by 60%, meaning that SWHs can achieve a 25% to 30% savings per month (SEA, 2009a: 10). It is also argued that SWHs can yield 70% savings, ranging from 17% to 50% (Van der Merwe, 2011).

Some companies submit overrated promises of SWH savings. For instance, Hudu is SWH company whose products have been installed in Stellenbosch, Khayamandi says "save up to 40% on your electricity bill and up to 90% on your water-heating bill by installing a solar geyser". In 2010, a UK based SWH salesman from one of the leading solar thermal providers known as Everest claimed that using a SWH could save 50% and yield £35 000 of financial savings over 20 years, a claim viewed as a massive exaggeration by WHICH magazine (Jamieson, 2010). Another UK based company Ideal, stated that SWHs could save 50% household energy costs. However, an independent SWH expert employed by WHICH magazine established that a SWH could only save 10% of domestic electricity costs (BC UPHAM, 2010). The main point is that during the time of research in 2009 Meyer questioned the origin of the referred local figures saying "unless they were derived from a peer reviewed study they cannot be trusted".

Eskom Western Cape energy supply is limited. Consequently energy shortages vulnerability have direct impacts on and negative consequences for the Stellenbosch Municipality as well. Western Cape supply is limited by the size of the Koeberg Nuclear Power Plant (1 800 MW), with each reactor unit (900 MW) producing 18% of total demand (SI & PREFE n. d: 90). "Cape Town and Boland have a 4300 MW peak load demand and draw on a total generation capacity of 4939 MW, mainly from long distance AC cables that transmit electricity into the Western Cape and from the Koeberg Nuclear Power Plant. This leaves a reserve margin of 5 per cent against an internationally norm of 15 to 30 percent" (SI & PREFE n. d: 90). In November 2005, Koeberg nuclear reactors had technical problems and resulted to Western Cape being plagued by an energy crisis until 28 February 2006. The failure affected several transmission lines and forced load shedding of 1 326 MW in Western Cape (African Journal, 2006: 18). The load shedding occurred because, at the time, and it still does, Western Cape was imported bulk of its electricity supply from fossil fuelled power stations that are mainly based in Mpumalanga (SI & PREFE, n. d: 89). When the load shedding occurred, the end-users and economic growth in the Western Cape including Stellenbosch Municipality (SM) were inevitably negatively affected. The SI & PREFE (n d: 90) observed that "whenever one reactor fails, load shedding is likely to occur to avoid system overload" in the Cape area.

1.5.1 Research motivation and purpose

Stellenbosch is experiencing high population growth, with the majority of the total population being younger than 15 years old. In 2006, 12% of the local population was unemployed and there were 12 500 indigents (SI & PREFE, n. d: 28, 35). The South African government has admitted that security of supply still remains a great concern (Naidoo, 2011a). The quality of life of many remained compromised, with the national unemployment rate being 25.7% (Reuters, 2011). The housing backlog is set to nearly double by 2017, if nothing is done to resolve the problem. The current and future housing backlogs in the informal sector were reckoned as being 14 361 units. The backlog in the overcrowded formal sector was estimated to be from between 21 000 and 30 000 units, yielding 44 361 total units (SM, 2009: 32). The existence of such backlog has direct implications on the provision of, and access to, various resources, including electricity to supply hot water for both domestic and business consumption in Stellenbosch. In essence, the town and building development planning of new building developments should take into cognisance the fact that additional energy will be required to meet new demand, and that new building development designs should be crafted and entail energy efficiency imperatives. In 2008, the Stellenbosch 2017 Housing Strategy argued that SWHs, CFLs, and photovoltaic systems (PVs) including a little bit of wind energy should be utilised in existing buildings to halve the high reliance on coal-fired electricity use and make small contribution to the global $C0^2$ emissions reduction. This means that in middle-to high-income households, the average electricity consumption, which stood at 774 kWh per month at the time at which the current report was compiled, should be cut to 350 kWh, with low-income households being enabled to increase their monthly electricity use from 274kWh to 350 kWh (SM, 2008a: 36; Winkler et al, 2005: 9).

1.5.2 Research purpose

From 1998, the South African White Paper on Energy Policy has outlined an overarching energy policy promoting an energy portfolio that embraced diversification which included sustainable energy and enhanced usage of SWHs nationwide. The research purpose of this current research sought to reflecting on the sustainable energy policy design and overlooked weaknesses of culture without refuting integrated SWHs benefits for various communities:

- Good quality sized SWH services can assist in improving lives of poor households.
- Strategic integration of SWHs, ceilings and CFLs enhance energy efficient household.
- Making use of SWHs leads to decreased monthly energy consumption and expenses.
- Massive SWHs installation may results to the stimulation of LED growth and jobs.
- SWHs installation leads to the creation of green jobs, technology and skills transfer.
- Culture is seen as the fourth pillar to enhance sustainable development with a people.

1.5.3 Logical spin-offs

The education system remains a key to the successful transition to sustainable energy systems and to the use of SWHs throughout the nation. Barcelona has incorporated green technology and the use of solar thermal systems into their education system (Lipschutz, 2009). The Barcelona and Marburg case studies will partially show that language plays a key role in communicating, writing about and marketing products, and in dispensing information relating to the benefits of SWHs, CFLs, and many other efficient sources. In 2009 in Stellenbosch, 69.4% of the population spoke Afrikaans, 19.8% isiXhosa, 8.8% English, and 2.3% other languages, but English language is a dominant language in all government and business spheres (Phaahla, 2006; SM, 2009: 32). SWH promotion entails action generative processes to enhance job creation not merely as part of logical spin-offs, but as basis for empowerment. SWHs in developed nations are used to (1) reduce fossil fuel use, (2) environment safety and (3) sustainable development. In the developing nations like South Africa embracing SWHs will drive local economic development, poverty reduction, abatement of unemployment and reduction of the effects of $C0^2$ emissions as logical spin-offs for the middle- to high-income households (Kohler, 2008: 19; Prasad & Visagies, 2006: 1; Roggen, 2009).

1.5.4 Inexhaustibility

The sustainable energy is the opposite of naturally exhaustible fossil fuels namely coal, gas and oil. Smit (2009: 20) has asserted the inexhaustibility of sustainable energy, which is a concept used interchangeably with a concept of renewable energy systems in the current thesis: “They are considered inexhaustible because all renewable energy originates from the electromagnetic radiation created via fusion inside the sun, a process that is expected to survive for countless years. This solar energy is further converted into wind energy, wave energy, tidal and oceanic energy, geothermal energy and bio energy.” This thesis has developed and evolved during the time when South Africa was borrowing funding from the World Bank, and the global bank was willing to give South Africa the loan despite vehement protests, and diverse legitimate arguments for and against financing carbon energy. Prof. Mark Swilling shared his own thoughts on this matter. “The South African government wants the World Bank to approve a loan to finance what will be the fourth-largest coal-fired power station in the world. Key strategic thinkers in the World Bank want this to happen because this finally gives them what they have never had before - a firm grip on the SA economy and, above all, their drug of choice-policy influence” (Swilling, 2010).

Furthermore Swilling (2010) continued to argue that: “Environmental groups, trade unions and key Western governments don’t think the World Bank should be financing coal-fired power stations in a country which is the 12th highest CO_2 emitter in the world and where we already emit more CO_2 per unit of GDP than any other country in the world. But this reading of the debate is far too simple. The key question is this: why have the South African government and the World Bank decided with no public debate that it makes economic sense to invest in an energy source that will steadily get more expensive over the next 30 years rather than in renewable energy sources that will get cheaper over the next 30 years?” Winkler et al (2005: 28) affirmed that renewable energy sources “on a time-scale of human relevance, they will not be exhausted, unlike the effectively limited stock of fossil fuels, coal, gas, oil, which have been laid down over geological time and are not being renewed at the rate at which they have been consumed since the Industrial Revolution”. The solar energy is available almost everywhere in South Africa makes it appropriate for Stellenbosch to consider engaging itself in collective consultative action generative processes to unleash the SWH industry potential, enhancing the local growth demand and creating green jobs. The inexhaustibility of solar energy and its ability to reduce energy consumption has helped to make the government and Eskom enhance their interest in SWH systems to arrest the energy crisis. In 2008, Eskom set up a 1 million target to embark on SWH rollout over five years until 2014, and sought to achieve daily energy savings by switching to SWHs, yielding 2300 GWh annually in the fifth year and contribute 2500GWh to primary sustainable energy supply. The national target could be achieved through installing SWHs with electrical backup and timer feeding of 3.3 kWh, or with SWH, without electrical backup and timer feeding of 4.6 kWh to replace an electric geyser consumption of 10.3 kWh (Eskom & Nano, 2008: 7). It is stated that could reduce household electricity usage by 30% to 40% and monthly electricity costs by similar range of percentage (Eskom & Nano, 2008: 5; SEA, 2009a; Thirion, 2009)[5].

Sustainable energy and energy efficiency sources, SWHs and CFLs are advanced for their inexhaustibility, durability, and extending access to hot water to those who lacked access before while reducing electricity usage and $C0_2$ emissions (Refocus, 2004). South Africa is committed to driving green economy revolution to stimulate local growth and creation of green jobs. South Africa's economy is predominantly driven fossil fuelled energy systems, contributing just above 1% of anthropogenic carbon emissions worldwide. With a supportive decision in favour of sustainable energy and energy efficiency systems, the government has recently resolved to enforce the following measures urgently to enable a sustainable energy:

- The green tax system in 2010 through tax in the form of levies on plastic bags, dirty fuels, electricity, vehicles, air travel, and emissions earned nearly R700m in revenue.
- South Africa seeks to build a green economy within and over the next decade through its 2011 National Green Economy Strategy, which was recently signed and approved in Pretoria prior to the hosting of COP17 in Durban from November-December 2011.
- Local business sector and labour unions are committed to create 300 000 green jobs.[6]

However the idea to improve quality of life through enhanced local SWHs and ensuring that promotion of SWHs is imbued in the life and culture of target communities remains severely undervalued and fossil fuel energy supply remaining dominant in the new capacity of Eskom. There is no adequate and enhanced commitment to promote SWHs across local governments to unleash the above mentioned potential green jobs while cutting poverty and $C0_2$ emissions.

1.6 RESEARCH METHODOLOGY

The research methodology entailed holding qualitative interviews with relevant stakeholders, diverse players in the SWH industry, local authorities, and community members. Some case studies were conducted where SWHs have been successfully installed such as in households in the Kuyasa, Mfuleni, Wallacedene, Khayamandi, and Cloetesville communities including some households located in the affluent Stellenbosch suburb areas.

Mouton (2001: 148) argues that a case study is defined as an empirical and ethnographic study. It is referred to as a qualitative research undertaken with a view to helping present an in-depth analysis of a number of small specific conditions. The case study communities fall within the range of low-income communities and were chosen because of SWH installations that had previously been done or which were currently being done. Substantive data were drawn from books, grey literature, journals, and government sources on sustainable energy

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[5] Dawie Thirion, 2009. Personal Interview in Paarl, SWH manufacturing company on October 01, 2009.
[6] Govender, S & Naidoo, S. 2011.

and development (Aca2k, 2008: 20; Mouton, 2001: 148-149). According to Burguillo & Del Rio (2009: 1317) “case studies allow the identification of economic and social relationships which are hidden in quantitative studies. The latter usually establish general relationships and omit aspects of the impact of the project on the local community. In contrast, case studies adopt an on the ground approach which goes down to the level of local actors and captures detailed socio-economic effects which are unnoticed by more aggregated analysis”. Most importantly it will highlight lack of freedom to make informed choices in poor communities due to low-income and affordability compared to those who can afford SWHs. In this thesis there are two case studies represent international collaborative successful stakeholder drive conducted in terms of the Barcelona municipality solar ordinance in Spain, and the correct ambitions to enforce SWHs but faced resistance by opponents of leading local authorities as epitomised by the Marburg municipality in Germany, see appendix 3 at the end of the thesis. The size of SWHs being given to the low-income households are at times greatly inadequate.

1.7 Data Accumulation

In response to the above-stated main research questions, the research methodology adopted in the current thesis relied on the following data accumulation. The data accumulation methodology included using electronic correspondences and sending semi-structured questions to the key actors concerned. The human development and the restoration of dignity can be attained through integrated SWH interventions. The thesis concentrates on the Stellenbosch SWH potential and drew lessons from the surrounding neighbourhoods. In February 2009 the Germany based German Development Institute (GDI) postgraduates from Bonn came to South Africa to do research on renewable energy systems and needed to work with local students. For further details on GDI South African research and more see Appendix 2 at the end of this thesis. In March 2009, the researcher was one of the two local students who worked with GDI students to conduct interviews with key stakeholders such as CEF, Nersa, Suntank, and Solahart SWH companies in Johannesburg and Pretoria in Gauteng, Xstream geysets in Paarl, International Technology Sourcing (ITS) in Somerset West, and Soladome SA in Stellenbosch. The GDI cooperation created access to interviews which would not have been possible without their help. All these companies were contacted and interviewed because they were active in the SWH industry and SWH projects during the time of this study. In Khayamandi, Klapmuts, and Stellenbosch, semi-structured questionnaires were filled in by 30 respondents. In Kuyasa 21 people whose age ranged between 27 and 67 years, attended the meeting on 27 August 2011. An informal discussion was conducted on benefits of SWH implementation and on the impact of SWH on their lives.

The e-mail was useful for collecting data from respondents who have access to it and was used with respondents from Uniepark to find out the reasons behind their use of SWHs, and the impact of SWHs on their lives. The researcher arranged meetings by e-mail or telephone with community leaders, local councillors, religious leaders, and with representatives from the Stellenbosch Municipality (SM), Sustainable Energy Africa (SEA), and Cape Town Energy and Environmental Resources management office, as well as with local SWH industry participants and experts, including those from Stellenbosch University (SU). A contact person residing in the targeted case study communities was contacted to approach ten main household members in Kuyasa, Mfuleni, Wallacedene, and Cloetesville. When the contact person failed to approach those concerned, the researcher drove out and randomly visited homes with SWHs in Mfuleni, Cloetesville, and Wallacedene. At times, such random visits yielded helpful leads to key SWH project actors in Cloetesville. In such a way, the home of Councillor Valerie Fernandez was located in Cloetesville on 3 September 2011, as well as were Patrick Kannemeyer’s cell numbers and Lakeside City Trading. In the current thesis the main household member is regarded as being the household head, or breadwinner, who might be either a man or woman, or even in exceptional situations, a senior child. Table 1.4 below presents the data assessment mechanism used to measure the life impact of SWHs.

1.8 Justification of action

There are number of problems that prevented sustainable energy systems growth and buying power is one of them. Table 1.7 below is presenting an average hot water demand for high-income households, and assumed that they installed size 150 to 300 SWH Ls, based on 50 L per person, with another 50 L being needed for dishwashing and other household chores (UNFCCC, 2011: 26). SWHs of such households mainly works, and, if not, they are capable of having a faulty system quickly repaired. On the contrary "generally low income developers need to go for lowest cost and most reliable systems. To date, the systems used in low income developments consist of low pressure direct systems with evacuated tube collectors" (SEED).

Table 1.7	**SWH data assessment indicators**		
Household	**Middle- to high-income household electricity consumption** ***Obtaining employment, buying power and information access***		
SWH unit	**SWH system**	**Indicators**	**Consumption (Average figure)**
5 family members	Working SWH, 300 L (50 L per person)	Employment & house income and language	774 kWh per month (without SWH)
Economic factors	Cutting energy usage and costs and job creation	Buying power Cutting energy costs	SWH system reduces electricity consumption and related energy costs. Reduces $C0_2$ emissions. **Saves 40% to 60% of energy**
Environmental factors	Cutting $C0_2$ emissions (2 tonnes per annum)	Reduced $C0_2$ emissions Information access Policy regulations	

Source: Author, 2012

The problem of unemployment and lack of buying power remains a major challenging question for poor households, as does the lack of access to information, and the difficulty in obtaining material in their diverse local languages. SWH-related reading material is usually available in English, which is a language mainly spoken, and understood by members of high-income households rather than by those living in poor communities. The main reason for the latter to adopt the use of SWHs is to reduce electricity consumption and costs. The reduction of $C0_2$ emissions only comes about as a by-product of the reduced usage of coal-fired energy. South Africa hosted the COP17 successfully in Durban to negotiate further plans and actions to reduce global carbon emissions to mitigate the occurrence of climate associated devastating disasters, but the country has a limited role to cut carbon emissions. South Africa is the 12^{th} largest $C0_2$ emitter with 10 tonnes of $C0_2$ per capita, but only emits 1.6 tonnes of the global $C0_2$ (National Treasury, 2010: 16; Govender & Naidoo, 2011). The entire Africa combined emits only over 3% of total global $C0_2$ (Davidson et al, 2007: 3). Gradual transition to sustainable energy systems and embracing energy efficiency policy design is of high significance to reduce fossil fuels while striving to improve human lives.

Table 1.8	**Low-income household electricity consumption** ***Scarce employment and limited buying power***		
Household	**SWH system, working**	**Indicators**	**Consumption** **Average figures**
Family members, 5 to 14 people.	100 L (suitable for only 4 people, 25 L per person)	Job creation to reduce unemployment rate Reliable hot water Satisfactory service	274 kWh per month
Economic factors	Cutting energy usage and saving on electricity costs	Scant buying power Cutting energy costs	Job creation Financial savings Acquiring skills Technology transfer
Environment factors	Cutting $C0_2$ emissions (2.85 or 1.4 tonnes per household per annum)	Spoken languages Information access Policy regulations	

Table 1.8 above reflects the dire state of poor communities and a need to improve the quality of life for low-income households, whose average monthly electricity usage is estimated at 274 kWh per month (Winkler et al, 2006). It also illustrates average size of poor households, which range from 5 to 14 family members per household, for whom the supply of 100 to 150 L of SWH would result in the cutting of $C0_2$ emissions by an estimated 2.85 tonnes per annum, with both figures having been derived from the Kuyasa Project experience (SEA, 2009a: 25). SWH initiatives are increasingly growing in South Africa. The Lynedoch green village is located in the Stellenbosch Municipality area at Lynedoch representing a situation where a community of divided socio-economic backgrounds has agreed to attempt to close widening gap between low-income and mid-income homes while also facing sustainability issues. "The renovation of the main building to provide premises for the Lynedoch primary school, the community hall and the Sustainability Institute was funded through a R5.5 million interest-free loan from the Spier wine estate. This will be liquidated once the main building is transferred via a deed of sale to Spier at some point in the future. The agreement with Spier is that the primary school, the Sustainability Institute, the performing arts group and various other groups have rent-free use of the premises on condition they cover all service charges and maintenance costs" (Annecke & Swilling, 2006: 319).

Previously it was difficult to make a financial case for SWHs in low income households because of [7]cheap coal-fired electricity and bulk of reconstruction and development programme households did not have electric geysers on the other hand. "Recent approaches to low pressure SWH system implementation in low income households, notably at Kuyasa in Khayelitsha, are beginning to make a financial case for SWHs in this sector" (SEED). Another reasons is that "the cost of grid energy will also rise faster than the average rate of inflation over the 20-year period as a result of the increasing scarcity of fossil fuels, the restrictions on high CO_2 emissions (which makes coal-fired power less viable despite extensive reserves), and restrictions on the expanded use of nuclear power caused by environmental opposition movements" (Annecke & Swilling, 2006: 321). For few more details see section 3.2.2. The job creation through SWH programme and associated savings determine direct impact of SWHs in terms of improving the quality of life. Tables 1.6 and 1.7 reflect a dichotomy of two varying electricity usage and buying power dynamics of both low-income households and mid-to-high income households, with low-income home showing that each person consumed about 25 litres of water per day compared to 50 litres per person a day for mid-to-high income households (UNFCCC, 2011: 26).

[7]Kohler, 2008.

1.9 Summary of Chapter One

The first chapter mainly shows that Eskom coal-fired electricity remains dominant and sustainable energy systems were not substantially promoted in South Africa until the energy crisis had a serious impact on the country as a whole from December 2007 to early 2008. A review of South Africa's electricity industry, February 2011 by Creamer Media opens with the following firm statement. "Electricity generation in South Africa is dominated by State-owned power company Eskom, which currently produces over 90% of the power used in the country. The balance is generated by municipal and independent operators, while there are also several companies that produce power for their own use. Eskom has a current nominal installed capacity of 44 175 MW, with some 86% of this capacity in place at the company's coal-fired power stations. The utility also has small installed capacities of nuclear (1930 MW), fuel turbine (2 426 MW), small-scale hydroelectric (661 MW), pumped storage (1 400 MW) and wind (3MW) facilities" (Creamer Media, 2011: 4).

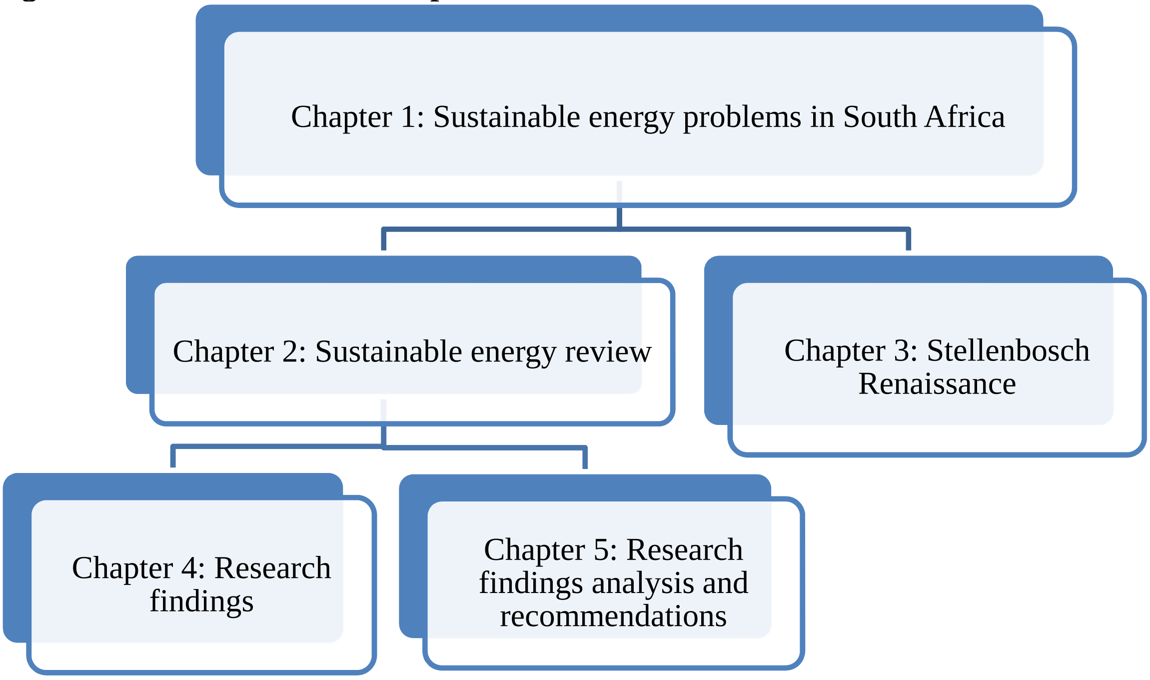
The energy crisis brought the energy supply, distribution, prices and efficiency into key focus, making such factors subject to serious considerations and a coordinated response. It became clear that the supply of relatively cheap electricity had reached an end and that high energy prices would have to be demanded in future. All this paved the way for energy policy shifts and opened up new business avenues for contributing to address severe socio-economic imbalances that were shown from subsection 1.4.1 to 1.4.4. The evidence has conspicuously shown that South Africa has the highest unemployment rate in the world. Stellenbosch is facing rising population growth, which has implications for integrated development plans (IDPs) to respond to basic humans needs for housing, jobs and reliable forms of sustainable energy. The justification for promoting the sustainable energy starting with energy efficient SWHs, CFLs and ceilings is premised on potential green jobs, new economic opportunities and associated byproducts namely reducing $C0_2$ emissions and environment safety. "Most low-income houses do not have electric hot water geysers; they use kettles, paraffin cookers and coal burners to heat water. Using paraffin stoves and coal burners to heat water is dangerous in terms of the risk of starting fires and because of health problems related to reducing indoor air quality. Using a kettle to heat water is far safer and healthier than using coal or paraffin but South Africa's electricity is predominantly derived from coal fired power stations. The use of electricity to heat water contributes to South Africa's greenhouse gas emissions and to global warming" (SEED).

Stellenbosch, is facing high inequalities, poverty and joblessness with housing among them. The current and future [8]30 000 housing units in overcrowded formal sector in Stellenbosch electricity demand will be more than 278 640 000 kWh annually over the next 20 years and beyond. Such an estimate is based on the assumption that this category of future households will consume no less than 774 kWh per month in terms of average energy usage. The future low-income households, which will mainly replace informal settlements, will be responsible for 274 kWh per household per month of average energy consumption (Winkler et al, 2005: 9). The current and future backlogs in the informal settlements is estimated at 15 361 housing units, are likely to demand about 505 06968 kWh annually over 20 years' time. The total electricity supplied in 2009 to Stellenbosch consumers was 39 712 222 kWh (SM, 2009: 3). It is important to learn how does SWH improve lives while highlighting undervalue of culture, mandatory SWH policy to enforce SWHs rollout and overrated SWH benefits. Next is the thesis outline of chapters followed by the sustainable energy literature review, Stellenbosch Renaissance, research findings, and research findings analysis and recommendations.

[8]Stellenbosch Municipality (SM), 2009: 32.

1.8 Thesis outline – Chapters 1-6

Figure 1.3: Thesis outline of chapters



CHAPTER 2 SUSTAINABLE ENERGY LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter has provided an overview of sustainable energy problems in South Africa, highlighted the 2008 energy crisis that happened against prevalence of the cheapest predominantly fossil fuelled power supply and inadequate actions to induce sustainable energy until 2008. Sustainable energy literature review will reveal some of the major driving factors behind the transition to sustainable energy systems and need to develop new understanding of impacts of SWHs in terms of improved quality of life, grounding in cultural context, and languages. It will also draw lessons from international best practiced sustainable energy policy regulations. The present thesis is focused on the Western Cape with particular focus on Stellenbosch, and touches on external pressures of global challenges, and on the economic crisis. The COP17 raised global climate change issues afresh again against genuine problems of global poverty, and inequality that plagued the world during the time of writing of this thesis has exacerbated economic drought, joblessness and poor quality of life. South Africa is mainly fossil-fuelled economy that is driven by Eskom coal-fired plants, as was demonstrated in subsections 1.3.1 to 1.3.2. The above-stated problems have a direct impact on improving the quality of life and there is a strong conviction that with proper coordination sustainable energy will be helpful. Burguillo & Del Rio (2008: 1316) stated that "crucial to the activation of the endogenous resources is the participatory approach to setting goals, procedures, and the implementation and control of economic activities. Thus, the local process of innovative entrepreneurship should meet the opportunities raised by enhancing traditional sources of income and bringing in new activities and technologies." Sustainable energy can enhance economic participation.

2.2 Dominating fossil fuels from 1990 to 2035

Global energy portfolio will largely remain dominated by the use of fossil fuels from the 1990s to 2035 (DOE/EIA, 2010). "In 2007, some 42% of the electricity produced globally was from coal-fired facilities. Key economies that depend on coal-fired power include the US and China, where coal-fired power represents 49% and 79% respectively of total electricity generation. Other countries that are heavily dependent on coal-fired power include South Africa (86%), Poland (92%), Australia (77%), India (69%), Israel (63%) and Germany (46%)" (Creamer Media & Kohler, 2011: 24). The above evidence affirms the dominance of fossil fuels. Figure 2.1 below shows world-wide marketed energy use by fuel type.

Figure 2.1: Global marketed energy consumption by fuel type

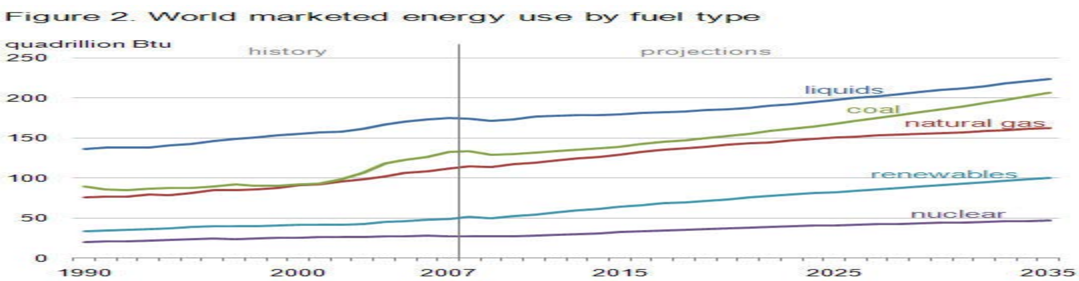


Figure 2.1 shows the International Energy Outlook released in July 2010 projected escalation of worldwide-marketed energy consumption from all energy sources from 1990 to 2035. The fossil fuels such as liquid energy sources, petroleum (oil), natural gas and coal usage are set to remain dominant globally (DOE/IEA, 2010). Creamer Media & Kohler (2011: 25) has

projected that, “in 2009, renewable power represented 18% of the total electricity generated worldwide. The share of such power is expected to grow to about 23% by 2035, with this growth expected to take place primarily in the subsectors of hydropower and wind power.”

2.3 Energy-related carbon emissions

Energy-related carbon emissions are emitted by fossil fuels worldwide. The energy- related greenhouse gas (GHG) emissions stand to increase from 29.7 billion metric tonnes in 2007 to 33.8 billion metric tons by 2020 and to 42.4 billion metric tonnes by 2035 globally, a 43% increment (DOE/EIA, 2010). The strong economic development and sustained heavy dependence on fossil fuels are likely to escalate in non-OECD nations. The most-anticipated GHG emissions increase, mostly $C0_2$ emissions will occur in developing nations (DOE/EIA, 2010). Sadly, the global inequalities in terms of access and consumption of natural resources still manifest a very rapid escalation of global poverty and socio-economic imbalances in a world with an extremely fast-growing population that reportedly exceeded 7 billion before the end of 2011 (see subsections 1.3.8 to section 1.3.9). Fernandez-Armesto, 2009, stated that “demand for resources, moreover, has hugely outstripped population growth. Not only does the world have more people than ever before, but they also demand, on average, vastly more food and goods and consume vastly more energy than ever before”. Sustainable energy and enforcement of SWHs are means to support agenda 21 to induce a low-carbon footprint development to reduce reliance on fossil fuels with ecological and socio-economic benefits.

2.4 Theoretical Framework

The theoretical framework behind sustainable energy is informed by the decisions that were taken in Brazil during and after the 1992 Rio de Janeiro Earth Summit that was alluded to earlier in chapter 1 in section 1.3.2. Among other things the Agenda 21, chapter 7 focuses on the envisaged development programme of action that entails promoting the following areas.

1. “Providing adequate shelter for all
2. Improving human settlement management
3. Promoting sustainable land-use planning and management
4. Integrated provision of environmental infrastructure, water, sanitation, drainage and waste management
5. Promoting sustainable energy and transport systems in human settlements
6. Promoting human settlement planning and management in disaster-prone areas
7. Promoting sustainable construction industry activities
8. Promoting human resource development and capacity-building for human settlement development” (United Nations, 1992).

The above stated programme of action has sustainable energy featuring alongside transport networks, human settlements, promoting human resource development and capacity building for human settlement. In 2002, the South African President Thabo Mbeki hosted and presided over the World Summit on Sustainable Development (WSSD) proceedings in South Africa, Johannesburg, Gauteng (United Nations, 2002: 73). “In response to the WSSD South Africa has developed a National Framework on Sustainable Development which sets out South Africa’s national vision for sustainable development and specific strategic interventions in order to re-orientate South Africa’s development path in a more sustainable direction. The Framework notes that sustainable development about enhancing human well-being, and quality of life of all time, in particular those affected by poverty and inequality. Resource use efficiency and intergenerational equity are the core principles” (UNEP, 2009: 20).

Evans (2002: 55-57) and UNDP, (2010: 1) with reference to Amartya Sen's perspective of human development have accentuated that human development involves enhancing people's freedoms and capabilities to enjoy the life they value by stimulating them to have a reason to value it. Such awakening entails expanding their ability to make choices freely. It affords the community members to understand new business and empowerment opportunities associated with renewable and energy efficiency systems. Actualising the liberty and capabilities would involve more than merely meeting essential needs. Vulnerable community sectors such as poor people, oppressed women and young people tend to have only limited access to work. The inability of small entrepreneurs to access credit should be overcome and low-income workers should be enabled to enjoy freedom of choice and capabilities allowing them to live the lives they aspire to live with a reason to value them. The advancement of such an outlook can go a long way to cultivating and entrenching a different understanding to that which is normally held. Human development must also focus, on empowering poverty-stricken communities with capacity to achieve liberty from poverty. Achieving such liberty includes engaging the people in actions that prompt people to value their lives which is something seldom achievable by individuals. Collective activity might appear superfluous in relation to capability, however, more especially regarding privileged communities and individuals, but for poor communities attaining development as an outcome of freedom demands collective action. Through collectively engaging in actions, languages and unity of purpose aimed at formulating common values, shared preferences, destiny and identity, and development goals, the manner of delivery can be seen to defy even strong opposition (UNDP, 2011).[9]

In a country such as South Africa, plagued by rising population numbers coupled with increasingly growing housing demands at local, provincial and national levels, franked by poverty and joblessness as discussed in sections 1.3 and 1.4.1 to 1.5.1 enhancing human capabilities, skills and free choices becomes more essential. Any action that seeks to stimulate uptake of sustainable energy systems should be informed by integration of these development pillars namely local cultural dimensions, economic dimensions, environmental safety dimensions and social dimensions. In South Africa, "sustainable development is defined as the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations" (DME, 2003: 26).

2.4.1 The promotion of sustainable energy

The promotion of sustainable energy system is underpinned by the increasing thinking that our carbon footprint should be reduced to enhance sustainable development. "Increasing the efficiency of energy use to reduce its polluting effects and to promote the use of renewable energies must be a priority in any action taken to protect the urban environment" (United Nations, 1992). It enhances the provision of more energy efficient systems and sustainable energy for human settlements and cutting negative effects of fossil fuel generation and usage on human health and environmental safety (United Nations, 1992). Denton et al (2011: 716) stated that "over the past few centuries, industrialized societies have transformed their quality of life by exploiting non-renewable fossil energy sources, nuclear energy and large-scale hydroelectric power". The rational thinking behind sustainable energy usage is based upon a reasoned yearning to transform dangerous energy production patterns (Winkler et al 2006).

[9]UNDP 2011. Sustainability and equity: A better future for all. Human Development Report 2011.
Evans, P. 2002. Symposium on Development as Freedom by Amartya Sen, Collective Capabilities, Culture, and Amartya Sen's Development as Freedom. Studies in Comparative International Development, Summer.

2.4.2 Sustainable development

Sustainable energy is based on what Smit (2009: 28) referred to as finiteness of earth natural resources and human obligations to achieve more equitable access to improved quality of life in the developing nations through natural resources exploitation. The definition of sustainable development by the Brundtland Commission of 1987, as adapted by Research on the Scientific Basis for Sustainability (RSBS, 2006: 8) argued that "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable development is underpinned by three pillars, social, economic and environmental dimensions, which have been assessed and given multiple insights regarding the global challenges of climate change, poverty and widening gap of inequalities after 1992 Earth Summit in Brazil and World Summit on Sustainable Development (WSSD) in 2002 in South Africa (Crane & Swilling, 2007: 2). [10]Mebratu (1998) stated that "the conceptual definition of the Brundtland Commission contains two key concepts: (1) The concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given, and (2) the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs". Sustainable development imperative whose achievement is subject to sustainable energy enforcement has many layers, weak sustainability and strong sustainability as some of them. Denton et al (2011: 713) with reference to Solow (1974) and Hartwick (1977) argue that "weak sustainability has been labelled the substitutability paradigm and is based on the idea that only the aggregate stock of capital needs to be conserved—natural capital can be substituted with man-made capital without compromising future well-being. As such, it can be interpreted as an extension of neoclassical welfare economics."

Denton et al (2011) continue to argued referring to Neumayer (2003) that fossil fuels can be substituted through sustainable energy resources and technological advancement induced by prevailing market prices. "Weak sustainability also implies that environmental degradation can be compensated for with man-made capital such as more machinery, transport infrastructure, education and information technology" (Denton et al, 2011: 713). While weak sustainability, Denton et al (2011) argument assumes an economic growth that flexibly adapts to the varying availability of capital systems, strong sustainability opens with an ecological perspective that proposes guardrails for socio-economic pathways. Denton et al (2011) argued with reference to Pearce et al (1996), Neumayer (2003) and Norgaard (1994), that strong sustainability is premised on the non-substitutability paradigm, which is based on the understanding that natural capital is impossible to substitute for production objectives or for the environmental provision of controlling, supporting and cultural services. Further, the researchers concerned also continue to state, with reference to Neumayer (2003) and IPCC (2007b) that limited sinks in the form of atmosphere's capacity to uptake GHG emissions could be better enhanced through enforcing the constraints of the strong sustainability notion.

All this present an opportunity to embrace sustainable energy systems. Denton et al (2011) argued, with reference to Ekins et al (2003) that the physical resource of specific non-substitutable resources, meaning the essential natural capital, must be preserved and the substitution between different forms of natural capital minimised. Strong sustainability views have been related to subjective views, whose main goal is to prevent development, under the pretence of environment protection, to safeguard their narrow personal interests. For Smit (2009: 29) this "ecocentric orientation towards sustainable development supports a strong, narrow and deep notion of sustainability premised on intrinsic value of environment not

[10]Desta Mebratu, 1998: 501.

development". Smith (2009), with reference to the Industrial Revolution, observed that modernity transformed the natural resources and commodified them for purely self-centred profit-making purposes. Furthermore, with reference to a plethora of thinkers,[11] Smit (2009: 29) points out that all have seen "the need to re-evaluate our relationship to and the power hierarchies with nature so as to appreciate nature as a source which informs our happiness and quality of life without commodifying or exploiting the Earth".

2.4.2.1 Culture at the heart of urban strategies

The European Union and South East Europe (2012:8) noted that "more often than not the word culture relates to lasting meaning, but all these meanings are useful since they all refer to a development process. But when it comes to sustainable development specific cultures have a specific impact". In 2002 the primary Global Public Meeting on Culture convened in Porto Alegre a guiding document for local cultural policies was issued to support cultural development to enhance sustainable development. This guiding document is for local culture what Agenda 21 meant in 1992 for ecological safety. The Fourth Forum of Local Authorities for Social Inclusion by the world cities and local governments was held in Barcelona on May 08, 2004, received and approved Agenda 21 for Culture as part of its Universal Forum of Cultures[12]. "In the Final Declaration of the founding congress held in Paris in May 2004, United Cities and Local Government (UCLG) states that culture has become an indispensable dimension for development. Nowadays, culture lies at the heart of urban strategies not just due to its intrinsic vocation of promoting human rights, shaping the knowledge society, and improving quality of life for all, but also on account of its role in the creation of employment, urban regeneration and social inclusion" (Agenda 21 for Culture n. d: 1).

European Union and South East Europe (2012: 4) stated that "cultural diversity is defined as a means to achieve a more satisfactory intellectual, emotional, moral and spiritual existence. There is relevance of governance in local development in the field of culture. Culture has to be intertwined with other policies in a process where local citizens can express their requirements. The recognition of cultural diversity as a component of sustainability is just as biodiversity is considered essential for survival of life on earth". In essence, "cultural heritage is creative. When economic, social and environmental perspectives are considered, cultural heritage appears as a potential source of employment, confidence-generation, social capital, cultural diversity, energy savings etc. It is therefore important to consider the various effects and the conditions required for producing these anticipated results effectively" (2012: 4). European Union and South East Europe (2012: 10). Nurse (2006: 36) has argued against the narrow view of culture stating that "for example, when discussing sustainable development it is critical to move beyond talking about preservation of 'the arts', "heritage" and 'cultural identities' to also include the broad civilizational notion embodied in culture as a 'whole way of life' because it informs the underlying belief systems, worldviews, epistemologies and cosmologies that shape international relations as well as human interaction with the environment". The new democratic South Africa born after April 1994 gave birth to a culture of constitutional democratic society that is governed by its Constitution Act No 108 of 1996 that embraced a sustainable development as attested in section 1.3.2 earlier in chapter 1 and also equally advanced the importance of 11 official languages for the new South Africa.

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[11]Smit (2009) refers to the following plethora of thinkers: Hattingh (2001: 9, 11-12); Gallopin (2003: 14); and Mebratu (1998: 511). The Deep Ecology Movement refers to Deval (2001); Naess (as cited in Deval, 2001); Macy & Young Brown (1998). Eco Theology refers to Macy & Young Brown (1998: 49-52) and Mebratu.

[12]European Union and South East Europe, 2012.

2.4.2.2 Significance of languages

The significance of languages is important to embrace in the same way as the South African supreme law embraced it if a transition to sustainable energy systems is to make an indelible cultured legacy of a genuine transformation from colonial and apartheid legacy of systematic exclusion of the black masses, Africans, Coloureds and Asians. In chapter 1 of the Statutes of The Republic of South Africa – Constitutional Law, Constitution of the Republic of South Africa Act, No 108 of 1996, under the Founding Provisions in section 6 made the following assertion about South Africa's languages. "Languages, – (1) The official languages of the Republic are Sepedi, Sesotho, Setswana, siSwati, Xitsonga, Afrikaans, English, isiNdebele, isiXhosa and isiZulu. Recognising the historical diminished use and status of the indigenous languages of our people, the state must take practical and positive measures to elevate the status of and advance the use of these languages"[13]. However, the glaring truth is pragmatic daily government and domestic business transactions still marginalize indigenous languages (Phaahla, 2006). Sustainable energy policy designs and promotions should find ways to start breaking down this languages barrier by communicating, translating material and producing development projects information in these indigenous languages. For instance Lee (2003: 9) observed with reference to Collins et al (2002), David and Rhee (1998), and Manson (1988) that "language barriers may also reduce patient's abilities to follow provider instructions and adhere to treatments", and continues with reference to Enguidanos and Rosen (1997) and Manson (1988), observed failure "to comply with instructions for follow up care". In 2003, in the US a study revealed that 18% of the population did not use English as a spoken language at home, because they came from Latin America, Asia or other non-English home language speaking areas of the world. The resultant language gap made it hard for some health practitioners and English-speaking doctors to communicate effectively with such patients during visits to health care facilities, with the lack of fluency in English leading to a need to make use of language translators during health consultations (Lee, 2003: 3).

South Africa is faced with similar challenges, despite the majority of its citizens speaking and understanding IsiZulu and IsiXhosa (Phaahla, 2006). In Stellenbosch Afrikaans is spoken by more than 69.4%, followed by IsiXhosa at 19.8% and English at 8.8%, and other languages at 2.3%, while English dominates government business and business transactions as stated in section 1.3.4. "In South Africa the majority of health care interactions take place across culture and language boundaries and at some health care sites as little as 5% of doctors are able to conduct interactions in the home language of the patient" (Watermeyer, 2011: 2). The situation has forced some doctors to learn the home languages spoken by their patients, which has enhanced doctor–patient services and has enriched human interactions in many ways. "The role of language in building deeper connections was a strong theme. Speaking the language was seen as establishing a deep relationship with patients, their faces changed, a rapport developed, hearts and doors were opened and friendships developed. Speaking the language removed barriers between doctor and patient, helping them to communicate at another level, which was impossible using an interpreter. Confidentiality in the doctor-patient relationship was improved" (Couper & Pfaff, 2009). The point of using doctor and patient analogy shows that promoters of SWHs overlooked the value of languages when promoting SWHs in diverse cultural contexts and communities. In sharp contrast to South African approach Barcelona solar ordinance was published in three languages, Spanish, Catalan and summary provided in English and for SWHs promotion campaigns (see appendix 3).

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[13]Statutes of The Republic of South Africa – Constitutional Law.

Okolo (2005: 4) has argued that "indeed, it is through language that the benefits of all man's other inventions are communicated and assessed. Interaction between individuals, among a group of people, across nations and continents is made possible through language. Beliefs, ideas, ideologies, culture, knowledge, experience, values and of course, prejudice are acquired and conveyed through language. Words act as guides to the interpretation of social reality and invariably, affect every aspect of a people's spirituality and material civilization and socio-cultural life." Sandile Gxilishe (2009) stated that "all the successful societies of Asia and Europe are societies which use their own languages. The fact that people use their own languages contribute immensely to their development endeavour in all societies". Watermeyer (2009: 5) argued that developing effective strategy to enhance communication involves verbal and non-verbal communication to build rapport and collaboration to improve understanding in cross-cultural human encounters. The culture of enhancing local languages and efficiency can be truly promoted in planning and building human settlements.

2.4.2.3 Culture as engine for new innovative way of life

Sustainable energy stands out as a primary mechanism to develop sustainable quality of life and affords people an opportunity to stimulate capability development for poor communities. "In the long term, the potential for fossil fuel scarcity and decreasing quality of fossil reserves represents an important reason for a transition to a sustainable worldwide RE system" (Denton et al, 2011: 717). The people require enhanced capacity to drive development. Evans (2002: 55-57) and UNDP, (2010: 1) both with reference to Sen's notion of human development accentuate that human development involves enhancing people's freedoms and capabilities to enjoy the life they value by stimulating them to have a reason to value it. SWH systems have the potential to enhance fruitful human interaction through mobilizing various kinds of people characterized by required diversity of skills that includes local community leaders, ordinary people, building developers, private and public sectors, academics, engineers, architects, artisans and technicians[14].

In 1999 the City of Barcelona mobilized its collective political will and harnessed all these stated assets to develop what became known as the best globally practiced solar ordinance to enforce SWHs (appendix 3). "Human development is the expansion of people's freedoms to live long, healthy and creative lives; to advance other goals they have reason to value; and to engage actively in shaping development equitably and sustainably on a shared planet. People are both the beneficiaries and the drivers of human development, as individuals and in groups" (UNDP, 2010: 14). Participating in developments allows the people an opportunity to breath new soul and refreshed culture of humanity through improving quality of life into beacon of hope in action. "Historically, economic development has been strongly correlated with increasing energy use and growth of GHG emissions, and RE can help decouple that correlation, contributing to sustainable development (SD)" (IPCC, 2011: 18).

The quality of life, as defined by CASE (2006: 14) is determined by life circumstances, the workplace, including income and working conditions; the place of residence, which includes the quality of settlement and living conditions; gender; social status; and culture – in short, the total way of life. Improving the quality of life involves the tangible measures that are taken to overcome poverty and poor quality of life, which results from lack of access to jobs and the deprivation of communities and of individuals of their rights to enjoy freedom and of their capabilities to participate in life processes (Adam & Taylor, 2009: 11).

[14]Barcelona, 2009.

2.4.2.4 Sustainable settlements

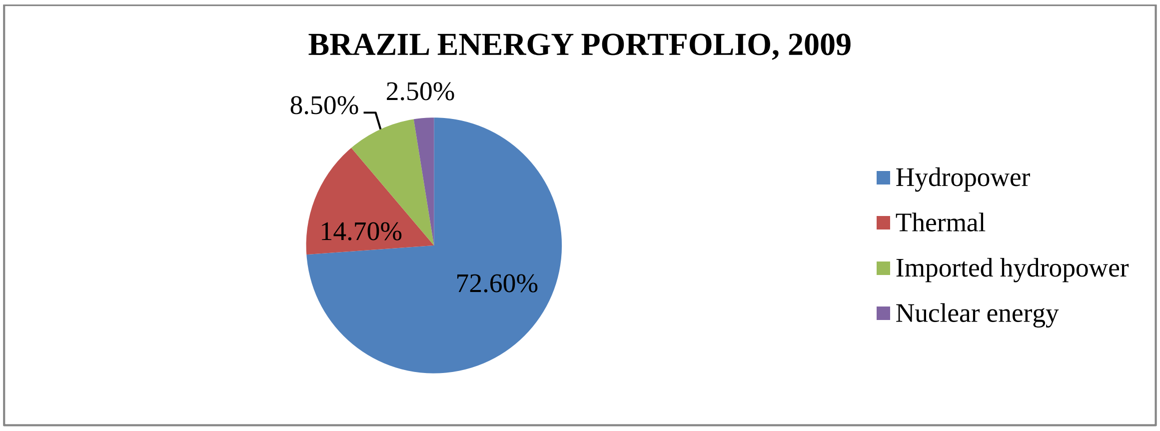
The totality of culture which has been briefly discussed above is expressed in communities and human settlements where people live, dream and share aspirations of their lives. The sustainable settlements are important as poor quality of life at times manifests itself through living and housing conditions of collective communities and individuals who cannot afford decent housing. There is a strong direct link existing between buildings, $C0_2$ emissions and capacity of natural life-support systems to absorb $C0_2$ emissions. The existence of such a link calls for well-considered, ecologically designed buildings to reduce the level of $C0_2$ emissions. The built environments are enormously spewing $C0_2$ emissions across the world. Worldwide, 40% of energy, 17% of fresh water, 25% of collected wood, and 40% of material utilised emanates from the constructed environments (Joburg, 2009). Buildings development and operations contribute 50% of the total $C0_2$ emissions, making them the main contributors to global warming (Crane & Swilling, 2007: 2).

The ecological design of buildings should balance social, ecological and economic needs of communities through enabling their participation in the formulating of sustainable solutions informed by local context (Smit, 2009: 22). The national, provincial and local governments including developers should build ecologically designed buildings with improved thermal performance. Developments are often done on green landsites, cutting down trees and many other foliage, such activity reduces the capacity of the natural environment to absorb $C0_2$ emissions (Joburg, 2009). The ecological design approach would to ensure that "instead of depending on cement, air-conditioning and electronic lighting, architects could use alternative building materials and designs to secure more natural light, maximize passive heating and cooling, improve insulation and so on, thereby reducing our cities' impact on climate change" (Crane & Swilling, 2007: 2). Joburg (2009) has stated that "more energy efficient buildings benefit their owners and tenants as they result in lower energy bills". The built environment provides opportunities to start enhancing energy efficiency systems and encourages energy diversification in any given country. This has happened and continues to occur in countries such as Australia, Brazil, China, India, Germany, Spain and Sweden.

2.5 BRAZIL ENERGY PORTFOLIO IN 2009

Brazil energy portfolio in 2009 was still heavily reliant on the hydroelectric generation more than other energy sources made its electricity generation and market distinctive.

FIGURE 2.2: BRAZIL ENERGY PORTFOLIOIN 2009



Source: AnsaldoEnergia, 2009: 11

Brazil derived more than 80% of its electricity needs are met through the hydroelectric power plants and it enjoys the largest capacity of water storage globally[15]. Brazil launched an economic transformation in the early 1990s, introduced free trade and developed a privatization policy framework for major state owned industries. Brazil drive was to privatize was informed by the Real Plan in mid-1994 to reduce inflation and manage inflationary expectations. The Brazil drive of restructuring and privatization of energy sectors occurred as reforms were enforced in the entire economic sectors. Brazil's energy demand declined in 2001-2002 and faced a highly severe energy crisis that slowed overall economic growth (Rice University, 2004: 3-5). Figure 2.2 above shows Brazil energy portfolio in 2009 dominated by hydropower (82.80%) and makes the country very vulnerable to extreme shortages of water supply due to drought as it happened in the 1990s resulted to 2001 energy shortage (AnsaldoEnergia, 2009: 11, 13).

Subsequently Brazil resolved to diversify its energy portfolio to reduce heavy dependence on hydropower through introducing natural gas (10%), solar energy, wind and wave energy sources including nuclear energy expansion (AnsaldoEnergia, 2009: 13). The Brazilian government introduced a national programme called 'Minha Casa, Minha Vida', which in English means 'My Home, My Life'. Brazilian government's programme planned building about one million homes for low-income families within a 24-month period, starting from 25 March 2009, with the programme also being intended to benefit the solar industry sector. Brazil enforced SWHs to mitigate the country's energy consumption and costs. Although implementation of the Brazilian government's envisaged action plan had to be delayed and it was unable to meet the initial target of achieving one million social housing within two years. However, the SWHs agenda and enabling policy regulation have been presented to the Brazilian people and the world. SWHs in Brazil are part of the federal government's current housing policy, seeking to improve the quality and sustainability of housing investments while saving energy and improving people's lives (Cardoso, 2011)[16].

Like Eskom, the national SWH programme seeks to deploy one million SWH systems with the same target, but a different approach. The envisaged SWH installation in Brazil should serve as a showcase for such technology transfer, with the first model, which utilises gas instead of electricity as an auxiliary heating source, having been implemented in Rio de Janeiro. The newly built multi-family homes concerned were designated as for low-income families. Each SWH unit has two flat-plate collectors and one thermal storage tank of 200 L, which is adequate to satisfy the hot water demands made by a family of five. The Brazilian Engineering Bureau Studio Equinócio was mandated by the GIZ to design the SWH project. SWHs were supplied and installed by Heliotek, a local collector and tank manufacturer, which is affiliated to the international Monier Group (Café, 2011)[17]. "Brazil is showing a trend towards solar water heaters in social housing projects. At the end of 2008, over 40,000 low-income families had already taken advantage of the extensive benefits provided for solar water heaters. The Brazilian government's announcement in early 2009 resulted to in the implementation of a programme called 'Minha Casa, Minha Vida' (My Home, My Life)".[18]

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[15]AnsaldoEnergia, 2009.

[16]Cardoso, F. 2011. Brazil: New requirements for solar installations on social housing.
[17]Café, C. 2011. Brazil: Low income multi-family house with individual solar water heaters and gas back-up.

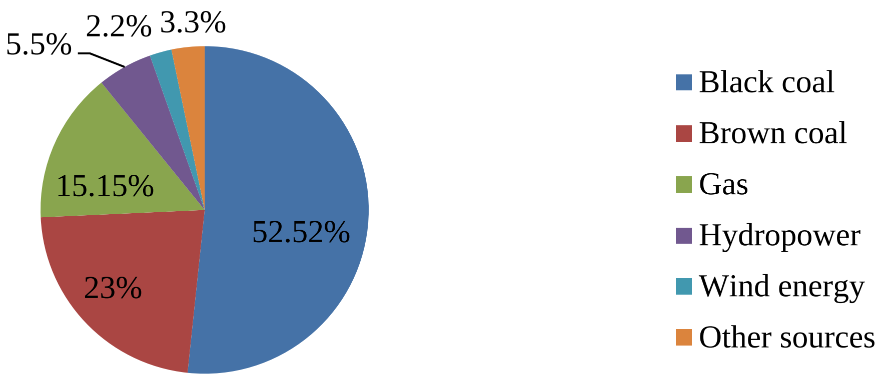
[18]Café, C.F. 2009. Brazil: How the "My Home My Life" Programme can help the solar water heater sector.

The programme was "equipped with a total budget of Brazilian Real (BRL) 34 billion, ... aims at constructing 1 million single family homes by the end of 2011" (Café, 2009). The Brazilian government announced, on 5 November 2010, enabling policy regulations requiring that all new buildings constructed through the My Home My Life programme, starting in early 2011, during its second phase, be built in such a way as to enhance energy conservation and to reduce energy expenses, by, among other requirements, incorporating the purchasing of water harvest tanks (Café, 2010). Brazil sustainable energy is married with social housing.

2.6 AUSTRALIA

Like many of the fossil fuelled dominated countries, Australia embrace sustainable energy and adopting energy efficient measures in buildings as stated below in a country deriving dominant coal-fired electricity power plants (75%) is the way to start. During its 2009/2010 financial year, Australian sustainable energy particularly hydroelectricity, wind energy and bioenergy only contributed about 8% of the total final electricity portfolio. Figure 2.3 below evidently shows that "most of Australia's electricity is produced using coal, which accounted for 75 per cent of total electricity generation in 2009–10. This is because coal is a relatively low cost energy source in Australia" (BREE, 2012: 33).

Figure 2.3: Australian energy portfolio per source 2012



Source: Bureau of Resources and Energy Economics (BREE), 2012: 33.

The South Australian government through the Department for Families and Communities (DFC) conducted a feasibility study on the possibility of introducing grid connected solar systems and/ or SWHs to Housing Trust. The study concluded that SWHs were cost effective solution to mitigate electricity consumption and reducing the corresponding carbon emissions compared to a grid connected solar system (DFC, 2008: 9). As from May 01, 2006 every new building and major renovations built in South Australia (SA) requiring hot water service were required to achieve five star energy rating and energy efficiency level. The energy efficiency codes are enshrined in the Building Code of Australia (BCA) and South Australian Housing Code (SAHC). In this regard Australia has committed itself and its resources to building sustainable settlements and to enforcing the upholding of sustainable housing principles. The country found that 40% of house heat was lost through roofs and ceilings, and 35% through the walls and floors. New housing was, consequently, to be designed to have insulated walls and ceilings, with an orientation geared towards the harnessing of sunshine, and to make efficient use of SWHs to reduce energy use and $C0_2$ emissions (DFC, 2008: 8-10).

2.7 TRENDSETTERS IN SOCIETY

Improving quality of life is an international challenge, because poverty and unemployment are a persistent cancer that continues to weaken the strengths of international community. The trendsetters in society have exclusive powers to put in place enabling policy frameworks to make people understand, in their own language and where they live, that the global dependence on fossil fuels for energy needs has two main disadvantages. One is that fossil fuels are a non-renewable resource. While their exploitation sustained demand for petroleum liquids and growth in the 20th century, concerns appeared about depletion of such fuel stocks. The second disadvantage is that they are responsible for global warming (Fernandez-Armesto, 2009: 1030). For this reason, policy frameworks have been put in place to enforce SWH use in various countries in order to mitigate the heavy usage of fossil fuels and so as to improve the quality of life for the poor. The most effective trendsetters in society tend to be churches, universities, municipalities, schools, and public health facilities. In Sweden, the Bua Church in Varberg installed photovoltaics (PVs) on its roof in 2008 to cut energy usage and the contribution that the Church was making to climate change. The same happened with schools in Stockholm, the City Theater, and the University of Lund (SEA et al, 2009b: 47). In India, the Energy Efficiency & Renewable Energy Management Centre of New Delhi stated that SWH carrying capacity size ranges from 100 L to 300 L or more, and that installing 1000 SWHs with a size of 100 L can result in each replacing 1 MW of peak demand per year and cutting off 1.5 tonnes of $C0_2$ emissions. The implementation of SWH systems will open up avenues to enforce ecological design in building developments to enhance improved quality of life while reducing some greenhouse gas emissions (GHG).

2.8 WHAT IS ENERGY?

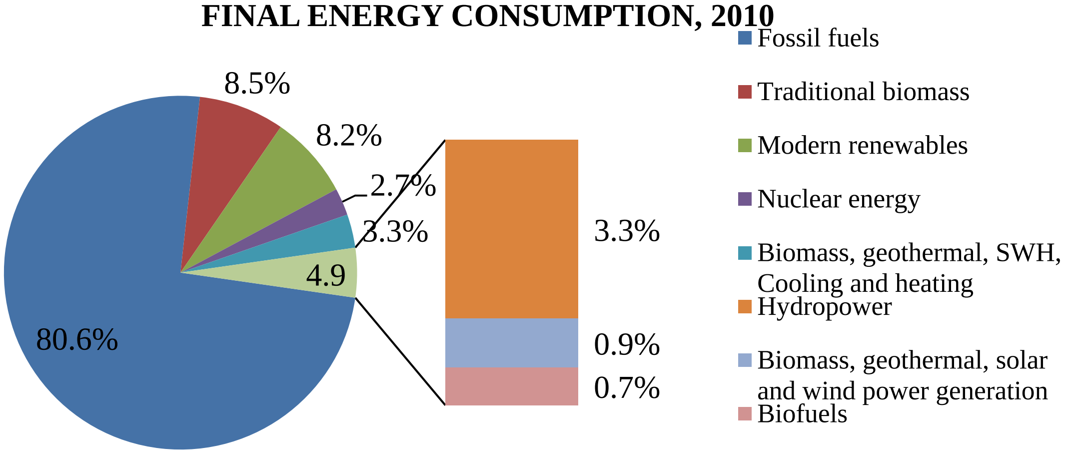
Energy is defined as the ability to do work (Swanepoel, 2007: 2. Energy remains essential to improving the quality of life with sustainable energy being fundamental means to achieving sustainable development. The sustainable energy systems include bio-energy, geothermal energy, solar energy, tidal energy and wave energy systems, and wind energy sources (Smit, 2009: 20; Winkler et al, 2005: 28). Davidson et al (2007: 2) argued that “sustainable energy is defined as energy providing affordable, accessible and reliable energy services that meet economic, social and environmental needs within the overall developmental context of the society for which the services are intended, while recognizing equitable distribution in meeting those needs”. Eskom generates as stated in sections 1.3.1 and 1.3.2, and distributes 95% energy supply in partnership with municipalities to the local and 45% to other [19]African countries end-users (Kohler, 2008: 7-9, 44-45).

2.8.1 Sustainable Energy Systems

In 2010, the recorded sustainable energy systems contribution to global energy consumption was 16.7% worldwide. Figure 2.4 below indicate the renewable energy share of global final energy consumption in 2010. It was estimated that in 2010 to 2011, the solar water heaters (SWHs) were installed in more than 200 million households globally, including most public and commercial buildings globally (REN21, 2012: 14). Now the second leading $C0_2$ emitter after China, the US in 2008 derived more than 70% of final electricity from burning coal, petroleum and natural gas, the other 20% came from nuclear energy plants, and more than 8% from sustainable energy systems, of which 7% is derived from mainly hydroelectric dams (US Department of Energy, 2008: 8). The “renewable energy supply sources are effective in lowering CO_2 emissions because they have low carbon intensity with emissions per unit of energy output typically 1 to 10% that of fossil fuels” (Yamba et al, 2012).

[19]South Africa Yearbook 2010/2011: 182

FIGURE 2.4: RENEWABLE ENERGY SHARE OF GLOBAL FINAL ENERGY CONSUMPTION, 2010



Source: REN21, 2012

In 2011, US increased sustainable energy contribution from 10.4% in 2010 to 12.7% of total electricity generation, bulk of which was from wind turbines and hydropower plants. China ended 2011 as a global leader in the uptake of wind turbines, hydropower producer, and manufacturing of solar PV (REN21, 2012: 23). “In addition, non-electrical RE technologies also offer opportunities for modernization of energy services, for example, using solar energy for water heating and crop drying, biofuels for transportation, biogas and modern biomass for heating, cooling, cooking and lighting, and wind for water pumping” (IPCC, 2011: 18).

2.8.2 Solar water heater (SWH)

A solar water heater (SWH) refers to a technology that harnesses sunshine to heat water. SWHs are listed among simplest ancient ways to harness sustainable energy systems and can contribute both to enhance climate protection and sustainable development endeavours. The SWHs functions according to two major principles. Firstly, as water heats, the portion that is hot rises as a result of density difference between hot and cold water, and this process is referred to as a thermosyphon effect and secondly black components absorb heat. This means that “the system operates through a thermsyphon, where warm water flows to the top of the tank and into the hot water pipes due to the natural density differences between cold and hot water. For most SWH, 45°C to 50°C is sufficient for bathing and kitchen use” (Refocus, 2004: 18). SWHs consist of three main parts, the solar collector, the storage tank, and energy transfer fluid system (Kaufman & Milton, 2005: 6; SEA, 2009a: 1).

2.8.2.1 Active and passive SWH systems

SWHs are distinguished as either active or passive and direct or indirect systems. SWHs consist of either flat plate or evactuated tubes collectors. In essence, the active closed loop SWH system uses a pump to circulate water between collector and storage system. The passive SWH system uses natural convection that is also known or referred to above as thermosyphon to circulate water between the collector and the storage system (SEA, 2009b: 7; SEA, 2007: 14). Kaufman & Milton (2005: 6) argued that the solar thermal systems have been in existence since at least the period of ancient Greeks who designed their homes to harness the winter sun. Currently the global SWH market is expanding rapidly with China strongly leading in this regard.

2.8.2.2 Type of SWH collectors

Flat-plate and evacuated-tube SWH collectors are currently available throughout the world. Such collectors are divided into direct and indirect systems. In direct solar collector systems the water is warmed directly, after which it circulates between the harvester and storage tank system. The system is mainly suitable for areas with frost and without lime, borehole water and treated water. In indirect solar collectors are equipped with anti-freezing element, and storage tank to preserve water. Such a system is generally recommended for those areas that receive frost, but could also be used in such frost-free areas as the Western Cape. In essence, flat-plate solar collectors have a transparent front cover, a collector home and an absorber. The system has been on the market for more than 50 years, during which it has proved to be very reliable. Evacuated tubes, which are relatively new in the SWH market, are mainly manufactured in China, (SEA, 2009a: 1-2). The internationally increasing enforcement of SWHs has been prompted by profound global recognition that fossil fuels are exhaustible (see subsection 1.3.5) and that they will be instrumental to reduce fossil-fuel based rising carbon emissions. “Over one-third of homes in Barbados are equipped with SWHs systems and in India, SWH is considered among the country’s most commercialized renewable energy technologies. Increasingly hot water is seen as a fundamental aspect of healthy and hieginic life and demand for it is growing steadily” (Kaufman & Milton 2005: 6).

2.8.3 Potential reduction of energy consumption through SWHs

The potential reduction of energy consumption through SWHs is widely distributed across sectors and the residential sector is one such sector. For instance, SEA (2007: 14; 2009b: 4) stated that the South African residential sector consumes 17% of electricity and this translates to 5% of total energy consumption. The bulk consuming appliance in households is the electric water heater which is responsible for 30% of the total household electricity usage. The solar water heater system may cut this electricity consumption by more than half. In 2009 the SEA study has outlined the national consumer benefits of using SWH systems:

> (1) The resultant reduction in domestic electricity consumption will improve energy security and reduce demand from the Eskom supply grid.
> (2) Fewer power plants will be urgently needed for future capacity.
> (3) SWHs will play a critical role in enhancing demand-side management.
> (4) The SWH industry will enhance technology transfer and result in job creation in both the manufacturing and installation sectors.
> (5) SWHs usage will reduce local $C0_2$ emissions by 2 tonnes per household.
> (6) SWHs can help reduce water-warming costs for mid- to high-income households by 60%, as attested in the CEF 500 study. “This amounts to 25 to 30% of saving on an average monthly electricity bill. With the price of electricity increasing sharply in the next few years the financial case for SWH is very strong” (SEA, 2009a: 4).

Understanding some of the above-mentioned SWH benefits is very important, because the entire development of South Africa is premised on the post April 1994 democratic national vision of the ANC led government of bringing “a better life for all”, which implies striving to improve the quality of life for the poor. Presently, South Africa is one of the many countries that battles with the challenges of poverty and unemployment, which makes South Africa a significant strategic partner in international efforts to achieve UN MDGs. In fact, enhancing access to advanced energy in developing nations is essential for poverty reduction, for industrialisation and for the achievement of the MDGs (WBGU, 2003: 2).

2.8.4 Main obstacles

The main obstacles included prices of SWH systems, poor public awareness and lack of political will to put in place supportive policy incentives. The buying power and affordability speaks volumes when it comes to the adoption of SWHs by low-income homes and local entrepreneurships. Worldwide, obstacles to growth in the SWH industry include the fact that SWH market penetration and growth are hampered by a lack of educative awareness, of enabling policy mechanisms and of high upfront costs for SWHs (Holm 2005: 19).

SWH market prices in China, India, Europe and South Africa explain it all. WEC (2007: 6) has stated that in China and India each SWH unit costs as little as €300 (R3 150.00, at an exchange rate of R10.50 per €1) to €400.00 (R4 200.00). The main point being emphasised here is varying high cost as barrier to increasing SWHs application. Each SWH unit costs as much as €5000.00 (R52 500.00) to €7 000.00 (R73 500.00) in Northern Europe. In European countries, the average cost of a SWH unit ranges from €600.00 (R6 300. 00) to €900.00 (R9 450. 00) per m^2 (WEC, 2007: 6). In Austria a 300L SWH with collector area of 6 m^2 costs €4200 to €4900 including installation and VAT, which compared very favourably with units of the same quality in Germany (WEC 2007: 15). In South Africa, a good quality SWH costs from R10 000 to R35 000 as was stated by Solahart, Solardome SA before closing down at the end of 2011, and Suntank ([20]February 2009; Hickey, 2009)[21]. Many successful SWH markets globally adopted enabling SWH policy designs to cut impact of high prices. Table 2.1 below under section 2.4.1 contains examples of successful SWH markets that introduced enabling SWH policy designs such as the European Union Countries solar building standards, incentives and awareness, sustainable energy law and building standards of China etc.

2.9 OVERCOMING OBSTACLES

2.9.1 Mandatory policy

SWH markets grow where the government shows political will to overcome obstacles of high upfront costs, and where enhanced educative awareness are enforced through embraced financing incentives. Israel has enhanced SWH markets through enforcing mandatory policy for the SWH uptakes, resulted in more than 80% SWH coverage followed by the Barcelona solar ordinance (Holm, 2005: 19-20; Hurwitz, 2009)[22]. However, those nations with good solar radiation without government mandatory policies have failed to achieve SWH market penetration and to transform the local SWH market (Holm, 2005: 19). In Spain, the Barcelona solar ordinance was approved in 1999 to:

- Enforcing sustainable energy systems in municipal buildings to cut energy use;
- Providing incentives for sustainable energy usage in domestic and businesses; and
- Installing SWHs in municipal buildings and sport facilities (Droege, 2008: 443, 445).

Table 2.1 below displays information relating to international leading SWH markets with enabling policy measures that are directed at enforcing SWH installations: the European Union countries, Germany, New Zealand, India and China. The national governments in some European countries, such as Germany and Sweden, have also partnered with religious institutions to enforce SWH-related action by means of word and practical deed in their relationships with influential local people (Huber, 2007; SEA et al, 2009).

[20]Brenen February, 2009, Personal Interview, Solardome SA in Stellenbosch, 23/09/2009.
[21]Jim Hickey, 2009, Personal Interview, Solahart, Johannesburg, 13/03/2009.
[22]Nuriel Hurwitz, 2009, Personal Interview in Pretoria, Suntank, 11/03/2009.

Table 2.1: International leading SWH markets with enabling policy measures			
Country	**SWH targets**	**Policy laws**	**Potential jobs**
European Union Countries	Meeting of 0.5% of energy demand from solar thermal by 2020. Cutting of 69 million metric tons of $C0_2$ per annum by 2020.	Solar building standards, financial support, and awareness campaigns. Tax incentives.	Creation of 470 000 new jobs.
Germany	Adoption of solar thermal to meet 4.5% of buildings' energy requirements by 2020. Cutting of 16 million metric tons of $C0_2$.	Solar Ordinance to enforce SWHs and cooling units. Renewable Energy Laws.	Creation of 150 000 new jobs.
New Zealand	Meeting of 50% of new residential sector requirements by 2020. Cutting of 175 000 metric tons of $C0_2$.	Support of private businesses, provision of interest-free loans and training skills.	Creation of 2 400 new jobs.
India	Meeting of 20 million m^2 from solar thermal. Cutting of 25 million metric tons of $C0_2$ by 2022.	Subsidies, soft loans, and soft import tariffs.	Creation of new jobs.
China	Meeting of 2.8% energy requirements with solar thermal by 2020. Cutting of 288 million (metric tons of $C0_2$ emissions).	Sustainable Energy Law, Golden Sun Demonstration Programme, and building standards.	Creation of 10 million direct and indirect new jobs
Sources: MNRE & REEEP, 2010; SEIA et al, 2009, MNRE & REEEP 2010.			

2.9.2 Clean development mechanism (CDM)

The clean development mechanism (CDM), which enhances sustainable energy systems and specifically SWHs dissemination to the global citizens, was constituted by Article 12 of the Kyoto Protocol, whose timeframe will come to an end at the end of 2012. The Protocol enables developed nations to meet their obligations to cut $C0_2$ emissions problems, as was covered in subsection, 1.3.6. The Protocol sought to supplying skills and technology transfer to the developing nations through enhanced foreign direct investment (FDI) with tradable certificates (Kaufmann & Milton, 2005: 7). An open window to CDM for developing nations can be attained through embracing the Kyoto Protocol principles that enhance the reduction of carbon emissions (Fakir & Nicol, 2008: 22). Prasad (2007: 2) contended that "South Africa signed the Protocol in 2002, but it does not commit non-Annex 1 developing nations such as South Africa to any emission targets in the first commitment period 2008 to 2012, and it creates no external pressures to reduce emissions". The Kuyasa Project in Cape Town near Khayelitsha in South Africa is registered as a model of CDM initiative to reduce escalation of future $C0_2$ missions and further details about the Kuyasa Project will follow later (SEED).

2.9.3 Climate change

The climate change problem entails the threat that it imposes on improving lives**.** It cuts our capability to overcome poor quality of life conditions, as was alluded to in subsection 1.4.3. Climate change leads to a rise in sea levels, and contributes to the killing off of ecological systems and ecosystems. Such change causes severe weather developments in the form of storms, floods and droughts, and, in the process, human lives are destroyed, or people are forced to move out to unknown places with shortages of food (Barbier, 2009: 21-22).

The developed nations, apart from the United States, which did not ratify the KP were required to reduce their $C0_2$ emissions by 5.2% relative to the 1990 levels from 2008 until 2012 (Bennett, 2001; Fakir & Nicol, 2008: 22). Although both the developed and the developing nations need to manage an average temperature increase below 2ºC through a reduction of 40% to 45% $C0_2$ emissions below 1990 levels in order to manage climate change, there has been a repeated failure to match these targets in 2009 in Copenhagen, in 2010 in Cancun and in 2011 in Durban (COP15-17). In the absence of a post-Kyoto Protocol climate agreement, there has been growing investment uncertainty over the future of the global carbon market and CDM after 2012 (Barbier, 2009: 15).

The summit**s** that were held end of 2009 in Copenhagen, Denmark (COP15), and December 2010 in Cancun, Mexico (COP16) failed to agree on post Kyoto Protocol expiring end of 2012. The UNFCCC summit hosted by South Africa end of 2011 in Durban at least reported that COP17 agreed to adopt some kind of universal legal agreement on climate change not later by 2015. The COP16 has (Greencarcongress, 2011). The governments also agreed to enhance implementation of the Green Climate Fund package in 2012 that included the Adaptation Committee to coordinate global adaptation actions and Technology Mechanisms agreed upon in December 2010 in Mexico (Our earth, 2012).

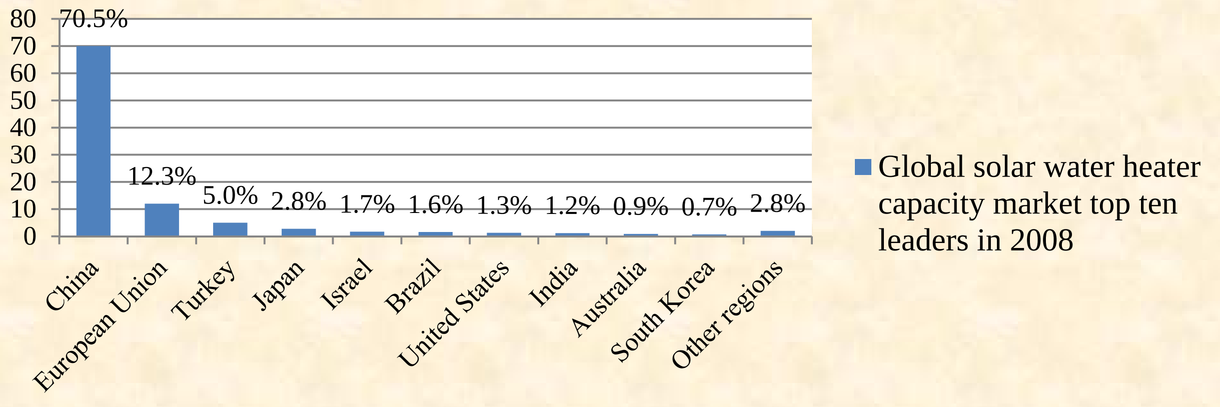
2.9.4 Green procurement

The municipalities leverage their powers through green procurement to enforce sustainable energy to force suppliers to provide environment-friendly services through clean technologies (Suffolk County, n. d: 2-18). Such leverage again affirms the exclusive privileges and powers vested within the hands of municipalities and universities. International experience shows that great institutions, such as local governments and universities, could make a remarkable impact through their procurement policy to induce efficient use of resources, including SWHs (Swilling, 2005: 8). Commitment to say “we will engage positively in the minimization of resource use, reduction in the size and weight of products, use of recycled materials, and the development of long-lasting energy saving, energy creating products” (Sharp 2006: 2). The enforcement of local green procurement policy also “helps local governments meet their own targets and environmental commitments like reducing energy consumption and $C0_2$ emissions with sustainable purchasing policies that also yield both economic and human health benefits (Culver, 2008: 4). Among many other things their guidelines promotes use of SWH systems.

2.9.5 Global SWH capacity market

The Kyoto Protocol opened up access to a Clean Development Mechanisms (CDM) largely by means of developing nations such as South Africa could explore sustainable energy and enforce SWHs just like China is playing a global leading role in SWH (Fakir & Nicol, 2008). In essence “the Bonn Renewables 2004 international conference recommended that public support to renewables be increased by one order of magnitude. SWH has been identified (Conningarth, 2004) as one of the most cost-effective interventions” (Holm, 2005: 57). Figure 2.5 shows in 2008 70.5% installed global SWH capacity market was from China only.

Figure 2.5: Global solar water heater capacity market top ten leaders, 2008



Source: REN21, 2010: 23

China added more than 29 GWth in 2009 to achieve more than 80% of total global SWH markets. With the exception of unglazed SWHs for swimming-pools, the existing SWH capacity has grown by 21% to achieve 180 gigawatts-thermal (GWth) globally in 2009 (REN21, 2010: 23). Most leading European Union countries have approved tangible supportive policy measures aimed at enhancing solar thermal application for five to more than ten years. The countries concerned have embraced Keymark Voluntary Certification to enhance their good quality standards, training and certification schemes for SWH installers, maintenance services, and provision of educative information for public awareness and maximum participation of civil society (World Energy Council, 2007a: 10-11). The love of humanity awareness is dependent on collaborative activity and environmental safety as solid basis for sustainable energy path as they foster good neighbourhoods. “Neighbourhoods are good human neighbourhoods if love prevails in neighbourly relationships and nations governed with love are societies of justice” (Koegelenberg, 1993; 75) for all the stakeholders.

Between 2009 and 2020, the European Union plans to spend €214bn on the creation of 470 000 green jobs (SEIP et al, 2009b: 19). The investments of China in the sustainable energy industry have increased from US$170m in 2005 to US$420m in 2007. With the investment value in the sustainable energy sector being about US$17bn, employment was already provided to nearly 1 million workers, including to 600 000 from solar thermal, 266 000 from the biomass energy generation sector, 55 000 from solar photovoltaics (PV), and 22 200 from the wind energy sector (Barbier, 2009: 104). Europe and Asia are creating green jobs.

2.9.6 Green jobs

For more than 33 years since 1978 China economic policy reforms helped in stimulating investments on the innovative green energy infrastructure and enhanced its foreign trade to achieve economic growth that range between 8% to 10% a year and lifted 500 million people out of poverty. “Deng Xiaoping in 1978 initiated an open door policy to reform and modernise the Chinese economy, promoting foreign trade and investment as the main catalysts of growth. With Deng Xiaoping’s reforms, in a few short decades China’s economy has gone from what some might call economically backward to that of one of the globe’s major economic players” (Enterprise Ireland, 2012: 2, 4). The policy reforms enhanced technology transfer, and leapfrogged developing nations from being reliant on fossil fuels to sustainable energy industry with green jobs (SEIP et al, 2011). Table 2.2 reveals employment distribution in sustainable energy industry of China, 2007.

Table 2.2:	**Employment distribution in sustainable energy industry of China, 2007**				
Industry	**Wind energy**	**Solar PV**	**Solar thermal**	**Biomass**	**Total**
Generation	6 000	2 000		1 000	9 000
Manufacturing	15 000	38 000	400 000	15 000	468 000
Service	1 200	15 000	200 000	250 000	466 200
Total	22 200	55 000	600 000	266 000	923 200
Output value US$ million	3 375	6 750	5 400	1 350	16 875
Source	Barbier, 2009: 104				

Substantial potential and contribution in terms of employment distribution of green jobs in the sustainable energy industry of China is reflected in Table 2.2 above (Barbier, 2009: 104). Social sustainability emanates from a high degree of sustainable and local employment creation through the SWH industry. Economic sustainability emerges from the lower life-cycle costs of SWHs and provision of affordable peak energy demand to avoid building new peak demand capacity. Sustainability of SWHs is derived from short-term energy payback periods, the abatement of ecological impact, and the reduction of greenhouse gas emissions (Holm, 2005: 17). In Sweden 95% of its municipalities and regions were engaged in energy efficiency initiatives in their own buildings and were able to buy certain percentage of their energy from green sources (Alber & Kern n. d: 7). Not only does disseminating solar energy brings with it sustainable energy, but it creates jobs. Solar energy transforms life quality and economic conditions in the developing nations by supplying electricity, bringing light, communications, computers, machinery by means of which modern education, health care, agriculture, safe business and the environment can be accessed (SEIP et al, 2009: 4).

2.9.7 Global economic conditions

The prevailing global economic conditions with special focus in the Eurozone countries extremely relevant to consider if Spain a country known as having popularized solar ordinance after Barcelona approved it in 1999 is listed among countries encountering economic challenges threatening their very economic growth. The impact of the 2008 global economic was afflicted South Africa during the last quarter of 2008 with nearly a million job losses, exception was increased revenue from R6.2 bn in 2004 to R13.6 bn in 2008. (South Africa Yearbook, 2010/2011: 374). South Africa is vulnerable to the happenings in the Eurozone. The world especially South Africa should be very concerned "if the global economy is experiencing a sovereign debt crisis that is spreading rapidly across the euro region and threatening several Western economies including Greece, Ireland, Italy, Portugal and Spain" (Overseas Development Institute, 2011). In addition "the Greek debt is more than five times bigger, $483 billion against $95 billion. The Italian debt, the second biggest debt-to-GDP ratio after Greece, is even larger – about $2.5 trillion" (Overseas Development Institute, 2011: 1). The global economic crisis from September 2008 to 2009 was caused by the insolvency of US financial institutions, however, the trigger of Eurozone crisis could be attributed to some European governments' inability to administer their debt (Overseas Development Institute, 2011). South African economy is directly affected by Eurozone crisis.

South Africa is a developing country, with a long history of importing more than it exports, mainly to the European Union countries. "One of the points of vulnerability in our economy is that we import far more than we export – this gap, called the current account deficit, has widened to an estimated R143 billion a year" (Manuel, 2008: 4). Subsequent to the economic crisis, with reference to the IMF (2010), worldwide financial markets remain in turmoil. Growth projections for developed countries have been constrained to just 1.5% in 2011, and worldwide growth is expected to slow down by more than 1% point from 2010 to 2012" (Overseas Development Institute, 2011). The Eurozone crisis is likely to affect developing countries in terms of spillovers through financial support and stock markets, the shifting of investment trends, and risks perceptions which, among other things, translate into decreasing capacity to import from South Africa and elsewhere. Other countries, especially Burundi, Kenya, and Mozambique, are more vulnerable to the Eurozone crisis than is South Africa (Overseas Development Institute, 2011: 2, 5). Our imports include renewables materials. Bulk of local SWH companies are importers (Hickey, 2009). When considering interventions to reduce the level of poverty and to enhance the quality of life we need to recall statements that have already been made. South Africa should manage its inflation rate to be able to improve the quality of life of the majority of its citizens. Manuel (2008: 4) states that "a policy stance that accommodates higher inflation cannot be consistent with a government that is intent on reducing poverty". Additionally, Manuel (2008: 4) said "part of this is because we are not investing heavily in infrastructure expansion, we are importing machinery and capital goods, in addition to the imports of fuel and other goods. The value of our exports, although boosted by high commodity prices, is insufficient to pay for our imports."

2.10 SOUTH AFRICAN CONTEXT

The gist of the South African sustainable energy policy design framework was outlined in subsection 1.4.5 with a view to improving the quality of life. In addition, the national building standards would require that all new commercial and domestic buildings designs to be energy efficient on their walls, roofs, windows, floor, SWHs, ceilings and outside with trees (South Africa Yearbook 2010/2011: 176). The current section demonstrates the renewable energy policy choices made by South Africa as a national response to both local and external pressures to enhance the growth of sustainable energy applications in meeting business and domestic energy needs, while reducing climate changes effects. It is no secret that, in some African countries, production from mostly rain-fed agriculture could be reduced by up to 50% by 2020, while local food supplies also stand to be negatively affected by a reduction in the availability of fish in large lakes (FAO et al, 2010). The fourth report of the 2007 IPCC estimated that, by 2020, between 75 million people and 250 million could face escalating water stress due to global climate change (Wlokas, 2009: 13).When considering the fact that poor quality of life cannot be merely improved without external assistance from some developed European countries, United States, China and other emerging economies, persistent vestiges of the late 2008 global economic crisis, in the form of the Eurozone crisis, are not good news for many developing nations (Overseas Development Institute, 2011: 4).

2.10.1 Poor quality of life conditions

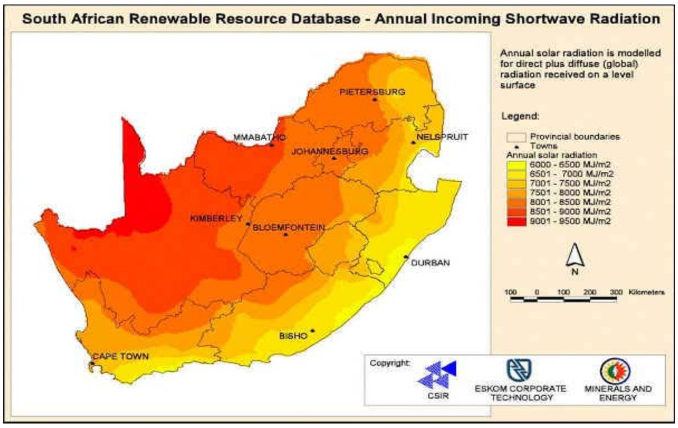
Poor quality of conditions including unemployment, inequalities and poor housing has been discussed in chapter 1 under section 1.4 and subsection 1.4.1 to 1.4.4. The South African sustainable energy policy is informed by understanding that poor quality of life conditions are compounded by the global climate changes, whose effects will mainly compromise access to water, agricultural production and food security across Africa (DME 2003). In the main the country is committed to drive sustainable energy expansion as shown in section 1.4.5 with specific targets to achieve 1 million SWH installations by 2014 and 5.6 million SWH rollout by 2020. This new green energy economy drive has the potential to creating about 300 000 jobs and enhance local manufacturing industry and reduce $C0_2$ emissions. "Global emissions are those that impact on climate change. Carbon dioxide ($C0_2$) is the principal energy-related global emission and is largely responsible for the alarming global warming phenomenon. Electricity is responsible for most of the $C0_2$ emissions” (Cape Town, 2005: 13).

2.10.2 Harness solar radiations

The South African SWH programmes are formulated to harness solar radiations. The primary incentive for great justification of South African SWH programmes is annual availability of sunshine. The amount of sunshine to which South Africa is exposed is similar to that of India. Indian sunshine is more than 5×10^{15} kWh per annum (MNRE, 2007) with daily energy average varying between 4 kWh to 7kWh per m^2 subject to specific region (Mani & Rangarajan, 1982) in India (Purohit & Michaelowa, 2008). “Most areas in South Africa average more than 2 500 hours of sunshine per year, and average daily solar-radiation levels range between 4.5 kWh and 6.5 kWh/m2 in one day” (South Africa Yearbook, 2010/2011: 185). South Africa’s sunshine is much more favourably distributed compared to the 3.6 kWh per m^2 of certain regions in the US and 2.5 kWh per m^2 received in some European countries. (DME, 2003: 20). The SWH programmes are designed to harness abundant solar radiations optimally so as to stimulate alternative potential growth avenues, and to create more small businesses and green job opportunities to enhance human development.

Figure 2.6: ***South African renewable resource database – annual income shortwave radiation.***

Figure 2.6 reflects images of South African renewable energy resource database. The graph



shown on the left shows South African regions that should due to high amount of their solar radiations, be incentivised in terms of strong local action to deploy SWHs, with the regions concerned Western Cape and Eastern Cape Provinces. Evidence shows that there is an optimal amount of sunshine sufficient to stimulate the growth of SWH markets, some green job creation and poverty alleviation countrywide. However, in 2008 inadequate policy and lack of integrated SWH promotion activity resulted to very limited progress being made to achieve the national SWH targets and tangible SWH rollout (Holm, 2005: 19; Kritzinger, 2011). The targets were real and necessary as 2008 energy crisis prompted an action to arrest unwanted energy shortages that plagued the entire South Africa and neighbouring countries.

2.10.3 R4bn required for national SWH programme

The 2008 Eskom rebate to enforce energy DSM intervention aimed at increasing the national number of SWHs from 925 000 to 1 million, which was originally said to require R4bn for its implementation has achieved very little. Instead of the R4bn requested, Eskom received R2bn to pay SWH rebates. “For indicative purposes, a first year achieved installation of 10 000 SWH systems with an annual increase over five years of 80% annually having been modelled here. This would result in approximately 1 million installed by 2014” (Eskom & Nano Energy, 2008: 4). Important institutions responsible for the promotion of SWHs included Eskom, the DOE, the CEF, the provinces, the Department of Environmental Affairs (DEA), municipalities, the South African Bureau of Standards (SABS), the Sustainable Energy

Society of Southern Africa (SESSA), higher education, research, public and financial institutions, private sector and international donors, residential households and communities (Farkir & Nicol, 2008: 19; Van Niekerk, 2009). However, the national SWH programme achieved below 1000 SWHs by the end of 2008, due to small rebate ranging from 20% to 30%, lack of public awareness, high upfront costs and cheap electricity tariffs still prevailed, and there was less incentive to switch to SWH usage (Hickey, 2009; Van Niekerk, 2009).The national SWH intervention sought to achieve the following range of savings over a five-year period, starting with saving 3 300 MWh (578 MW) coal-fired power, reducing 1 850 tons of coal per year, and 3 303 tons of $C0_2$ emissions per year as well as 4 756 kilolitres of water (DME, 2009: 10, 13). Most sustainable energy literature postulates that SWH installation will result to 35% and 70% savings on electricity consumption and associated monthly expenses (Kritzinger, 2011: 3; Thirion, 2009). The savings in costs, therefore, are between 21% and 35% (DME, 2009: 3). In the same study collection, claims were made that SWH could achieve 35% to 40% savings (DME, 2009: 8).

2.10.4 Quality assurance of SWH systems

As was stated in subsection 2.4.4 above, the European Union countries have approved Keymark Voluntary Certification standards to ensure and to manage the quality of SWH products from within and beyond the European Union countries (WEC, 2007a: 10-11). In South Africa, SABS is responsible for managing the quality assurance of SWH systems. The CEF-500 SWH study was done in partnership with key cities and municipalities in South Africa, including the City of Cape Town (CCT) and the Nelson Mandela Bay Municipality (NMBM). It set up a code of practice for SWH installers, requiring SABS to measure, assure and control SWH quality. The project was instrumental in the development and drafting of the CCT SWH by-law (UNDP et al, 2008). The municipalities have embarked on long-term SWH low-pressure rollout programmes (DME, 2009: 17-18).

Energy audits have internationally been used across sectors to identify efficiency measures that can be implemented in a cost-effective manner. However, to be most effective often requires audits, the implementation of mandatory policy measures, and client responsibility to pay, where doing so is deemed applicable. Energy Service Companies (ESCOs) specialize in designing and making energy audits to enforce energy efficiency usage (ESMAP, 2011: 6). SESSA has been promoting renewable energy and energy efficiency for more than 40 years, representing various stakeholders and affiliates to the International Solar Energy Society (SESSA) (Holm, 2009). The building standard requires a qualified technician to evaluate the roof structure to ensure compliance with South African National Standards (most notably SANS 10400) for building development prior to SWH installation (Kritzinger, 2011: 59). Du Toit (2010: 47) argued that “solar water heating can play a central role in the achievement of further development amongst the rich and the poor of the world. It can reduce the intensity and ecological footprint of rich households that currently use electrical and gas heaters, and it can allow poor households without water heaters to improve their quality of life with only a marginal increase in their resource use levels and their ecological footprint.” While the above argument is sensible, there is, internationally, an increasing amount of overrating SWH savings as pointed out in section 1.3 earlier. We need prudent policy choices and accessible energy efficiency information for people to know the benefits of using solar water heaters.
It is equally clear that successful implementation of SWH systems depended not only on the collectively organized activity, partnerships with religious institutions, communities, private sector, professionals and public institutions policies as stated in 2.9.1, but also on a deliberate move to create new culture of responsible consumption and a good standardized way of life.

2.10.5 Overrating SWH savings

SWH contribution to supplying satisfactory hot water services for diverse markets and family needs is at times marked by overrating SWH savings led by some SWH companies to enhance their own sales. The overrating of SWH benefits was made by Ideas on Energy stating that an unnamed Councillor of Ward 37 in a low-income community at Nyanga community near Cape Town International Airport was happy about the positive impact of 80 L SWH installations in each household. Reportedly, the councillor has said, “The project has improved lives through improved water heating systems and shelter. The major impact has been reduced electricity bills in households, and enhances income savings. Those who live in the Nyanga community are among the poorest of the poor and hence need more support from the government to increase access to clean and low cost energy technologies” (Ideas on Energy). The dear councillor might not have been very happy if he really cared more about his constituency and knew that the size of the stated SWH which is 80L will not service the hot water needs of more than three people if the number of intended beneficiaries of that household was more than three, if the ratio of 25L per person in low-income is taken into careful and serious consideration (see Table 1.5) and also see section 2.10.6 below.

An installation of a SWH or heat pump system by an ITS-accredited dealer will qualify for an Eskom rebate and achieve savings up to 75% on water heating costs. This translates to 30% to 40% of electricity savings and costs per month, and the cutting of $C0_2$ emission by 2.8 tonnes per annum (Hickey, 2009; ITS; Suntank; SolarTech). Kayema and Elsol installed 117 SWHs at the Da Vinci Legacy Hotel in Sandton, aimed to save up to 60% of hotel expenses previously spent on hot water supply (Israeltech). Referring to increased SWH rebate in 2010, Eskom Renewable Energy Portfolio manager Cedric Worthmann said “our improved scheme, which will provide purchasing assistance for systems supplied by Eskom-approved suppliers accredited by the SABS, will offer more South Africans access to solar water heating. This could result in an increased number of households having their energy costs being cut by between 30% and 50%” (De Bruyn, 2010). In section 1.5 it has been mentioned that Britain also experienced a share of overrating SWH savings to stimulate SWHs sales.

Table 2.3: SWH with two M^2 collector harvesting 2 000 kWh per annum	
Potential coal savings	1 080 kg
Potential water heating savings from Eskom	2 800 L per annum
Potential ash savings	320 kg per annum
$C0_2$ emissions	1 956 kg per annum
Sulphur dioxide ($S0_2$)	17.9 kg per annum
Nitrous oxide ($N0_x$)	8.4 kg per annum
Saving and reduction of electricity consumption	40% on monthly electricity costs
Source: Sessa, 2009.	

South Africa stated that “not only will a thriving SWH sector contribute much to the development of South Africa’s green economy but it will also relieve pressure on the country’s electricity grid and help reduce its carbon footprint” (Engineering News, 2010). Cape Town installed SWHs upon some public buildings, including on 44 clinics, to which 86 SWHs were installed in 2010. Water heating through electric heaters is one of the biggest electricity users in the city – SWHs could reduce this by 60%, a big saving on all fronts for the (City Cape Town, 2011). Kakaza Trade Company conducted household research in the same community and found that the SWH project had dramatically changed the lifestyle of the beneficiaries. It refers to one of the senior community residents, Bonisiwe Mhlanga (91), who, as head of a household of five, was extremely happy to have an 80-L SWH, as she no longer had to spend much on electricity for hot water. The SWH had cut her household's electricity costs from R150 to R50 per month. The researchers responsible for the study stated that other community members reportedly shared similar experiences of their SWH benefits (Ideasonenergy. 2011).

2.10.6 Investigation

The matter of SWH savings requires further investigation to establish the extent to which SWHs reduce electricity consumption both during summer and winter for the middle to high

income and low-income households that use either high or low-pressure SWHs. Establish how the SWH-related reduced energy consumption translates into financial savings per month, per annum and over a SWH lifespan-cycle. In 2009 the claim of 40% SWH savings attributed to electricity usage and related financial costs was contested by Riaan Meyer (2009) because he was of the view that there was no evidence to substantiate that such SWH savings claims were findings of a peer reviewed research. Nevertheless most sustainable energy literature wrongly or incorrectly stated that SWH usage could reduce household energy consumption by 35% to 40% or by 60% per month, and enhance reduction of electricity costs accordingly (DME, 2009; Mangena, 2007). Riaan Meyer is a qualified engineer with valuable expertise on SWH technical aspects, and works for the SU Centre for Renewable and Sustainable Energy Studies (CRSES) in research and development divisions to enhance the necessary skills development to support the deployment of sustainable energy systems in South Africa. Meyer (2009) has clearly argued that "this 40% – 60% figure is quite an important figure. From our investigation there is currently very little data or measurement or study backing this figure. I think the 774 kWh is a good figure. You will find houses with higher consumption of course".

Amidst such accounts of overrated SWH savings, there is gradually growing momentum for an increase in the number of SWHs countrywide. President Zuma has encouraged the nation to support energy efficiency. "We should all play our part in order to avoid load shedding. To increase energy capacity we will continue searching for renewable energy sources, especially solar electricity and biofuels as we implement the Green Economy Accord with economic stakeholders. To date we have installed more than 220 000 solar geysers nationwide. The Government target is one million solar geysers by 2014-2015" (Zuma, 2012). There is a very strong realization in government that we need to work together (SM, 2012) The country is determined to ensure that the same experience of energy crisis that was encountered in 2008 will never happen again. One million SWH rollout programme has installed up to 230 000 SWHs as of June 2012. "At the utility scale South Africa's 2010-2030 power generation strategy is encapsulated in its Integrated Resource Plan (IRP)" (Buddensiek, 2012: 38).

2.11 SWH PROJECTS

2.11.1 Kuyasa Project

Kuyasa Project has come a long way since the initial 10 households SWH pilot project was started in 2002, with three main interventions in mind in the Kuyasa low-income community in Khayelitsha about 30 km away from the CCT, which is responsible for providing local government oversight. Kuyasa Project sought to enforce the installation of (1) SWH systems, (2) CFLs, and (3) ceiling insulations. The main purpose was to introduce SWH technology to suppress energy demand, to provide some jobs to cut poverty, to reduce $C0_2$ emissions from fossil fuel plant, paraffin and energy use, and to cut back on the financial expenses of the Kuyasa community (Cousins & Mahote,2003: 2).

The study argued that the above- stated interventions resulted in dramatic change to those living in the targeted community. The change entailed a reduction of energy or paraffin use to heat water for bathing, cooking and space heating, a cutting of electricity use and associated financial savings ,a reduction of the amount of sand inside the house as a result of ceilings, and the improvement of health problems associated with indoor, extremely dangerous smoke (Cousins & Mahote, 2003). The installation of SWHs, CFLs, and ceiling insulations started in early 2008. The work created 87 jobs for mainly women who had not been employed before and finished with 1 800 houses at the end of 2009, out of 2 309 houses and cut 2.85 or 1.8 tons of $C0_2$ emissions, gaining 40% in carbon credits (Goldman, 2010; Ndamane, 2011; SEA, 2009a).

2.11.2 Zanemvula Project

In 2009, the NMBM pilot project installed 1263 low-pressure SWH systems at Zanemvula low-income community in Port Elizabeth, employed 24 people, and the members of 89 households said that access to SWHs at their homes would improve their entire lives. Improved health conditions were attributed to the hot water supply by 70 households (Wlokas, 2009b: 4, 34). Nomfuneko Bungu related a life story of a poor middle-aged woman whom she interviewed who lived together with her husband, affected by chronic disease, pneumonia, and the cold facing daily struggles to secure sustainable food for her own family. Before the installation of a SWH in their home, the woman had struggled to heat water, as she had to put a pot filled with cold water on the (paraffin or two-plate electric) stove for a few minutes for the water to heat up, and then to pour the hot water into a hot-water bottle, which she placed between her husband's feet to keep them warm. Bungu states that the woman liked the new technology, because it "has brought a lot of positive things to her especially financial and health wise". Bungu noted other household concerns. "Sometimes it worried her as there were days they did not have fuel for heating that water, but now that she has a solar water heater she is still doing that and it has brought positive results to her husband's health. His cold feet problem is not the same now" (Wlokas, 2009a: 2).

2.11.3 Winterveld Project

The family of unemployed Austin Maluke, his wife and two children live in the Winterveld in Pretoria. Their two-roomed house was one of 270 low-income houses that were furnished with SWHs. Maluleke allegedly informed President Gedleyihlekisa Jacob Zuma during his visit to his home on 29 April 2010 that the installation of a SWH had changed his life. "It has really changed our lives, we don't waste electricity anymore and we don't run out of electricity like we used before the solar water heating system was installed in November," Maluleke reportedly said. Obviously Maluleke was partially rehearsing what the promoters of SWHs had told him and his community when they wanted the community to accept SWH technology in their homes. All this occurred during or after the launching of the 200 000 SWH annual rollout that is intended to achieve one million SWHs rollout by 2014. The rollout was attended by Zuma and the Minister of the Department of Energy, Dipuo Peters, in the rural Winterveld north-west of Pretoria on 29 April 2010. However, on the same occasion Maluleke complained to Zuma about the scarcity of jobs, to which Zuma replied, "We are trying to address that problem". Maluleke reportedly retorted, "I will probably be dead when the job opportunities arise", to which Zuma answered, "You should never lose hope" (SAPA, 29 April 2010).

The three above-mentioned SWH projects represented varying local initiatives that started in 2002 and continued to 2010, aiming at enhancing sustainable energy system uptake across South Africa. While installation of SWHs, CFLs and ceilings, helped to improve conditions of low-income people, however, such improved home thermal performances and hot water access are not penecea to all of their problems.

2.11.4 The important role played by energy prices

South Africa increased electricity prices for its citizens, as was mentioned in subsection 1.3.4. In the light of the high upfront SWH expenses that were highlighted in subsection 2.9.6 above, financial incentive is necessary to mitigate costs and in order to benefit from promoted

SWH savings through obtaining good- quality SWH units. As stated earlier in January 2010, Eskom rebate increased from R2 bn in 2008 to R5.4bn (Van der Merwe, 2010a). "The energy prices play an important role and are positively correlated with sustainable energy use. The higher energy prices are, the more responsive are households with regard to energy savings" (ZEW, 2009: 19). However, the effects of high electricity tariffs for the majority of poor families are negative and affect poor communities more than they do those communities that are better off. The South African free basic service policy is designed to cushion the poor. The free basic services (FBS) policy for poor people was declared in 2000, and was enforced in 2003 to give free 50 kWh of electricity to all identified indigent households. The FBS policy design was premised on University of Cape Town (UCT) research that proposed that, on average, 56% of poor households used no more than 50 kWh of electricity per month. The UCT study concluded that the proposed amount of electricity would be sufficient for basic cooking, as well as for TV, refrigeration, and radio use and for basic ironing. The amount proposed has been criticised for limiting the ability of people to develop themselves (Adam, 2010: 14, 16).

Adam (2010) revealed that providing free 50 kWh or 60 kWh per month to the indigents is applicable nationwide, including in Stellenbosch, but it does not help much, because energy supply is not enough to meet basic energy needs. The energy audits conducted by means of a community survey between 30 October and 30 November 2009 found that four 60W light bulbs utilised for 4 hours per day consume 20 kWh. While the electric stove used for an hour per day for a month consume 42 kWh and boiling water at least for [23]30 minutes per day through electric kettle consumes 21 kWh per month, totalling 63 kWh per month. The study indicates that the amount of electricity estimated as being required by poor households deliberately hampered the poor from bettering their lives, because overload results in a power stripping. The fundamental demand is that poor communities should be afforded a free 200 kWh per month. The Ekurhuleni Metropolitan Municipality (EMM) already provides 100 kWh a month free to deserving citizens, which can enable some people to develop themselves (Adam, 2010: 5-6).

2.11.5 SWH residential market

The need to improve the quality of life of the poor includes admitting that the country has not yet done enough to create awareness of the SWH residential market. South Africa has a limited production capacity for a limited market of high-income homes. After launching a SWH programme in 2008, fewer than 3000 SWHs seem to have been installed in 2009. In December 2010, about 30 960 SWH installations were achieved through the Eskom SWH programme. "However, 70 % of the installations are high pressure installation and hence less than 10 000 installations have been done in the low income sector. This capacity can be scaled up significantly to supply a bigger market" (UNFCCC, 2011: 7). As from April 2011, the SWH programme has delivered over 115 000 systems countrywide (Peters, 2010). In May 2012 the installed SWH units increased to more than double to 250 000 SWH units in efforts towards meeting the 2014 SWHs target (Esterhuizen, 2012). In section 2.10.3 it was pointed out that the South African SWH programme was launched in 2008 and the above mentioned figures present progress report on national government and Eskom led SWH rollout. In South

[23]30 Minutes per day refers to various short times the electric kettle is being turned on for boiling water.

Africa, 5.3 million do not use electric geysers to heat water, 1 million earning less than R6000 in income per household per month have electric geysers, 2 million middle-class have electric geysers and earn between R6000 and R16 000 per month, and 1.2 million earning more than R16000 per month have electric geysers (Afrine-Okese, 2009: 7). The captured inequalities manifest the prevailing greater inequalities globally including Stellenbosch as was reflected in sections 1.4.1 to 1.4.4 earlier. Most South Africans are entangled in abject poverty, with little chance to improving quality of life and they cannot afford to install a SWH without subsidy and financing. After 1994, South Africa vowed to build many low-cost houses for more poor people, and in the process sacrificed quality for quantity and perpetuated apartheid development patterns. The pattern is changing now to include diverse income households and those households with high incomes with decently built low-cost houses strategically close to work to reduce travelling costs and poverty. This would enhance sustainable livelihoods and neighbourhoods (Cross, 2008: 2, 4-6; Swilling, 2006: 46-47).

2.12 TRANSITIONAL DEVELOPMENTS FOR SOUTH AFRICA

Recently Eskom has sought 16% electricity tariff increase for the next five years, 2013/2014 to 2017/2018 financial years. The economic growth of South Africa is estimated at 2.5% to 3% per annum, and the bulk of Eskom's sales declined. Eskom estimates 1.9% of future sales growth per annum with 4% of economic growth. Independent Power Producers (IPPs) will be supported by 3%, while 13% of the total price increase is required for Eskom's needs. The Development Bank of Southern Africa (DBSA) provided R9 6685 of loan facilities to support enforcement of sustainable energy systems (Hazelhurst, 2012).

Table 2.4: Renewable Energy Projects

Project name	**Systems**	**Capacity (MW)**	**Exposure**	**Province**
1. De Aar Solar	Solar PV	48	647	Northern Cape
2. Droogfontein	Solar PV	48.3	650	Northern Cape
3. Abengoa KaXu	Solar SCP	100	1300	Northern Cape
4. Jeffrey's Bay	Wind	133.9	1 057	Eastern Cape
5. Bokpoort	Solar SCP	75	1 900	Northern Cape
6. Abengoa Khi	Solar SCP	50	600	Northern Cape
7. Herbet	Solar PV	20	160.5	Northern Cape
8. Scatec	Solar PV	75	350	Northern Cape
9. Greefspan	Solar PV	10	110	Northern Cape
10. Lesedi	Solar PV	75	400	Free State
11. Letsatsi	Solar PV	75	400	Northern Cape
12. Touwsrivier	Solar CPV	36	470	Western Cape
13. Khathu	Solar PV	75	521	Northern Cape
14. Kalahari	Solar CSP	75	1103	Northern C ape
Total		**896.5 MW**	**R9 6685 billion**	
Source	Ethel Hazelhurst, 2012. Business Report, October 23, 2012			

Table 2.4 presents an outline of renewable energy projects that have been approved and will be developed in South Africa. Recently Eskom has sought 16% electricity tariff increase for the next five years, 2013/2014 to 2017/2018 financial years. The economic growth of South Africa is estimated at 2.5% to 3% per annum, and the bulk of Eskom's sales declined. Eskom estimates 1.9% of future sales growth per annum with 4% of economic growth. Independent Power Producers (IPPs) will be supported by 3%, while 13% of the total price increase is

required for Eskom's needs. The Development Bank of Southern Africa (DBSA) provided R9 6685 of loan facilities to support sustainable energy systems rollout (Hazelhurst, 2012). Following Eskom application for additional 16% electricity tariff hike last week, "Energy Minister Dipuo Peters reported on Monday that the Department of Energy (DOE) had received "concurrence" from the National Energy Regulator of South Africa for a Ministerial determination opening the way for the procurement of 7 761 MW of baseload capacity from independent power producers (IPPs) between now and 2025" (Creamer, 2012). For now the total cost for renewable energy projects is about R47-bn to yield renewables capacity of 1 415 MW (Creamer, 2012a).

Speaking during an event hosted to declare government's and Eskom's preparedness to sign agreements required for the construction of the first 28 sustainable energy projects being procured through the Renewable Energy Independent Power Producer Programme (REIPPP), Peters stated that details would be published in the Government Gazette in November 2012. In addition, a total 1 470 MW had been designated for onshore wind, 400 MW for CSP, 1 075 MW for solar PV projects, 47.5 MW for biomass, 47.5 MW for biogas, 60 MW for small-scale hydro, and 100 MW for small-scale renewables projects (Creamer, 2012a). "The first determination related to baseload generation capacity and included 2 500 MW of coal-fired generation for introduction into the system by 2024; 2 652 MW of gas power by 2025, some of which would probably be imported; and 2 609 MW of hydroelectric power imports by 2024" (Creamer, 2012a). South Africa seems to be gradually moving to practical actions. "The base-load allocations were informed by a request for information issues last year and were aligned with the Integrated Resource Plan (IRP) 2010-2030. The current version of the IRP, which is likely to be revised during 2013, anticipates coal's contribution falling from more than 90% of the current mix to about 45.9% by 2030. However, 16 300 MW of additional coal-fired generation would still need to be added by 2030" (Creamer, 2012a). The Zuma administration is committed to increasingly enforce sustainable energy systems as part of South Africa's energy portfolio. "Besides increasing the supply of renewable energy, the government wants to produce 2 500 MW more energy from coal and 2609 MW from hydro-power by 2024 and 2 562 MW of extra gas power by 2025" (Business Report, 2012).

2.13 WESTERN CAPE VISION FOR SUSTAINABLE ENERGY SYSTEMS

Before the above renewable energy projects were announced Western Cape has already declared its plans to produce 15% of green electricity as stated in section 2.13.4 below. Following the 2002 WSSD, in June 2005 the Western Cape Province convened its own summit for sustainable development with the theme: A Sustainable Home for All – Now and Forever. The summit presented a framework for placing itself as the province that will lead the path, both locally and internationally, regarding strong regionally-based sustainable development interventions. At the heart of its theme emerged the Declaration of Intent which defined sustainable development as follows: "For the Western Cape Province, sustainable development will be achieved through implementing integrated governance systems that promote economic growth in a manner that contributes to greater social equity and that maintains the ongoing capacity of the natural environment to provide the ecological services upon which socio-economic development depends" (Swilling, 2005: 2-3). The new shape and transformed Stellenbosch envisaged embracing sustainable energy systems and efficient use of resources as a catalyst for inclusive transformation to boost local economic development (LED) and job creation. The local LED division is slowly leading to this path (Moses, 2011). Kuyasa Project represented a new shape. "The project planning effort took three years (1999-2002) and was a collaborative effort of the City of Cape Town, a Dutch nongovernmental organization SouthSouthNorth (SSN) and the residents of Kuyasa" (ESMAP, 2012: 1).

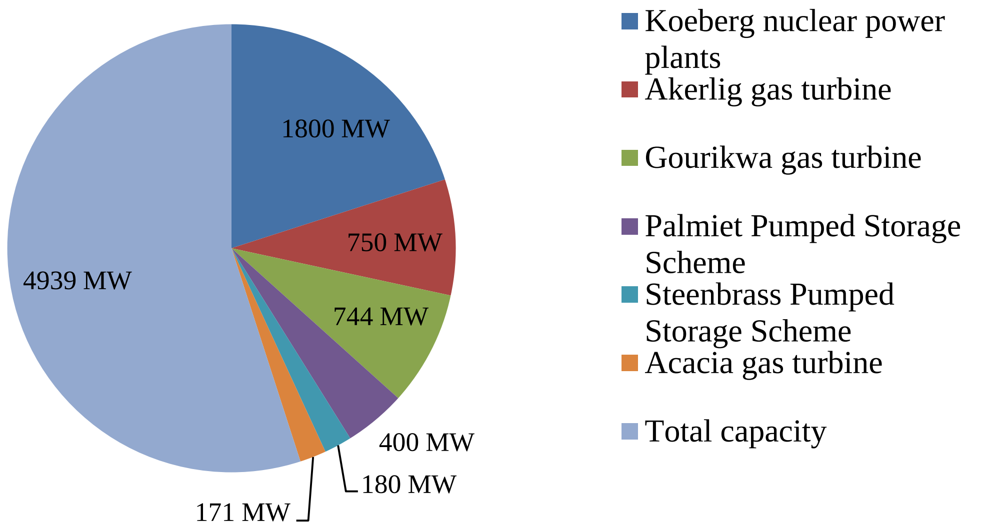
Most importantly as stated in section 2.11.1 that “the project model was piloted in ten houses and the successful implementation of the pilot project was used to register the project as a Clean Development Mechanism (CDM) with the United Nations Framework Convention on Climate Change (UNFCCC). The project had a total budget of US$4.67 million (R33 million) allocated to the installation of the SWH (45 percent), ceiling insulation (46 percent) and CFLs (9 percent)” and most funding came from different government grants (ESMAP, 2012).

2.13.1 Solar radiation and SWH systems

Proper and sustainable building development planning is among the key incentives to ensure the capturing of optimal solar radiation. With regard to solar radiation, Du Toit (2010: 39) has argued, with reference to Holm (2005: 61), that the figures submitted above do not capture all the energy found in SWHs. The maps are premised on direct surface sun rays, whereas SWH harvesters are positioned at an optimal angle of 10° so as to have maximum exposure to sunshine. The installation position enhances energy availability. With an optimally tilted aperture, Cape Town obtains 2198 kWh per m^2 per annum of solar radiation, which translates to 6.02 kWh per m^2 a day. The kWh is 15% more than the figure of 1915 kWh per m^2 a year, which is 5.45 kWh per m^2 a day, as shown on the Eskom et al map earlier. “As a result of the local sunshine conditions one square metre of horizontal surface will receive more energy in one area than another. This is shown on most of the conventional radiation maps. Radiation increases from the coastal south-eastern areas to the north-western. If however, a SWH absorber is tilted at an optimal angle equal to latitude plus 10° the energy received produces an entirely different picture. It is evident that the conventional radiation map seriously underestimate the available solar radiation” (Holm, 2005: 61).

2.13.2 Western Cape energy generation capacity

Figure 2.7: Western Cape Energy Generation Capacity



Source: (SI & PREFE, n. d: 90).

Figure 2.7 above shows that in 2008 Eskom Western Cape energy generation capacity was 4939 MW. In 2001, Western Cape energy usage was 19 177 GWh and the projected future usage was estimated at 3% economic growth rate per annum, ranging between 23 844 GWh and 26 545 GWh by 2012. Stellenbosch electricity supply is constrained by the limited capacity of Western Cape, and if one nuclear reactor failed to work, the supply is likely to be severely interrupted (SI & PREFE: 90). The industrial, transport and residential sectors use a great deal of energy. Energy supply is critical and accounts for 15% of South Africa's total GDP (DME, 2003: 42). Nationwide, the industrial (41%), transport (28%) and domestic sectors (17%), on average, were the major electricity users in South Africa. The energy usage of the industrial (47%) and transport (38%) sectors apart from the domestic sector (14%) was higher in the Western Cape and Cape Town, compared to the above stated national average (see Table 2.5 below). The energy sector injects 15% to the gross domestic product (GDP) and employs 250 000 people in South Africa. Energy is centralised and residential sector consumes 17% of energy. SWHs cuts domestic usage (DME 2005: 7; SEA, 2009: 3, 10).

2.13.3 Energy consumption

The energy consumption patterns always represent one of the areas requiring joint efforts.

Table 2.5: Western Cape Energy Consumption Energy consumption per sector in 2006	Cape Town	Western Cape
Industrial and commercial sector	47%	34%
Transport sector	38%	48%
Residential sector	14%	9%
Agricultural sector	4%	5%
Other sector	1%	4%
Source: SI & PREFE, n. d: 90.		

Western Cape, where Stellenbosch is located, has average medium to high-income household energy usage of 774 kWh per month relative to 274 kWh for low-income. "Western Cape and Cape Town is one of the wealthiest areas in South Africa. The housing standard in Western Cape is with 83% of formal housing, the highest in the country. Percentage of households using electricity for cooking is highest in Western Cape (89% compared to national average of 67%. The province has a high degree of households using electricity (94%) compared to national average of 80%. The province has the lowest migration to other areas in the country and the second highest migration to the province" (Custura & Ngwana 2008: 29).

Table 2.6: Electricity consumption features use per item		
Electricity	**Electricity used**	**Monthly basis**
Lighting	108.3 kWh	Per month
Refrigeration	55.9 kWh	Per month
Space heating	80.9 kWh	Four months in winter
Cooking	148.2 kWh	Per month
Water heating	380.8 kWh	Per month
Total household electricity use	774.1 kWh	Per month
Source: Winkler et al, 2005.		

Table 2.6 shows that water heating consume more energy in medium- to high-income homes, consuming 380.8 kWh (40%); cooking 148.2 kWh and lighting 108.3 kWh, on average per month. The refrigeration accounts for 55.9 kWh and space heating during cold days was 80.9 kWh a month for 4 months (Winkler et al, 2005: 9). The question of buying plays a major effect in the consumption of goods. "In poor countries and communities, households demand less services because they cannot afford to buy more. Demand is suppressed or remains suppressed due to a budget constraint or lack of infrastructure" (Winkler et al, 2005: 415).

2.13.4 Green electricity

Western Cape seeks to stabilize capacity and ability to enhance sustainable development to reduce poverty and meet MDGs, while sustaining its economic growth (Swilling, 2005). WCPG plans to produce 15% of green electricity from sustainable energy by 2014 to cut its coal-fired electricity usage and carbon emissions by 10% by 2014 to enhance environmental safety. Western Cape stands to cut electricity usage of specific provincial buildings by 5% to 10% by 2014 (Davenport, 2010). "The provision of reliable and affordable energy for business and domestic market underpins everyone's quality of life. Renewable energy that is produced from sustainable natural resources will contribute to sustainable development" (DME, 2003: 26). The White Paper on Renewable Energy Policy, 2003 also captured the definition of sustainable development, as stated in the National Environmental Management Act (NEMA, 1998) that "sustainable development is defined as the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations" (DME, 2003: 26).

The poor low-lying nations in Africa are the mostly vulnerable to the global climate change. Although Africa makes a minimal 3% to 4% contribution to total global carbon emissions, the continent is one of the most poor and vulnerable to negative impacts of climate change. Africa needs to embark on sustainable energy paradigm shifts that are less carbon-intensive than were those of the past (Davidson et al, 2007: 03; Engineering News, 2011). The Western Cape has multiple ecosystems with admirable share of biodiversity. Four years ago, the Cape Winelands Biosphere Reserve was registered on 18 September 2007 with UNESCO to facilitate the promotion of conservation and sustainable land use and development planning (CWDM, 2010: 55). The Stern Review shows that mitigation action costs to reduce carbon emissions cannot be compared on the same footing with the following: "... the desire of business and governments to continue to develop and grow their economies. The costs of intervention could be 1% of worldwide gross domestic production (GDP), 1% of global GDP against the 5% knock to global GDP as a cost of inaction" (DEADP, 2007: 9).

2.14 LOCAL GOVERNMENT APPROACH

The South African local government approach on legislative laws is premised on improving the quality of life through the integration of planning, decision-making and implementation. In adopting Agenda 21, South Africans have approved integrating social and economic development needs with ecological security to enhance the sustainability of our natural resources and the prosperity of all humanity (Mbeki, 2002). After 1994, South Africa embraced "the requirements of elements contained in Local Agenda 21, such as integrated development planning, co-operative and developmental governance, and promotion of a safe and healthy environment, are built into the South African Constitution (Act 108 of 1996). The White Paper on Local Government 1998 tasks local governments with the responsibility, among others, for environmental stewardship and adopting a more sustainable approach to planning and development" (DEAT, 2001). Improving quality of life and SWH promotion has always been part of South Africa on paper, but lacked implementation. Jansen (2003: 48-50) outlines various policy frameworks, capturing a demonstration of a local government challenges, areas that require transformation, and municipal institutions that require policy choices to be made. The integrated development planning (IDP) process represents the country's understanding that "strategic planning is the cornerstone of every common-interest community. Without strategic planning the community will never know where it is going, much less know if it ever got there" (FCAR, 2001: 4). The City of Cape Town and business launched the Kuyasa Project as an energy efficiency retrofit programme in 1999 for 2 309 low-income houses in the outside the City of Cape Town, South Africa (ESMAP, 2012: 1).

2.14.1 Local government powers and functions

The local government powers and functions enshrined in the Municipal Systems Act (MSA) 32 of 2000, Municipal Structures Act 53 of 1998 and the NEMA (1998) advance sustainable energy systems usage to arrest the occurrence of an energy crisis and $C0_2$ reductions to support sustainable development (DME, 2003: 6; Msomothane, 2009). The Municipal Structures Act 117 of 1998, among other things, gives effect to the ward committee mechanisms in South Africa, without allowing for decision-making powers on municipal affairs. The Act allows for stakeholder-representatives to be appointed from among civil society organs, youth, women, development forums and religious structures for ensuring the equitable representation of political structures, women and youth (Davids, 2006: 16). Among many other things, the Municipality Systems Act enhances inclusive governance, the involvement of people in planning and processes of decision-making, and empowers the local government with executive powers to design policy regulations, to procure services, to raise funds and to allocate funding to deliver services in a sustainable manner, and in a safer environment (Jansen, 2003: 42). All the above-mentioned prescripts are stipulated in section 156(1) of the Constitution of the Republic of South Africa Act 108 of 1996, which states that the municipality has powers to enforce governance on matters assigned to it, to design and to administer by-laws for the effective administration of own affairs (Gildenhuys, 1997: 21).

2.14.2 Integrated development plans (IDPs)

Consideration must be given to what should be done to enhance LED and to reduce poverty. The White Paper on Local Government Policy of 1998 outlined constitutionally enshrined developmental functions for municipalities. It shifted from technocratic to human interaction and holistic planning to allow participatory cooperative governance to address community needs and accountability through IDPs (Achmat, 2002: 2). The local government functions can no longer remain as mere national government agents to bringing such basic services as electricity, clean water, sanitation, housing and waste refusal, but will be higher cardinal partners of cooperative governance in enhancing sustainable development. As a result, sustainability must be captured in IDPs with a view of advancing equitable budgeting, social, economic and ecological needs in partnership with provincial and national government organs, as well as with the private sector, religious, youth, women and civil society structures (Jansen, 2003: 42; Swilling, 2006: 49). “Local government must also contribute to local economic growth, job creation and social development” (Jansen, 2003: 42). Starting in 2004, South Africa established a new national funding source, the Municipal Infrastructure Grant (MIG), to coordinate investments worth more than R15bn to enhancing some municipal infrastructure development (Swilling, 2006: 23) spurring on the much-needed transformation. MIG is one of the funding that can be harnessed and spent on enforcing SWH rollout as part of infrastructure development for all municipalities. The planning infrastructure development should entail dimensions of transformation, cultures, languages, and educative awarenesses.

2.14.3 Local Economic Development

The Stellenbosch Municipality’s Local Economic Development (LED) division started a series of LED Strategy draft revision in March 2011 to April 2011 attended by various stakeholders including the researcher, culminating to feedback report that indicated strongly expressed necessity to have LED focused among other things on renewable energy systems. The latest LED Strategy draft session was on September 10, 2012 (Gosa, 2012). The strategic significance of promoting sustainable energy systems is supported by both national and the provincial energy policies to create clean energy approach and jobs (Barbour, 2012: 4, 6-12). LED enhancement was one of the driving forces to launch Kuyasa Project and it resulted to the provision of 100 litres of SWH units, ceilings, CFLs and 87 jobs (ESMAP, 2012: 5, 8).

2.15 MAJOR LESSONS LEARNT

Among many major lessons learnt from both chapters 1 and 2, the energy crisis that in South Africa from late 2007 to early 2008 caused huge economic losses for the country, and triggered serious SWH rollout. It afforded the country a golden opportunity to reflect on its energy portfolio, current and future energy usage patterns. The government was forced to embark on drastic energy-savings. Major lessons learnt included:

- Cheapest electricity supply ended as electricity prices increased rapidly from 2008 onwards, as shown in subsection 1.3.4 to support the new capacity building programme costs (Eskom, 2008a: 19) and further to incentivise adopting energy efficiency and sustainable energy systems to reduce $C0_2$.
- Energy supply and access remains essential to achieving an improved quality of life.
- Building new capacity normally takes more than five years (Eskom, 2008), demand-side management embarked on a 1 million SWH rollout to arrest increasing demand.
- SWH and CFLs were among key technology interventions to mitigate energy demand.
- Energy provision and improving lives are constitutional obligations (DME, 2003: 6).
- Cultural and language contextualization of SWH projects will enhance understanding.
- Adoption and enforcement of energy efficiency systems would help South Africa avoid unnecessary loss of R50bn as it occurred very early in 2008 (Hallowes, 2009).
- Establishment of a strategy can support national and global efforts on sustainability to address the problems of finite resources, poverty and inequality through renewables.[24]

2.15.1 Key challenges

Achieving demand-side management targets of 3000 MW included making some energy supply cuts and required major energy consumers to support 10% reduction in consumption. Such local consumers included the major industrial, commercial and municipal energy users. This is where the mammoth challenges of poverty, housing backlogs, unemployment and inequalities always emerge, as can be seen from section 1.4 to subsection 1.4.4, which ask for careful consideration and priority attention. At the centre of the above-stated challenge is the requirement to improve quality of life of the world poor, with the SWH systems uptake receiving international approval in 2004 in Bonn, Germany. The following key challenges, however, prevented an uptake of sustainable energy and SWH systems across South Africa.

- An abundance of coal reserves and a heavy reliance on a supply of cheap fossil fuel.
- Cheap coal-fired electricity and lack of supportive policy regulations for renewables.
- High upfront capital costs and lack of financial incentives for sustainable energy use.
- Lack of buying capability, power and enabling capacity to facilitate transformation.
- Poor political will and leadership in creating enabling policy for sustainable energy.
- Poor integrated development planning and poor awareness of sustainable energy.
- Poor access to information and the coordination of sustainable energy programmes.
- Poor access to skills and development of spoken languages to advance SWH systems (Crane & Swilling, 2007; DME, 2003; Kohler, 2008, Agenda 21 for Culture).

2.15.2 Impact of energy crisis to finding sustainable solutions

One form of energy crisis has prompted Germany, Israel and South Africa to embark on a sustainable energy drive to manage energy demand and cut usage of fossil fuels. Sustainable solutions to energy crisis included implementation of enabling policy measures and joint actions to induce sustainable energy usage, as it was the case in Israel, Spain and Germany

[24] Eskom. 2008. Eskom Holdings Limited Annual Report. Johannesburg: Eskom. 28-29.

etc. The South African energy crisis has been devastating in many ways and has cost the national economy R50bn early January 2008 (Hallowes, 2009). Energy crisis also created opportunities for exploring energy efficiency and sustainable energy system usage in South Africa in a similarl way the oil crisis forced Germany to adopt renewable energy systems. "Renewable energy policy in Germany began in 1974, after the first oil crisis" (Lauber & Mez, 2004: 1). Germany is championing sustainability globally, and has been instrumental in supporting 1978 Chinese policy reforms.

2.15.3 Specific policy measures

Brazil supported the building of cheap social housing enhanced the installation of SWHs (Cardoso, 2011). Israel, the first country to put mandatory policy globally that compelled that all building structures requiring hot water service to install SWH system and approximately over 80% of Israelites households are equipped with SWH systems (WEC 2007: 11). Between 1990 and 1998, the Federal Government of Germany put in place specific policy measures and allocated more than €1bn for all sustainable energy systems and provided over €3bn soft loans to enforce renewables during the same period. Germany required massive support to overcome fossil fuel interests. With reference to Hustedt (1998), Lauber & Mez (2004: 6) said "an intense political battle ensued, culminating in a massive demonstration in which the metalworkers union, farmer and church groups joined forces with environmental and RES associations. The confederation of investment goods industries gave a supportive press conference". The evolution of 1990 Renewabe Energy Act, changes and enforcement programmes were outcomes collection of German's best minds (Lauber & Mez 2004: 6).

2.15.4 Dynamic power of collective development

The dynamic power of collective developments and action was evident in Germany, where not only the civil society and churches exerted massive pressure, but the municipalities also did including the private sector supporting the use of renewable energy systems. Germany approved reduced loans to induce Wind energy, 100 MW and 1000 roofs initiative, and later the 100 000 PV roof programme and installed 350 MW in 2003 exceeding the target of 300 MW (Lauber & Mez, 2004: 6, 14). Before the Spanish City of Barcelona approved its solar ordinance in 1999, Berlin attempted it first and failed. The German City of Berlin was the second city to develop a solar ordinance idea from 1990 on, and it was approved in 1995. However due to poor consultation lobbyists associations prevented it and it was never enforced at all (Ropcke, 2008: 44). In Sweden, a collective body of citizens and the church leadership supported sustainable energy enforcement and installation of solar thermal systems (SEIP et al, 2009b: 4, 47). Such support has been very helpful to creating opportunities for programmes purposefully designed to enhance people's capabilities and choices. Despite growing concerns today over the persistent Eurozone crisis that emerged in the European Union countries shortly after the global economic crisis, it appears that emerging collective development trends are encouraged to embrace strengthening human development interventions. Crucial angles in empowerment development mechanisms demand key consideration of, and included the following major interventions:

- Capacitating citizens to participate freely in transforming and improving their lives.
- Engaging in shaping equitable and sustainable development actions on a shared earth.
- Striving to attain acceptable degree of well-being, and satisfactory standard of living.
- Enhanced an understanding that abundant solar radiations alone do not expand the uptake of solar energy and wind energy systems outside the people's culture.
- Providing ample opportunities to create cultured sustainable green economy growth.
- There is potential for green jobs through SWH industry, as seen in subsection 2.9.6.

- The provision of 200-L SWH systems by Brazil, with the systems concerned being suitable for a family of about five members with gas backup, because the Brazilian population relies on gas for water heating, and not electricity like in South Africa.

2.15.5 Local approach

The local approach to improving the quality of life for all is a product of years of costly liberation struggle against colonial and apartheid discriminatory policies that culminated into a democratic South Africa after the elections of 27 April 1994. The local authorities work together in networks, exchanging activities and experiences including coordination of joint actions within specific cultural contexts. Furthermore “cultural diversity is the main heritage of humanity. It is the product of thousands of years of history, the fruit of the collective contribution of all peoples through their languages, imaginations, technologies, practices and creations” (Agenda 21 For Culture). The led ANC government, committed itself to achieve ‘a better life for all’. 2011 ANC Manifesto stated: “The fourth local government elections since the dawn of our democracy in 1994 bring another opportunity for South Africans to build on the progress we have made in realizing our vision of a better life for all” (ANC, 2011).

The White Paper on Energy Policy of 1998 and White Paper on Renewable Energy Policy, 2003 sought to achieve10 000 GWh from renewables, of which 23% would be SWH systems (Fakir & Nicol, 2008: 22). The government policy on improving quality of life through embracing sustainable energy systems use was not always matched with tangible actions taken to drive implementation (Smit, 2009; Winkler et al, 2005). The economy remained reliant on fossil fuels and on old ways of doing business, until the energy crisis prompted Mbeki (2008) and Manuel (2008) into calling for the restructuring of the existing economic systems, increase energy prices and triggered more energy efficient pattern. Fossil fuels will also remain prominent for many years, due to the huge investments made in the development of new coal-fired plants, namely those of Medupi and Kusile, which will be equipped with modern systems to cut $C0_2$ emissions, as was stated in subsection 1.3.5 above to fuel our energy transition. According to Khan and Haupt (2006: 41), “There is an emerging trend in South Africa that recognizes that development is much more than expansion of income and wealth and that economic growth, though essential, is not enough. The focus is increasingly on human development, which ranges from enjoying a decent standard of living to enjoying a greater sense of participation in the various activities within their communities.”

The Economic Development Partnership (EDP) to which further details will be provided in section 4.2.2 was crafted to give an integrated sustainable development path for the Cape. EDP is a result of long engagement processes of strategic stakeholders such as the Western Cape Provincial Government’s Department of Economy, Finance and Tourism, business community, and civil society partners captured in Future Cape Contextual Report to support South African economic growth by 7% per annum between 2012 and 2025 to be able to arrest poverty and various imbalances. The National Planning Commission has skilfully captured major challenges facing South Africa and in the Western Cape: We must transform the nature and performance of the economy to simultaneously realize sustained economic growth with greater environmental resilience, and enhanced better inclusion reflected in radically lower joblessness and inequality (African Centre for Cities and Sustainability Institute, 2012: 2-3). EDP understands that “an economy’s competitiveness cannot be reduced only to GDP and productivity because enterprises must also cope with political, social and cultural dimensions. Therefore nations (and regions) need to provide an environment that has the most efficient structure, institutions and policies that encourage the competitiveness of enterprises” - IMD World Competitiveness Yearbook 2012 (Boraine, 2012).

2.16 SUMMARY OF CHAPTER 2

The sustainable energy system literature review revealed that the transition to renewable energy systems is gradually shaping up across the world as a result of numerous reasons, of which two are major inducers in favour clean energy sources. Replacing electric geyser with a SWH can cut 40, 21% of domestic electricity consumption to manage energy demand from Eskom, and carbon emissions (Frost & Sullivan, 2011: 4). Domestic energy usage accounts for 17%, and South Africans have been urged to embrace sustainable energy systems, and increased SWHs can stimulate green economic growth. There are few matters worth recapturing again that are major drivers of sustainable energy. Energy crisis triggered action.

- Agenda 21 after 1992 to 2002 onwards triggered greater drive for sustainable energy.
- Rising population, energy crisis as attested earlier, and increasing demand are all triggers. Globally the question of poverty, climate change and unfair distribution of resources is problematic. It has become clear that society needs to maintain all energy options open to meet the rising energy demand. The previous century witnessed the dominance of finite resources such as fossil fuels, high hydro and nuclear power. Figure 1.1 in section 1.3.6 shows that fossil fuels release high carbon emissions and contribute negatively to the rapidly increasing global climate change trends[25]. Local cultures, languages and contexts in SWH projects are underestimated.
- At times SWH benefits are overrated as stated in sections 1.5, 2.11.2 and 2.11.3.
- South Africa's economy is still driven by fossil fuels as shown in section 1.3.1.
- The 2010 IRP envisaged sustainable energy systems to contribute 42% of new generation, nuclear energy (23%), and 15% coal by 2030 (Manyi, 2011).
- Achieving 1 million SWH rollout by 2014 and 5.6 million SWHs by 2020 will enhance energy efficiency, local content, SWH markets and new jobs (IPAP2, 2010).

The enhancement of human capabilities and freedom of choice is increasingly regarded as one of the major principles that should drive enforcement of sustainable energy systems. It allows for introduction of tangible transformative intervention programmes with a view to stimulate a human development and skills capacity. The governments put in place policy frameworks that take into cognisance that any desired transition to sustainable energy should be driven by collective political will and joint actions of stakeholders. Joint initiatives to stimulate SWH markets and growth were evident in Barcelona and Germany (Barcelona, 2009, Ropcke, 2008).

Sustainable energy systems impact, especially the SWHs, should be based on their true impact on enhancing human development, useful skills transfer, job creation, improving the quality of life, affordability, energy savings and cultural grounded restored human dignity. The 2005 framework of Reinventing Stellenbosch or Stellenbosch Renaissance argued for authentic cultural diversity to establish an inclusive home for all while driving the sustainable energy sources uptake (Swilling, 2005). The UN is calling for extending sustainable energy systems for all and made sustainable development a business of everyone (REN21, 2012). "However to achieve sustainability, a pact will be required with all South Africans – including business, labour, municipalities, communities and all customers and suppliers. We must save electricity" (Zuma, 2012).

[25] International Chamber of Commerce (ICC), 2007: 2

CHAPTER 3 STELLENBOSCH RENAISSANCE CASE STUDY

3.1 INTRODUCTION TO THE STELLENBOSCH RENAISSANCE

South Africa grapples with a legacy of poverty and joblessness. Reinventing Stellenbosch: A Strategic Framework idea was an outcome of a study commissioned in July 2005 by the Stellenbosch Municipality (SM) Mayor–Stellenbosch University (SU) Rector Forum, a joint working interaction between SM and SU to address many issues facing our modern changing world. It is purposefully assumed that Reinventing Stellenbosch is synonymous with Stellenbosch Renaissance. Through it, the ideas collected ranged from embracing a vision of sustainability to adopting sustainable energy systems to reduce electricity consumption while slowly moving into enhancing sustainable livelihoods, poverty reduction, organic farming, efficient consumption of resources, authentic cultural diversity, multilingual context, and equitable opportunities through local sustainable economic growth (Swilling, 2005).

According to Swilling (2005: 2), "The essence of the Reinventing Stellenbosch idea is the desire to chart a new history for a town and a University which share a colonial and apartheid past. Neither can do without the other. Both share a commitment to greater social equity and well-being, increased levels of economic development, and a deeper commitment to ecological sustainability. Whereas the past was about 'all for some for now', the future should be about some for all forever." The current thesis focuses on the SM jurisdiction and argues that making a careful shift towards sustainable energy systems has the potential to create sustainable jobs to enhance quality of life through the integrated SWH interventions if enabling policy measures are put in place. SWH interventions cannot necessarily lead to the desired savings and improved quality of life if the beneficiaries' contexts, languages and understanding are not enhanced. SWHs have been installed and were operational at the time of the current study in many urban areas and rural towns including these focus communities in the Western Cape, namely Mfuleni, Wallacedene, Stellenbosch and Kuyasa. The present study assess buying power, family income, sizes of family and SWHs, culture, and language.

3.2 STELLENBOSCH ECONOMIC CONTEXT

The Stellenbosch economic context reflects it to be the second major contributor to the total GDPR of the Cape Winelands District Municipality (CWDM) by 27%, following after the Drakenstein Municipality contribution of 34% in 2004. From 1995 to 2004, the WC024 experienced an average economic growth of 3.5% a year, more higher than CWDM 2.9%. From 2000 to 2004, SM's average annual growth increased from 3.5% to 4.4%, exceeding the Western Cape's growth of 4.3% and the CWDM's growth of 3.5% over the same period (SI and PREFE, n. d: 38; SM, 2009: 4). The GDPR increased from R3 834bn in 2001 to R5.234bn by 4% per annum, compared with the 3.2% of the CWDM between 2001 and 2009 (Western Cape, 2010: 131). Stellenbosch is home to rich farm estates, including to eight large corporate firms that are registered with the Johannesburg Stock Exchange (JSE). The tourism sector injected R3.9bn for 2008/2009 and created 18 000 jobs in the SM Area (Ferns, 2011).

3.2.1 Holistic approach

The bulk of the SWH beneficiaries who were approached and interviewed live in low-income communities and earned less than R3500 per month. They were mainly women, with more than 70%, and 60% coming from Mfuleni and Wallacedene respectively, while Stellenbosch gender beneficiaries was more balanced, whereas 80% of the beneficiaries in Kuyasa were women. Household sizes varied from a family of only three to large families of 9 to 14, including children and backyard dwellers. The age of beneficiaries varied from middle 20s to over 65 years old. The main language spoken by those interviewed was isiXhosa, and few

Afrikaans people, and English was used to communicate with non-isiXhosa-speaking beneficiaries. Swilling's strategic framework, 2005 and sustainability imperatives submitted to the powerful institutions of this town, Stellenbosch Municipality (SM) and Stellenbosch University (SU) did not really lead to the implementation of tangible joint programmes drive to enhancing efficient resources use and inclusive participation towards building Stellenbosch Renaissance. Instead Stellenbosch Municipality experienced political instability, changing of political powers since 2006 to 2009 and remained less stable until May 18, 2011 national local government elections (Eikestadnuus, 2010a; Eikestadnuus, 2010b). Stellenbosch Municipality, 2010: 1). In Brazil, Dos Santos (2011: 3) described the profile of the quality of life in Brazilian states, with reference to Erikson (1993), in the following pragmatic terms: "Quality of life frameworks and models allow us to view someone's situation holistically. Examining the quality of life of an individual or a group requires that we know about the resources of beneficiaries and their conditions of life from various perspectives. Knowing about economic conditions is not enough. Instead we need to strive for greater understanding about the aspects of people's lives that create the whole person, aspects such as health, knowledge and skills, social relations, conditions of work and so forth."

In South Africa, infrastructure delivery in terms of energy supply, communications, transportation, clean water and sanitation are core needs for all households and for the economic production, and should be made available to all to improve the poor quality of life. Access to reliable energy, clean water, and sanitation mitigates mortality and morbidity, and avoids wasting time. Access to information and transport enhances employment and economic participation (Khan & Haupt, 2006: 41-42). There is a huge gap between good policy rhetoric on paper and actual implementation in South Africa. Our policy imperatives tend to be selective. South Africa regards access to hot water as a luxury (Zwane, 2009). This is explained by Refocus. "Hot water supply is not a basic demand in many countries due to their warm climates. Moreover as long as the supply of more essential goods and services is insufficient, the supply of hot water is a less pressing issue and is regarded as a luxury" (Refocus, 2004: 20). Again our policy discrepancies are exposed in the following assertion on South Africa. "The Constitution expressly recognises 11 languages. The old practice, where English and Afrikaans were exclusively used in our Courts undermines the spirit of the Constitution. Ordinary South Africans interacting with the legal system still experience difficulties in communicating in their language of choice" ANC (2007: 8). Similarly SWH Projects develop around English is the major language used when to the local communities.

Watermeyer (2011) acknowledged the existence of a multiplicity of problems encountered by many South African doctors who cannot communicate in the home language of some of their patients. Studies have indicated that language barriers hamper effective communication and understanding in doctor–patient interactions (Lee, 2003: 9). Earlier it has been noted repeatedly stated that South Africa is confronted with a crisis of great poverty rates, joblessness and social imbalances which also included the language dynamics. This crisis is carefully explored in a paper entitled How to solve the economic-social crisis in South Africa, 2012 by Herbert Vilakazi. "Thinkers who have proposed solutions to this crisis have failed to accept the fact that the current South African economy still bears the scars and shape of a colonial economy. The majority of Africans are trapped within deep underdevelopment in preindustrial rural areas; through the migrant labour system, some millions were forcibly brought to work in mines and urban areas; a large bulk of the African rural population has migrated together with their poverty and misery to urban areas, forming shanty-towns attached to the original townships" (Vilakazi, 2012).

During apartheid years due to the political sanctions of the country, its energy policies were mainly centred on energy security. After April 1994, the democratic South Africa energy policies were geared to addressing the injustices suffered by the majority population who had been excluded from basic services, energy access, equity and justice were therefore the primary goals. From 2000, energy policies focused on attempted to achieve the targets and timeframes the government set out after 1994. Such targets related to job creation, economic stability, and recognise that development paths have to proceed in a sustainable way to protect local and global environments (Winkler et al, 2006: 5-6). Although not rooted locally SWH solutions are enforced to heal the inherited scars. Again in Winkler et al (2006: 14), Lukamba-Muhiya & Davidson 2003 stated that “a limited programme was carried out at Lwandle in the Western Cape shows that with the right policy, solar water heaters can be viable”. In 1999 the Lwandle SWH project was launched and was demonstration during WSSD as a typical example of how SWHs were beginning to be extended to low-income households in Cape Town (Hom, 2005: 34).

3.2.2 Turning to the SWHs

Turning to the SWHs application in Lynedoch which is part of Stellenbosch and 30 minutes drive to the City of Cape Town. Lynedoch green village concept dates back to 1999, is home to Sustainability Institute (SI) that works in partnership with Stellenbosch University (SU) to do applied research while promoting sustainability. Lynedoch ecovillage among other things is informed by understanding that black people in South Africa suffered from exclusion from economic ownership in this area since agriculture started after 1652, and also were excluded from housing, education and higher learning. Lynedoch green village is an attempt to build and coordinate an inclusive community where blacks, namely the Africans, Coloureds and Asians, and white people with various educational expertise and the farm workers constituted such a green community. Lynedoch has learning facilities not only for postgraduate studies, but also for early childhood and primary school (Annecke & Swilling, 2006).

“The most significant aspect of Lynedoch from a sustainable design and construction point of view is that it provides a working example of integrated sustainable development, integrated because it connects social, economic and ecological objectives and because it incorporates technologies that span the energy, water, sanitation and materials fields, sustainable because of the commitment to a long-term vision of social, economic and ecological sustainability and developmental because of anti-poverty and local economic development objectives” (Annecke & Swilling, 2006: 316, 317). Lynedoch green village gets bulk of its electricity from Eskom grid and installed SWHs in existing and new buildings with a thermostat that switches to electricity during overcast days and in turn this reduces 60% of normal electricity consumption. Low press gas hobs are used for cooking instead of electric stoves and in most instances the existing and new structures are erected with proper north-south building design orientations, equipped with CFLs, PVs, SWHs, plantation of trees, recycling of used water and recyclable materials and also provides integrated human settlements for low-income and middle income households (Annecke & Swilling, 2006: 323, 325).

The latest South African SWH programme progress report shows that in February 2012 there were 220 000 SWHs installed nationwide (see section 2.10.6), and it nearly doubled 115 000 SWHs installed in February 2011 and increased from 220 000 to 250 000 in May 2012 (see section 2.11.5). When Stellenbosch SWH Project started there is no indication that its main drivers attempted to go and view the Lynedoch green village or Kuyasa. Table 3.1 below reflects more than 40 SWH beneficiaries from different SWH projects ranging from Stellenbosch, Cloetesville, Khayamandi, Kuyasa, Mfuleni and Wallacedene during 2011.

3.3 SWH BENEFICIARIES INTERVIEWED PER COMMUNITY

Table 3.1: Various solar water heater projects	
Khayamandi community	20
Kuyasa community	21
Cloetesville community	10
Mfuleni community	10
Stellenbosch suburbs	8
Wallacedene	11

Table 3.1 captures diverse SWH users, ranging from those who were capable to freely choose their SWHs because they had adequate buying power to switch over to reduce water heating electricity usage to achieve financial savings to those who had limited freedom of choice and small input in decision-making because they are poor with no buying power. They end up getting poor-quality and small SWHs imposed upon them after being informed that SWHs provide hot water for free, reduce water heating electricity usage and improve lives. In Khayamandi, the Stona (2011) family, consisting of ten members has received a 100L SWH. During the time of interview in 2009 Stellenbosch was home to one of the oldest local SWH manufacturing companies, Solardome SA which has been active player in the SWH industry since 1969, and it had about 50 workers, including casual workers (February, 2009) before it was closed down end of November 2011. More details on Solardome SA will follow later.

3.3.1 Stellenbosch SWH Project

The Stellenbosch SWH Project started towards the end of 2010 in Cloetesville where low-pressure SWHs were installed in low-income households mainly targeting pensioners first, and later it was also extended to everyone interested to reduce electricity usage and achieving financial savings, as well as helping to create few job opportunities, reducing $C0_2$ emissions and skills development (Fernandez, 2011; Isaacs, 2011). The Department of Environmental Affairs (DEA) allocated about R25 million to organize and enforce a SWH rollout in the greater Stellenbosch area. This information was initially shared by Fernandez and later confirmed by Martin Albertus who had his office at Cape Winelands District Municipality (CWDM) and worked for the DEA until late 2011 (Albertus, 2011). After talkig to him the next person was Geral Esau from Stellenbosch Municipality (SM). Getting answers from relevant departments at SM offices can be very difficult and frustrating at times. Fernandez forwarded details of Gerald Esau who worked as an assistant director in the directorate of Environment, Sports and Facilities after encountering the usual obstacles with him. This SWH initiative was initially done without LED division of SM Strategic Corporate Services directorate and many other strategic stakeholders such as Stellenbosch University and research community as well as business community. “The LED was not involved and did not know much about the SWH Project running in the greater Stellenbosch” (Widmark, 2011). Gerald Esau on November 22, 2011. “Good morning Thumakele, Perhaps I should start explaining to you how my department function. My department is called Environment, Sport & Facilities which consist of the following: Parks & Rivers, Nature Conservation & Cemeteries, Urban Greening, Sport, Facilities, Libraries. As you may note from the above the installation of solar heaters in the Greater Stellenbosch form not part of the core description of my functional areas. We deal with the management of public open spaces, developed and undeveloped areas. The solar heater project is an initiative of National Government driven by the Department of Environmental Affairs in the Greater Stellenbosch. DEA have funded the project, appointed an implementer for the installation of 2 400 solar water heaters only in the Stellenbosch region. Stellenbosch Municipality only supports the project because it falls within its jurisdiction of operations. Therefore we have no say whatsoever as to what happens to the project, who are the beneficiaries and how they were chosen, what the carbon credits will be and what the future role out of the project will be. My department was nominated by the Municipal Manager to ensure that we assist the implementer in procuring operating sites in Kayamandi, Ida's Valley and Cloetesville" (Esau, 2011).

The SWH Project was designed to serve poor population of Stellenbosch whose total population figure remains covered by a great degree of uncertainty. Stellenbosch population ranged from 188 601 in the Cape Winelands District Municipality local economic development strategy (CWDM, 2011: 26) increasing up to 200 527 in 2007, to 207 315 in 2009 and 222 575 in 2010 in the Stellenbosch IDP documents (SM IDPs, 2007: 13; 2010b: 12-13). The unemployment rate in Stellenbosch was 17% in 2011 (CWDM, 2011: 41). The Stellenbosch SWH project resulted to the employment of 155 local people**,** including administrative workers, community ambassadors and installers, who mostly earned R146 per day (Isaacs, 2011; Lawrence, 2011). The greatly increasing housing backlogs in Stellenbosch over the next two decades and future spatial development framework plans make the area suitable for SWH rollout, as was shown in subsection 1.4.4 above. The reality is that the bulk of working people, including those in the Kuyasa, Mfuleni and Wallacedene communities earn less than R3500 per month, as was shown in subsection 2.11.5 earlier).

3.2.2 Kuyasa project was better planned

Kuyasa Project was better planned and well organised community with consultation and human interactions between the beneficiaries, community leaders and CCT as key driver behind the project (Ndamane, 2011). Kuyasa SWH project was started in 2002 as stated in section 2.6 earlier and the beneficiaries received SWHs free of charge, employment was provided for some people who were unemployed before, with most of its employees being women including working SWH beneficiaries earning less than R3500 per month. The SWH rollout promised some job creation and savings on energy usage and energy costs. They were promised an improved quality of life, and a reduction in $C0_2$ emissions possibly resulting from SWH usage to heat water to replace the usage of electric kettles or paraffin stoves. The promised opportunities were discussed with the beneficiaries and captured through a feasibility study that was conducted to determine the SWH impact on social dimensions and their economic benefits (Cousins & Mahote, 2003). The community conducted extensive workshops and cultivated collective support for the initiative by making efforts to establish understanding, local participation and acceptance (Ndamane, 2011). The SWH installation covering 2309 households started early in 2008 and was completed around September 2010. At the time of the current study, Kuyasa was attracting some international tourists (Ngamile, 2011). One missing point at Kuyasa Project was making material available in isiXhosa the language spoken and known by SWH beneficiaries. For instance, Lynedoch green village drivers simplified its constitution and made it available in both English and Afrikaans to build better understanding, excluded isiXhosa and Sesotho (Annecke & Swilling, 2006).

3.2.3 Kuyasa Project employment figures

While it was not possible to know the total population, and capture specific employment and unemployment figures for Kuyasa, the provincial population figures were available. In 2011, the Western Cape province was estimated to have almost 5.3 million inhabitants. In the first quarter of 2011, the Western Cape average unemployment figure was 22.2%, of which black Africans formed 32%, coloured Africans 21.9% and African whites 5.6%, as was shown in subsection 1.2.1 above (Provincial Treasury, 2011). The Kuyasa Project employment figures from its start in 2002 to its end in September 2010 ranged from 87 to more than 90 people who were employed during the implementation of the project who had not previously been employed, with most being female workers (Goldman, 2010; Ngamile, 2011). The benefits obtained from SWH installations included more than just the provision of jobs and the installation of SWHs in homes that previously had had no access to any form of geyser to heat water, as they also provided an opportunity to coordinate technology and skills transfer to cut $C0_2$ emissions. It was stated that unlike fossil fuels, "solar technologies have low lifecycle greenhouse gas emissions and quantification of external costs has yielded favourable values compared to fossil fuel based energy" (Arvizu et al, 2011: 338).

3.2.4 Stellenbosch suburbs

The following two families are based in one of the Stellenbosch suburbs at Unipark, (1) Sknner family and (2) Cain-Ravenscroft family with unlimited access to electricity not less than 60 Amperes have shared their SWH usage stories. The first family of six members electricity usage ranged from 1100 kWh per month before the installation to 760 kWh in October 2010 after installing two 200L SWH units (Skinner, 2011). The second family's electricity usage ranged from 1021 kWh a month in January/ February 2008 based on 32.93 daily average, before the installation of the SWH units to 809 kWh in January/ February 2010 based on 24.51 daily average, and 969 kWh in February/ March 2011 based on 28.5 daily average after a 150L SWH unit was installed for a family of four including two children. Apparently the family became aware of SWH after "Phillip heard a guy from Atlantic Solar - Helmut - speak at STIAS at a professional workshop. Legislation can improve awareness of SWH" (Cain, 2011).

In September 2010, Julia Cain's husband Philip Ravenscroft wrote to Karen Kritzinger, "A couple of years ago (November 2007) our geyser at home burst. We were at home, there was no major damage and we did not bother with getting insurance to pay for a replacement. I took it as an opportunity to replace the geyser with a solar geyser but did not get the solar panel installed at the same time as I had limited time available for research at the time. I looked at the Solardome, Sonpower and Kwikhot geysers and eventually I went with the Kwikhot based on a balance of price and reliability (based on discussion with a couple of people I thought knew better than I. Last year, after hearing Helmut speak at a workshop at STIAS, I approached Altantic Solar to install the panel". Both families have taken conscious decisions to buy SWH units with electric back-ups to reduce electricity consumption and achieve some energy savings to reduce electricity costs (Cain, 2011).

Michael Ravenscroft (2011) from Hermanus, father of Philip Ravenscroft installed 200L SWH from Solardome in 1992 without a backup in his holiday home, followed by the Sonpower Hermanus 200L evacuated tube installed on his holiday cottage in 2010 and 200L flat plate on his retirement cottage in 2011 both with electric back up. Ravenscroft senior with many years of experience with SWHs does not seem to bother knowing about SWH savings and was not really sure how much electricity and financial savings were achieved as a result of using SWH systems. Ravenscroft senior installed SWHs due to "economy and fear of consequences of alternative" associated with continued use of fossil fuels (Ravenscroft, 2011). The Skinner family was more specific and said "to save electricity as the prices per unit increased" (Skinner, 2011). Ravenscroft-Cain (2011) family installed SWHs "because of both environmental reasons (bringing down family's carbon footprint) and because of rising costs of electricity". In essence, "globally per capita incomes are positively correlated with per capita energy use and economic growth can be identified as the most relevant factor behind increasing energy consumption in the last decades" (Yamba et al, 2011: 718).

3.2.5 Mfuleni and Wallacedene SWH Projects

No evidence of Mfuleni and Wallacedene SWH projects job figures was found, because the initiatives concerned were undertaken by the MHI long before the current study took place. The Mellon Housing Initiative (MHI) was the result of the Nail Mellon Township Trust, which was established in November 2002, shortly after South Africa hosted the WSSD. The presentation received from William de Villiers in Blackheath gave some more light on the project, and it was working partnerships and collaborations between South Africans, the Irish people and Americans, including local and international students. The Trust committed to building decent eco-friendly homes focusing on ecological and energy security through the provision of access to basic clean water, effective lighting, and insulation. The Trust has built up affordable houses for shackdwellers in Gauteng and created new townships in Eden Park, Etwatwa, Katlehong, and in many more places. In the Western Cape, new townships emerged in George, Khayelitsha, Klapmuts, Mfuleni, Paarl, and Wallacedene. The Trust intended to enhance the family structure by providing decent homes and assisting to build sustainable communities and enhanced local SWH manufacturing industry. To improve the quality of life for some poor township dwellers through replacing poor settlements with decent, affordable housing equipped with SWHs and energy-efficient lighting and community facilities. The projects used the Xstream SWH systems (De Villiers, 2009; Nail Mellon Township Trust)[26].

3.4 ELECTRICITY CONSUMPTION LEVELS

In 2009 William de Villiers was working for the MHI based in Blackheath and covering the Western Cape areas with very low electricity consumption. The electricity consumption levels of low-income households are limited due to their access to prepaid meter-contained electricity being limited to 20 Amperes (Zwane, 2009). In 2000, the national policy of free basic services was introduced in South Africa. Adam (2010: 16), argued "the policy states that poor households generally have a low demand for electricity and thus their needs could adequately be met by restricting the current drawn from their supply to about 20 Amperes. The limited current restricts what appliances can be used and often runs the risk of tripping the electricity." This access limitation limits the people (Adam, 2010: 17-18). Most respondents from Kuyasa, Mfuleni, Wallacedene, Cloetesville and Khayamandi were eligible to receive and received 50kWh of free electricity from their municipality. Most of them spend 10% to 15% of their income on electricity. Free electricity supply is provided to mitigate high electricity costs, and to enhance access to meet basic needs (Eskom, 2008: 43). The difficulty when it comes to electricity consumption levels most people do not really know how much savings they achieve with SWHs. "First of all, many consumers are sadly ill-equipped to calculate their energy savings themselves and need to be spoon fed. Secondly, exaggerated claims in the press don't help the situation" (Van den Bosch, 2011).

3.5 Findings on SWH Savings

The findings made in relation to statements made on SWH savings by various consumers included the following statements relating to such savings that were made from September to November 2011. In Mfuleni, most houses were freely built in 2006 and equipped with SWH systems by the Nail Mellon Housing Initiative (MHI)**.** A family of four, including two children, stated that they spent about R150, on average, for electricity. During summer, their electricity costs decreased to R80 per month in Extension Six, Mfuleni (Mphokeli, 2011). A largely Zimbabwean family of six, consisting of a young couple, and including three children and one brother, spent about R800 per month on electricity and, when their SWH worked,

[26] William de Villiers, 2009. Personal Interview at his office in Blackheath, Mellon Housing Initiative (MHI), and received a copy of Nail Mellon Township Trust, Cape Town, September 11, 2009.

they saved R180 on electricity costs per month (Siziba, 2011). In Kuyasa, the family of Macingwana (2011), consisting of five members, stated that they spend R150 per month on electricity and saved R50 per month in summer. Bhambatha (2011), who is the father and husband in a family of six members, including four children, stated that, in summer, SWH use helped them to use less than R100 per month on electricity. It helped to save the time taken to heat water by means of an electric kettle or stove, and avoid the risks of children being burned (Ngayi, 2011). The Skinner family, with six family members, reduced its electricity use from 1100 kWh per month before SWH installations to 760 kWh per month after installing 2 ×200L SWHs with an electric backup in 2010, saving them R400 per month (Skinner, 2011). A family of three, a single mother with two children, spent R150 per month on electricity and did not really know their savings (Manyathi, 2011). The household of Stona (2011) did not know their SWH savings. The middle-income household also did not know how much savings it achieved after SWH use (Ravenscroft, 2011).

3.6 SWH PROBLEMS

SWHs worked well during hot days and provided hot water as if it was heated by electricity. During cloudy days the hot water was inadequate. In 2011, in Wallacedene, nearly 100% of Xstream SWHs were out of order. The plastic valve could not endure the hot water pressure and a result very few SWHs were still working with dangerous leakges. Siziba (2011) stated that “the SWH was leaking and hot water was overflowing uncontrollably, and we decided to switch it off. We use electric jug for heating water and use nothing for space warming.” Pauli (2011) family has nine members, including 7 children their SWH was still working, except on cloudy days and electricity cost was R150 plus free 50kWh (Jonasi, 2011). “Most common problem is leakage, and there is no coordinated effort to resolve this problem. Each person should take a responsibility to repair her or his SWHs while many people still remained unemployed, and faced daily struggle to survive all our lives” (Jonasi, 2011).

3.6.1 SWH inefficiency on overcast days

The SWH inefficiency on overcast days rendered the system less useful and compromised its ability to provide a reliable supply. No hot water service on cloudy days (Manyathi, 2011). Yet, not much attention has been given to addressing this problem because some SWH promoters and implementers are aiming to installing more SWHs with minimal costs as possible, while, in the process, depriving households of sustainable quality hot services. The SWHs are provided free of charge in Cloetesville, Khayamandi and Franschhoek (Bergstedt, 2011). SWH beneficiaries were only informed that a SWH provided hot water on sunny days and that its use reduces electricity consumption and energy costs, and it was not really possible to tell how much electricity and costs saved (Mpophoma, 2011).

3.6.2 Outline of SWH installation lessons

SWHs should comply with SABS requirements to ensure good quality and avoid installation of inferior SWHs. Kuyasa is counted as the first CDM SWH project in South Africa to qualify and register for carbon credits provided under the now expiring Kyoto Protocol in December 2012, and it would receive 40% of its revenue (Ndamane, 2011). “Future carbon funding imminent: The argument of ‘suppressed demand’ (measure of potential future energy use of household) is one which has been made to and accepted by the CDM board, and agrees fundamentally with the concept of sustainable cleaner development” (SEED). Kuyasa organised a feasibility study and educative workshops to enable the beneficiaries to understand the principles underlying the usage of SWHs, of which there was no evidence that it was done for Stellenbosch SWH Project (Fernandez, 2011), Mfuleni, and Wallecedene. The number of jobs created during the lifespan of a SWH project provided temporary relief for those who were previously unemployed. Sustainable energy systems can only take much needed impact if the means to help people embrace a transition to sustainable energy driven economy culture are simplified and grounded in their minds and daily interactions with life.

3.6.3 Making information accessible

The Afrikaans and isiXhosa as languages spoken by most SWH project beneficiaries were not effectively used to empower them with written SWH information material and manuals of how to keep SWHs working well. Failure to localize any form of development including technology innovation undermines the core aim and purpose of stimulating sustainable transformative development. Civil society in partnership with local authorities has the power, the ability and capacity to raise educative engagements in the language that local people speak to enable them to understand and relate to sustainable energy systems, SWH system. The move towards embracing renewables and inducing energy consumers to start switching to sustainable energy consumption in the form of SWHs and efficiency is a great challenge. Making information accessible and available in the languages spoken and understood by the communities will play a vital role to inculcate a sustainable energy usage culture with clear purposes, commitment and collective ownership responsibility.

Failure to making information accessible does not only undermine the Constitutional values of South Africa as provided in chapter 2 under the Bill of Rights, section 32, and enhanced by the Promotion of Access to Information Act No 2 of 2000, in chapter section 9 (Republic of South Africa, 2000), but it also disempowers the majority of citizens and merely reduce them to being spectators of civil society that claim to represent the public interest. SWH information should not be preserved for the privileged few like energy and electricity information is, but it should be made available in all official South African languages. Stellenbosch Renaissance stands out a non-negotiable requirement to transform Stellenbosch to truly reflect a town that has been a leader in advancing colonialism and engineered apartheid to a new community embracing true transformative cultural inclusivity and sustainability after April 1994 (Swilling, 2005).

3.7 SUMMARY OF CHAPTER 3

The Stellenbosch Renaissance idea could lead to the genesis of an enduring legacy and systematic designed Stellenbosch transformative agenda from its current state of being largely intact as if no transition and change occurred in South Africa following many years of liberation struggles leading to April 1994. The sustainable energy was located as part of the required mix to effect changes in Reinventing Stellenbosch Framework. Stellenbosch University (SU) and Stellenbosch Municipality (SU) partnership was informed by the following principles to unleash strategic sustainable development options (Swilling, 2005: 4):

1. "Transition to renewable energy alternatives and energy efficiency
2. Zero waste via re-use of all waste outputs as productive inputs
3. Sustainable transport, with a major focus on public transport
4. Sustainable construction materials and building methods
5. Local and sustainable food (especially organic food)
6. Sustainable water use and re-use of treated sewerage
7. Enhancing biodiversity and the preservation of natural habitats
8. Valuing authentic cultural diversity and a sense of community via a participatory culture".

However, the picture painted above can be indicative of a Stellenbosch that has not managed to keep up and follow its jointly envisaged sustainable development vision to truly chart new history by building bridges by striving to closing down a legacy of centuries racial, cultural and socio-economic divisions (Swilling, 2005). The political instability and power struggles events in the Stellenbosch Municipality since 2006 on resulted to a noble forward thinking vision, and promising tangible ideas falling out of its major priority attention. Stellenbosch comes across as one of the wealthiest towns in South Africa and its diverse tourism industry sector had 18000 employee in 2011, as stated in section 3.1 earlier (Cain n. d; Ferns, 2011).

SWH initiatives at Kuyasa, Mfuleni, Wallacedene, Cloetesville and many others including Khayamandi were indication that sustainable energy systems were made part of improving access to hot water services. It was through initiatives such as Kuyasa Project that SWH installation in low-income households gained new impetus because the concept of registering Kuyasa Project in clean development mechanism as a suppressed demand programme, and the CDM board approval of the idea has attracted international attention (SEED). Kuyasa Project is counted as one of the first South Africa's registered CDM projects, and mostly subsequent SWH project interventions would keenly learn from its experiences and SWH model that has also helped to creating temporary jobs for more than 86 people, mostly previously unemployed women and men. Although nobody knew with absolute certainty as to how much electricity and electricity costs did they save after having SWHs installed in their homes, everyone agreed that in summer they did not use electricity for water heating. The success story of Kuyasa Project consisted of a combination of SWHs, CFLs and ceilings that all played different roles to improving living conditions ranging from accessing hot water supply when the sunshines, cutting electricity usage and improved thermal performances. The Stellenbosch SWH project supported by the DEA with R25 million capital at the end of its 18 months duration would result to, and leave 2400 homes equipped with low-pressure SWHs in the Stellenbosch Municipality area. The Stellenbosch SWH project has created about 155 temporary jobs. The SWH beneficiaries were residing in the following communities, in Cloetesville, Khayamandi, Klapmuts, and low-income community of Franschhoek Valley.

CHAPTER 4 RESEARCH FINDINGS ANALYSIS

4.1 INTRODUCTION

The measurement to undertake research findings analysis for the present thesis will involve consideration of impact of SWH projects, and impact of SWHs on household electricity usage, costs, and affordability. Reflect on overrating SWH benefits and major obstacles to SWH access and information, and SWH industry outlook. The measurement of SWH impact involves the consideration of the positive impacts that SWH projects have had on the target communities, local economy and SWH beneficiaries. The SWH industry has a long history in South Africa. “In 1961 bureaucratic bungling by the South African government strangled the fledgling solar water heating industry. By imposing high transport tariffs on solar water heaters, their price was pushed beyond reach of most people and local firm that had been producing them since 1954 was forced out of business that same year” (Meyer 2008: 48). In light of persistent global economic recovery how the country, Western Cape and Stellenbosch positions itself will determine its own green outlook growth. Africa dodges much of Europe’s downturn by Reuters published in Business Times, October 14, 2012, Sunday Times, has stated that “most countries in Africa have largely escaped major harm, with the exception of South Africa, which has financial and trade ties with ailing eurozone markets”. The economic growth of Africa is estimated at 5% for 2011/2012 and 2012/2013 respectively. Southern Africa’s fastest growing countries such as Ghana, Kenya, Mozambique, Tanzania and Uganda buoyed by recent oil and gas discovery. International Monetary Fund (IMF) has estimates that the following countries will grow as follows, Ivory Coast by 7%, Ghana 7.8%, Democratic Republic of Congo (DRC) 8.2% and Mozambique 8.4% in 2013 (Reuters, 2012).

4.2 SWH INDUSTRY OUTLOOK

The Stellenbosch SWH industry is part of the South Africa SWH market that yielded about 35 000 per annum, contributing 700 green jobs, including those in such sectors as 200 in manufacturing, 400 in SWH installation, and 100 in administration. The local SWH market was dominated as much as 90% by flat-plate systems, with 10% consisting of evacuated tube SWH systems. SWH imports were growing, having captured 40% of total local markets in 2009 (IPAP2, 2010: 42). Most SWH businesses were risk averse, due to uncertainty about demand and market growth that was attributed to South Africa’s small-scale manufacturing capacity and compare it to rapidly growing import sectors. “The entire supply chain creates employment from manufacturing to maintenance. More than 50% of total employment is involved in the installation stage” (IPAP, 2010: 42). Ironically in 2011 Solardome went out of business and jobs were lost. Until 2011, Solardome SA was the only flat-plate SWH manufacturer in Stellenbosch for more than 40 years, which charged no less than R15 000 per SWH unit in 2009. The company employed 50 workers, including 20 casual workers and skilled workers (February, 2009). The Solardome SA competes with a few other similar flat-plate SWH manufacturers operating in South Africa and exporting to neighbouring countries. In Pretoria in 2009, Suntank had been a flat-plate manufacturer for more than 17 years, with its SWHs each costing between R13 000 and R18 000, and employing 35 workers. Using a SWHs saves 40% to 50% of electricity bill per month (Hurwitz, 2009). Solahart has been in the SWH business for more than 25 years in Johannesburg, importing flat plates from Australia, costing R15 000 to R35 000 per SWH unit, with 15 workers and 45 SWH distributors nationwide, with 4 workers each in Cape Town, Botswana and Namibia. In 2009, South Africa had more than 132 SWH companies, mostly importers (Hickey, 2009). In 2008 records have shown that ”South Africa is 13th on the GHG emitters list, with emissions of 9.25 tons per capita and a total of contribution of over 451 Mt per year” (ESMAP, 2012: 2). SWH systems are internationally recognized for having a potential to mitigate $C0_2$ emissions.

4.2.1 SWH access obstacles

Interacting with SWH beneficiaries reinforced the fact that SWH access obstacles included high upfront costs, lack of awareness, and lack of necessary capacity and policy regulations requiring installation of SWHs in new and renovated buildings (UNFCCC, 2011). The existence of such obstacles was confirmed by Spencer (2009) and Janasch (2009), who state that, in the light of high upfront costs and lack of government support, financing and policy regulations to stimulate SWH industry growth were all constituting SWH access obstacles. The problem of high SWH costs is mainly an international challenge, as it was shown in subsection 2.8.4 earlier. However, one of the major obstacles to truly understanding SWH dynamics is the adoption and usage of local spoken languages on all SWH projects being conceived, under consideration, during planning and real implementation phases. Under such conditions and in such processes measurements collectively ensure that truly consolidated actions are put in place to ensure that logical spin-offs of adopting SWHs will be achievable. There is a need to reduce compromised SWH installations and enhance awareness campaigns against misleading claims regarding overrating SWH savings and ensure that the written SWH information in local languages and complimented by educative awareness interactions.

4.2.2 SWH manufacturers problems

The requirements for enhanced and ensuring good quality in SWH markets are essential, until November 2011 lacking SWH mandatory policy left South African SWH manufacturers vulnerable to cheap imports and threatened jobs in Western Cape. SESSA ambassador, Irvan Damon reported that regulatory constraints, costs and inferior imports have had a negative impact on local SWH manufacturers, because South Africa has attracted new entrants into the field without creating local SWH market demand. The required payment of R70 000 to R100 000 to have a SWH unit examined by SABS to qualify for the Eskom rebate has constrained growth of local SWH manufacturers in the Western-Cape (February 2009; Naidoo, 2011).

In November 2011, two local SWH manufacturers were planning to halt business. It has been noted that “the difficult operating environment has already led to the closure of the SWH manufacturing facility of Western Cape-based Solardome South Africa. The company was established in 1969, and will now retrench 21 employees. Solardome MD Tertius Lindenberg said imported products had flooded the market, and believed not enough was being done to protect local manufacturers and ensure a competitive local industry. He said the demand for SWH in South Africa did not justify the costs absorbed by manufacturers” (Naidoo, 2011). Furthermore, “SolarMax MD Jacques van Dyk also warned that his business would have to close its manufacturing facility next year, if conditions did not improve. ‘We are ‘hanging on’ and hoping for a positive change to the regulatory framework, including that of the testing of systems, and for protection against imports’” (Naidoo, 2011). Exactly the same cheap imports problem was highlighted by Xstream Geysers Managing Director, Dawie Thirion, stating that the unfair competition with very low-cost Chinese SWH imports threatened to close their businesses. South Africa should enforce necessary import duties to protect local manufactured goods and enforce legislation to enhance local SWH markets (Thirion, 2009).

4.3 SWH IMPACT ON IMPROVING QUALITY OF LIFE

SWH impact on improving quality of life could be used as a leverage to drive Stellenbosch Renaissance just as Pittisburgh Renaissance capitalized on effective flood control and rebuilding programme in 1945 in the USA (Westman, 2006: 10). The churches, civil society, municipalities, private sector and community members took a collective massive campaign to mandatory policy frameworks to enforcing sustainable energy systems in Germany and Spain (Barcelona, 2009; Laubser & Mez, 2004). Interacting with some of the religious leaders from the Anglican, Presbyterian, and Uniting Reformed Church ministers, as well as from the Islamic faith, revealed that the SM area did not, at the time of the current report, have sustainable energy promotions, and the awareness of renewable benefits was very limited. They admitted that most of them lacked adequate insight into sustainable energy and SWHs, but had come to know that high upfront capital costs prohibited the uptake of SWHs. However, Hunter (2009) has stated that poor households require government subsidy to access SWH technology, with such subsidies only being granted if there is evidence of it being a priority need. Mostly the key responsibility for coordinating development projects including SWH impacts on improving quality of life has been left to the local authorities. Van Zyl (2009) argued that high prices for SWHs should not be used as an excuse to continue using electric geysers, because some people can afford SWHs and we can find creative ways to enable local poor citizens to access them. Stellenbosch should start embracing a "theology of green hope" (Rom 15: 13) through sustainable energy promotion initiatives. Inevitably, doing so would involve critical human interactions driven by, among many other things, understanding that "crucial to the activation of the endogenous resources is the participatory approach to setting goals, procedures, and the implementation and control of economic activities"(Burguillo & Del Rio, 2009: 1316) on improving the quality of life.

4.3.1 Second Industrial Policy Action Plan and New Growth Path

The second Industrial Policy Action Plan (IPAP2) envisaged to address what Manuel referred to earlier as South Africa importing more than we export, and increasing local production of SWH systems constitutes a significant share of this vision (IPAP2 2012: 42). In 2008 way before the 2012 Marikana tragedy[27] occurred, South Africa was reported to have a fairly good environment to do business. However, "despite the advantages of its relatively good business environment, South Africa faces high unemployment and widespread poverty. The proximate causes of these problems are that growth has been slow and has not absorbed as much labor as it could have" (The World Bank Group, 2010: 5). Between 1998 and 2008, especially in 2003 to 2007, the South African economy was driven consumption while overlooking local manufacturing, contextualization of development through local languages and empowering its people. South Africa should strive to grow faster than it has been doing and begin to grow by 10% per annum (Pan-African, 2011). Therefore among other things we need "to grow faster and to increase annual jobs growth, South Africa needs to increase exports and attract more FDI. This is because domestic savings currently fall well short of what is needed for faster growth" (The World Bank Group, 2010: 5). Further employment of about 454,000 could be created, which will contribute favourably towards the target set by the government's New Growth Path (NGP). This shows that a sustainable boost in manufacturing could go a long way to enable the required job-creating growth for the economy (Pan-African, 2011). SWH systems and other renewable energy systems have the potential and ability to integrate local and international cultural experiences including languages to drive change. "In addition, FDI also helps boost productivity, as knowledge and technology transfers often accompany foreign investment projects. Because manufacturing industries and the tradable sector more generally are the more labor-intensive parts of the economy, the expansion of manufacturing exports is also a useful strategy for employment generation" (The World Bank Group, 2010: 5). As state earlier most of South Africa's peers are growing faster than South Africa's 2.5% growth for 2012, which declined from 3.1% in 2011, China 7.6% in 2012 (BER, 2012: 4, 6). The country seeks to enhance its green economy outlook and attract more green investments.

[27]In Marikana in the North West Province, the striking Lonmin mine workers were demanding more pay accompanied by a violence that resulted to death of 44 people and 78 injured in August (Maharaj, 2012).

4.3.2 Reasons for using SWH systems

However the reason for using SWH systems does not revolve around building a Stellenbosch Renaissance. The Stellenbosch town is largely operated as if the energy transition contains no transformative opportunities. Growing energy demand and energy security are two major pertinent reasons for using SWHs. Managing energy costs and future energy demand for the Stellenbosch Municipality (SM) area would require 329 146 968 kWh in 2030, nearly equal the total amount of electricity distributed in 2009, 39 712 222 kWh. The need to reduce electricity consumption and local $C0_2$ emissions provided opportunities for promoting sustainable energy systems such as the SWH interventions (Western Cape, 2010: 136). The Municipality approved tariff increases in May 2010 for application in July when the new municipal fiscal year started to comply with the Municipal Property Rates Act 6 of 2004 and with the Municipal Finance Management Act (MFMA) 56 of 2003. Property rates did not increase in 2010; electricity increased by 24.9%; water by 6.0%; sanitation by 6.9% and refuse removal by 6.0% (Fernandez, 2011; Nuusbrief, 2010: 4). The impact of costs, especially the electricity costs for various households has induced some people to install SWHs and has prompted Stellenbosch to embrace SWHs (Cain, 2011; Fernandez, 2011).

4.3.3 Findings on SWH projects experiences

This section will capture findings on different SWH projects experiences from communities such as Cloetesville, Stellenbosch suburbs, Kuyasa, Mfuleni and Wallacedene. Cloetesville is a starting point, a predominantly coloured community and Valerie Fernandez has been one of the councillors of this community for many years now, and is a mayoral committee member (mayco member after our May 18, 2011 national local government elections). Councillor Fernandez as is now responsible for the portfolio of housing. It sounds more appropriate to refer to the Cloetesville SWH case as Cloetesville SWH installation experiments than to refer to it as Cloetesville SWH experiences.

Table 4.1: Cloetesville SWH installation experiments	
Incorrect installation	87.9%
Lacking awareness of SWH installers	95.10%
Lacking awareness of SWH sizes	96.10%
Lacking awareness about SWH benefits	97.11%
Lacking awareness of SWH lifespan	98%
No written SWH information provided in local language	99.11%
SWH without electric back up for cloudy days	99.11%
Job creation figure	155

Table 4.1 shows some 2011 Cloetesville SWH project incidents in percentages, and specific figure. In 2011, about 87.9% of respondents from Cloetesville indicated occurrences of incorrect installations. The 153 jobs created although of a temporary nature helped to relieve some joblessness. Lacking awareness and access to information in local language (99.11%) undermined understanding of how and why SWHs were important in respect of underlying reasons of reducing reliance on fossil fuelled electricity usage, enhance ecological safety, improved living conditions and new economic opportunities through promoting sustainable energy as opposed to unsustainable finite fuels use (SEA, 2007). Accurate SWH installation involves correct orientation to ensure optimum efficiency. The performance of 87.9% SWHs in Cloetesville was compromised by incorrect installations, and implied poor transfer of technology skills. The 18-month-long Stellenbosch SWH project was approved without a feasibility study done prior the project. The LED was not involved (Fernandez, 2011).

Table 4.2: Mfuleni and Wallacedene SWH Problems after 2006 - 2011	
Lacking SWH information in local languages	99.12%
Lack of money for SWH repairs	77.9%
No SWH project maintenance office	98.12%
Overwhelmed plastic valves leads to leakages	96.12%
Still using electric kettles to heat water	93.11%
SWH not working at all	90.11%
Still using paraffin for water heating as a back up	86.10%
Lacking awareness of SWH installers	89.11%
SWHs without electric	99.12%
Source: Author, 2011	

Table 4.2 shows that more than 90% of the SWHs in Mfuleni and Wallacedene were not working. Most SWHs experienced severe leakages (96,12%), and as in Cloetesville, few people had knowledge of their SWH installers and many do not know how much savings they achieved due to using SWHs. More than 98% stated that there is no maintenance office to report SWH problems and over 93% still used their own electric kettles to heat water for bath and dish washing purposes. In Cloetesville, Kuyasa, Mfuleni and Wallacedene, SWHs were installed with no power backup. This means than more 98% of households still used paraffin for water heating during overcast days in Mfuleni and Wallacedene.

4.3.4 The Kuyasa SWH experiences

In sharp contrast with the Cloetesville, Mfuleni and Wallacedene SWH beneficiaries, the Kuyasa SWH experience represented a positive image of SWH project operations.“Sharing the necessary learning investments might be a good idea. To bring new technologies into the markets industries must benefit from research but also learn from doing. A certain amount of “learning investments” is thus needed. Coordinating national or local efforts to support early deployment may accelerate this process” (Philibert, 2004: 5).

Table 4.3: Kuyasa SWH experiences

SWH still working	94.17%
Copper replacing plastic valves	99.17%
SWH without electric back for overcast days	99.17%
Maintenance office	99.17%
Repair technicians	4.1%
Still using electric kettles as back up	90.16%
Jobs created (temporary jobs)	87
Source: Author, 2011	

Life experience and story of Kuyasa represent such thinking and approach of learning through collective action. Table 4.3 portrays an outlook of Kuyasa SWH experiences in their daily life and SWHs became part of their lives since the first pilot SWH installation was started in 2002 with ten houses for senior people, and resumed again in May 2008 until it was completed in September 2010 ended (Ndamane, 2011). At Kuyasa, the feasibility study was followed by many other similar research undertakings to assess suitable technical features of SWHs, the azimuth angle, solar radiation, the hot water temperature, the efficiency of performance, the electrical backup and amount of electricity savings per annum. Out of ten low-income sample households, four households were chosen, namely households 56013, 54610, 55747, and 56586 from Kuyasa. The results indicate that, on average, every SWH that faced between 34° to 52° east of true north with a tilt of 25° from the horizontal, including random daily hot water demands, yielded 912.5 kWh of solar energy a year (UNFCCC, 2006: 9-10). Table 4.3 below gives few Kuyasa SWH experiences. When considering the Kuyasa Project, more than 94% of SWHs were still working. Kuyasa Project success was attributed to proper support from the City of Cape Town, proper plannings, inclusive participation, and appropriate interactions through workshops and public meetings (SEED). An administration office was made available to receive complaints regarding maintenance challenges and ensuring that the technicians attended to them (Ndamane, 2011; Ngamile, 2011).

However during overcast days, over 90% of SWH users resorted to using electric kettles to meet their hot water needs for bathing, dishwashing and cooking. Kuyasa Project created 87 temporary jobs from 2008 until its end in September 2010. The installation of SWHs, ceilings and CFLs contributed to improving living conditions in Kuyasa (Ngamile, 2011). It was also credited for contributing in stimulating the local SWH manufacturing sector, because, when they started, all their SWHs were imported, and, as time progressed, they bought their SWHs from the South Africa SWH company, Xstream Geysers in Paarl. This SWH initiative has also inspired elements of Ubuntu by fostering community trust and cooperation (Kretzmann, 2009). The CDM carbon credits would make up 30% to 40% of its revenue (Kuyasa Energy Efficiency). The major foundations of Kuyasa Project was not only its ability to enhance significance of ubuntu through caring and taking responsibility of work done at their neighbours but on the power of collective actions to change their living conditions for better. This has placed Kuyasa Project is a beacon of hope and promise to secure carbon credits provided through the international driven CDM programme allows development countries to reduce their carbon emissions by investing funds and clean technology in clean development programmes in the developing nations. Kuyasa Project designed indicated that each SWH unit can generate 1.4 tonne per annum and carbon credits could yield €10 per tonne from the carbon market and SWH beneficiaries would contribute R20 – R30 per month (SEED).

4.3.5 Minimum standards of energy efficiency

For many years South Africa had no minimum standards of energy efficiency requiring usage of renewables. The SWH projects stated above were enforced without a mandatory policy requiring SWH use as it was the case in Israel and Spain, Barcelona. Things have changed in South Africa before December 2011. In a significant development that sees all new buildings and refurbishments in South Africa having to comply from 9 November 2011 to minimum standards of energy efficiency, the SABS have developed SANS 10400 part XA – the first of a set of minimum standards for environmental sustainability in new and refurbished buildings" (DTI, 2011). Among many other things the above stated new buildings regulation standards made it compulsory for new and renovated buildings to be equipped with efficient systems such as SWHs, CFLs, north-southern building orientations, efficient building walls and windows, and ceilings insulations. Overall Kuyasa, Mfuleni, Stellenbosch, Wallacedene, Winterveld and Zanemvula projects are happened without mandatory policy. Most SWH projects done to help South Africa meet its energy needs do very little in terms of giving an empowering information. World Bank loan to Eskom had attracted more debates. "The response from environmental groups to the loan, however, has been mixed. Sixty-five civil society organizations coordinated by the South African environmental group Groundwork are campaigning against the loan. In a critique published at the Groundwork web site, the groups described the loan as financing 'a bad project, contributing to energy poverty and environmental destruction'" (Browne, 2010: 380). However the most objective statement is this. "But other environmental groups argue that the Medupi project is an inevitability. 'We prefer low carbon options, but Medupi will take place irrespective of whether the World

Bank loan comes through or not,' said Saliem Fakir, a spokesman for the World Wildlife Fund in South Africa, in an e-mail message. 'Medupi is being built as we sit.' Mr. Fakir added that South Africa could not finance all of its energy needs and that the loan must be 'seen in this context'" (Browne, 2010: 380). The minimum standards of energy efficiency forms part of a strategic approach by One Cape 2040 Vision. The researcher has attended the first Economic Development Partnership members forum meeting on June 19, 2012 in Cape Town. Among other presentations that were made on that day, Building effective partnerships for inclusive growth Introduction to the Western Cape Economic Development Partnership (EDP) was one of them. EDP envisages to develop and strive towards achieving One Cape 2040 Vision. The Once Cape 2040 vision is premised on pursuing the following ambition: "A resilient, inclusive and competitive economy with low rates of unemployment producing growing incomes, greater equality and an improved quality of life" (EDP). It entails development opportunities in education, research, entrepreneurship, sustainability and green economy constituting strategic areas of focus for the One Cape 2040.

1. Every person will be appropriately educated for opportunity to enhance knowledge
1. Recognised centres of ecological, creative, science & social innovation excellence
2. Anyone who wants to be economically active is able to work
3. The entrepreneurial destination of choice
4. Functioning ecosystems working for & with communities
5. Leader and innovator in the Green Economy including green jobs creation.

Green economy drive renewables and energy savings, but overrating its benefits is a concern. "As Austin points out: "You see a lot of these brochures or adverts that say 'save 80% of your power' trying to convince you to buy a heat pump based on the fact that it absorbs heat out of the air. But a heat pump's peak efficiency is 80%; it's not an average. So the advertiser's claim is not only misleading, it's downright false."This sentiment is echoed by Naidoo, who says "I think the biggest risk to consumers in regards to misleading information right now is probably on the lighting side. I'm astonished to see claims in the media of a 50% or even 80% saving if you change your lighting. That's impossible since most people's lighting contributes 20% or less to their consumption. So even if you had to keep all your lights switched off permanently you wouldn't save close to 50%" (Van den Bosch, 2011).

4.3.6 Sustainable economic growth

The Economic Development Partnership (EDP) seeks to inculcate a sense of responsible promotion of energy efficiency systems and shifting from being only consumers towards building sustainable economic growth through its green One Cape 2040 Vision. For many years South Africa neglected investing in manufacturing and SWHs growth. "As a result, the production side of the economy was neglected, the effects of which were felt during the recession of 2009. Imports into South Africa recorded an average nominal growth of 14.8% per annum, over the 10 year period, while export growth averaged 12.6% over the same period. Lower export growth saw the economy fall deeper into de-industrialization, as the economic structure shifted towards the tertiary sector activities" (Pan-African, 2011: 8).
The EDP attempts to align its One Cape 2040 Vision with the National Development Plan that sought to ensure that South Africans assume a collective responsibility to write a new story by building a country and developing an economy that will be inclusive of everyone. The fundamental idea is to reducing poverty, although the planers would like us to believe that we can eliminate poverty and reduce inequality by making the economy more inclusive and grow faster. These are twin imperatives. South Africa's New Growth Path seeks to create 5 million jobs by 2020. Our national planers seek to create eleven million jobs by 2030. The country must shift to a more greener economy (National Planning Commission, 2011: 9-10).

4.4 SUMMARY OF CHAPTER 4

The SWH industry of South Africa has always been characterized as small poorly developed sector. However, one of the interesting findings is that the SWH systems have a long history in South Africa dating as far back as 1961 as stated in the introduction. Solardome SA from 1969 up until they were forced out of business by new cheap imports, and rising competition in SWH industry shortly before 2011 ended, represented an enduring legacy of sustainable energy systems when it was less fashionable worldwide. Stellenbosch SWH project presented Stellenbosch with an opportunity to stimulate uptake of SWHs, but the local authorities did not do enough to unleash such opportunity to its full potential. The Stellenbosch Renaissance entails transformation of poor and cultural barriers through using renewable energy systems. The bulk of the SWH beneficiaries were earning not more than R3500 per month and cannot afford to choose and buy good quality SWHs, therefore they freely receive cheap SWHs.

The national SWH programmes seeks to achieve 1 million SWH rollout by 2014 and 5.6 million SWHs by 2020, but there is very little coordinated effort to ensure implementation of such targets at local community levels. The local government does not have a plan in place to stimulate the promotion and educative awareness of sustainable energy systems. The Kuyasa Project represents one of the organized SWH initiatives and was counted among the very first CDM projects for South Africa. Despite huge potential for SWH installations, local SWH market remains underdeveloped in the Stellenbosch Municipality area and countrywide. Their mandate to provide low income housing makes the government key player in renewables. “The significance of government’s role in sustainable energy’s big picture is twofold: not only are they responsible for creating legislative measures, they are also potentially one of the industry’s largest customers” (Van den Bosch, 2011). Mostert in Van den Bosch has noted “Government needs to get more seriously involved. I would like to see them commit to projects. They’ve drawn up the draft document on alternative energy that plans the next 25 to 30 years or so; however there’s been no action on the ground. There are many applications, from affordable housing to infrastructure development. These are very large scale developments and although they’re busy with something, we don’t see a change in pace to try and accelerate it” (Van den Bosch, 2011).

The experiences of Mfuleni, Wallacedene, Cloetesville and Khayamandi SWH beneficiaries have revealed that many people did not really have the capability to understand their savings. As Van den Bosch put it bulk of consumers are not well equipped to calculate their energy savings. Significant number of SWHs did not work at Mfuleni, Wallacedene and Cloetesville during the time interview between September and November 2011. Many SWHs had some dangerous leakages because the plastic valves could not stand hot water pressure mostly in Mfuleni and Wallacedene. Furthermore bulk of the beneficiaries were either unemployed or earned very little to afford to repair their SWHs and decided to switch it off by themselves. At times their SWH systems were not big enough to meet hot water needs of big families of 9 to 14 members with 80L to 110L SWHs per household. This was in sharp contrast with the sizes of Brazilian 200L SWHs per household with a gas back up to take over when sunshine is insufficient. South Africa provides no such benefit for its poor because the government and SWH promoters plans are to install as many SWHs as possible at the lowest cost possible just as the country has done with low-income housing and resulted to production of poor houses.

The significance of providing written SWH information in local languages where such SWH projects are planned and implemented is not factored into the budget, and falls away. SWH promoters and government are breaching constitutional principles and laws of the country as stated in sections 2.4.2.2 to 2.4.2.3 in terms of languages, information access and culture.

CHAPTER 5 SUMMARY OF RESEARCH FINDINGS AND RECOMMENDATIONS

5.1 INTRODUCTION

The current thesis started with a general introduction to the South African energy context and to the possible end of the era of cheap electricity, and the beginning of a new era, with higher energy tariffs to help Eskom deal with the crippling energy crisis that negatively affected domestic and business activity in early 2008. An overview has been provided of the South African energy policy, together with insights into the limited supply in the Western Cape Province, and how such limitation has affected such municipalities as the Stellenbosch Local Municipality in their ability to dispense sustainable and reliable electricity. The case study undertaken assessed the SWH impact on improving the quality of life. The literature review showed the drivers of sustainable energy policy designs and cases-enhancing renewable energy diffusion globally, and highlighted problems of global poverty, inequalities, climate changes and institutional implications pertaining to national, provincial and local structures. The local government, together with the most ignored crucial partner the community of faith, local cultures, local languages and buying power emerged as the most fundamental elements necessary to the contextualize transition to an effective sustainable energy and SWH rollout.

5.2 SWH RESOURCE INCENTIVES

The key finding when discussing the promotion of solar thermal utilisation is the availability of incentive resources. SWH resource incentives, in the form of more than 2500 hours of sunshine a year, with average solar radiation ranging from 4.5 kWh and 6.5 kWh per m^2 per day is prevalent in South Africa, subject to geographical variables. Adequate sunshine is a primary incentive for solar energy, especially SWHs (UNFCCC, 2011: 2). The national housing backlogs of more than 2 million households and similar challenges that are likely to accumulate in Stellenbosch over the next two decades, and persistent energy insecurity and national SWH programmes are incentivising a transition to SWHs (Engineering News, 2011).

The South African Local Government Association (SALGA, 2011: 9) and partners outlined the role of municipalities in the implementation of New Growth Path (NGP) as follows: “South Africa’s economic policy defined by the New Growth Path starts by identifying where job creation is possible, both within and across economic sectors. In summary the NGP focuses on the creation of five million jobs over the next 10 years, especially in the green economy, agriculture, mining, manufacturing and tourism. Infrastructure investment will focus on energy, transport, communication and housing. The aim is to target limited capital and capacity so as to maximise the creation of decent work opportunities using both macro and micro economic policies to create a favourable environment.” This NGP imperative has vaguely pioneered opportunity to think innovatively on how to address our major problems.

The New Growth Path (NGP) is focused on the green economy, specifically on sustainable energy systems to address energy security and job creation while striving to reduce carbon emissions. In 2011, greater Stellenbosch experienced the beginning of SWH installations in Cloetesville, Franschhoek, Khayamandi, and Klapmuts, with a R25m allocated by the national Department of Environmental Affairs (DEA) to install imported SWHs (Albertus, 2011; Isaacs, 2011). However, Stellenbosch has shown no strategic thinking and planning on how best to utilize the above funding by means of stimulating development of SWH and green economy, instead it has focused on now only. Like previous Low-cost SWH projects such as Lwandle SWH projects, Kwa-Nokuthula SWH project, Wallacedene SWH project and Mfuleni to mention but a few there is no evidence of contextualizing SWH knowledge, and SWH benefits to the culture, and languages of the people whose buying power is weak.

5.3 SOCIO-ECONOMIC IMPLICATIONS

The conclusion drawn from interviewing people regarding the 18-month SWH Project in Stellenbosch was that it was not planned and implemented to stimulate LED, manufacturing sector, building knowledge, and assessment of the best possible manner to drive massive SWH rollout (Fernandez, 2011; Moses, 2011). The Stellenbosch area is characterised by the diversity of affluent estates, varying farming and business communities, major headquarters of more than six mega-corporate companies, internationally recognised university and research institutions, a diversity of schools and languages, health and sporting facilities, shopping facilities and road networks, very rich, middle income and very poor communities. The planning design of development intervention should have a central point, where the vast diversity of greater Stellenbosch is pulled together to trigger sustainable collective action. SM area has more than 16% joblessness, and job opportunities are always on high demand. The European Union Directive for Europe on renewable energy recognises the necessity to promote sustainable energy sources as a priority mechanism, seeing that their exploitation stimulates sustainable development and creation of local green jobs, with a positive impact on social cohesion, amongst many other benefits (Burguillo & Del Rio, 2009: 315). When reflecting on the real impacts of SWH projects, the anticipated contributions are as follows:

- SWH projects beneficiaries are generally promised electricity and financial savings.
- SWH projects provide temporary green jobs to relieve the poverty of some people.
- Enabling policy regulations, financing and incentives are put in place to induce action.
- Low-income SWH project beneficiaries are also promised an improved quality of life.
- The lack of buying power deprives people of freedom of choice, capability and voice.
- Buying power affords access to information on good quality and right size of SWHs.

One of the reasons why Stellenbosch was lagging behind on SWH rollout was priority areas. Property services highlighted that there were other pressing priority areas for SU and that it was really not seen as a priority to create SWH markets, but, rather, plans were under way to support SWH rollout (Dolf, 2009). In 2008, the energy crisis experienced by South Africa started to create an energy use paradigm shift, which made the authorities realise that energy efficiency should be one of key priority areas of concern. By the time of the current study, SM had not put in place an aggressive energy plan and initiatives to drive it. However, the Stellenbosch SWH project started towards the end of 2010 in Cloetesville (Fernandez, 2011). The leading proponents of greater Stellenbosch SWH project have revealed that nothing was done to determine the volume of electricity kWh consumed by the target communities per day, week, month, or annum, or the variance in seasonal use. In most cases, electricity savings and financial savings becomes difficult to quantify. Many low-income households lack monthly budgets for electricity, as they buy limited kWh that lasts for a short while, but very few have adequate cash to buy electricity for a month. More effort is required to collect the fragmented pieces of information relating to the accumulation of relative savings. The SM authority and civil engineering and electricity services have not yet seen a need for an energy audit study to assess current energy consumption patterns and demand, energy inefficiencies, and possible options for enforcing an enabling policy to stimulate energy efficiency and start promoting sustainable energy consumption to reduce electricity usage, costs and joblessness.

5.3.1 SWH benefits

The SWH benefits provided by the Kuyasa Project were derived from a research conducted by the Energy Sector Management Assistance Programme (ESMAP) under the Energy Efficient Cities Initiative, Good Practices in City Energy Efficiency, Cape Town Kuyasa Settlement, South African Low-Income Energy Efficiency Housing Project, in January 2012.

Table 5.1 below outlines the Kuyasa Project savings envisaged to be achieved over 20 years, included energy and carbon emission savings from the 2309 low-income households, which are likely to be 155 million kWh and 135 187.33 tonnes of CO_2 respectively. Furthermore, each household has been reportedly saving about R150 per month (US$21) over the winter seasons, due to not having to use paraffin for water and space heating, and R50 (US$7) on electricity costs savings per month. It has also contributed to short-term poverty alleviation by creating 87 jobs. The poor thermal performance of RDP houses, as stated in subsection 1.4.3 (CURES, 2009: 11), was improved by combining insulated ceilings, CFLs and SWHs in Kuyasa, which resulted in improved thermal performance. The improvement concerned enhanced indoor environmental quality and health benefits, and community-building efforts. Below is a summary of Kuyasa Project benefits, namely energy and carbon emission savings.

Table 5.1: Energy and carbon emission savings

ENERGY EFFICIENT SYSTEMS	**BASELINE ESTIMATES**		**PROJECT ESTIMATES**		**SWH PROJECT SAVINGS**	
	ENERGY USE (kWh per year)	CARBON EMISSIONS (tonnes of $C0_2$ per year)	ENERGY USE (kWh per year)	CARBON EMISSIONS (tonnes of $C0_2$ per year)	ENERGY USE (kWh per year)	CARBON EMISSIONS (tonnes of $C0_2$ per year percentage)
Insulated ceilings	7710.00	6.86	6213.48	5.53	1496.52 (19%)	1.33 (19%)
SWHs	1447.00	1.23	0.00	0.00	1447.00 (100%)	1.23 (100%)
CFLs	331.00	0.29	74.16	0.07	256.84 (78%)	0.23 (78%)
Total (per household)	9488.0	8.384	6287.64	5.60	3200.36 (34%)	2.80 (33%)
Total number of households			2 309			
Total annual emission savings			6437.49 tonnes of CO_2			
Total annual energy savings			7.40 million kWh			
21-year emission savings			135187.33 tonnes of CO_2			
21-year Energy savings			155 million kWh			
Source: ESMAP, 2012: 8						

5.3.2 First-hand experience with SWH beneficiaries

However, the first-hand experience with SWH beneficiaries revealed that there are no really dramatic electricity and financial savings, especially during the winter season, because on overcast days, when SWHs are inefficient, people resort to using electric kettles to heat water. The size of the family and SWH quality matter, because large families, either in winter or summer, do not have enough hot water for all. In Cloetesville, the Skeppers household, consisting of ten members, namely the parents, with their two married daughters and their husbands, and children, spent about R700 per month on electricity costs and received their 100-L SWH in July 2011 to reduce electricity usage and to achieve financial savings. However, the Skeppers (2011) remained unsure of how much electricity and money was saved, because the children continued to use electric kettles. Similarly for the Mtyhali family, which consisted of more than 13 people, if the allowance of 25 L per person (UNFCCC, 2011: 26) is adhered to, the 100-L SWH was clearly inadequate for both Skeppers, and Mtyhali families hot water needs. The result was that many people still had to use electric kettles to heat water (Guzi, 2011; Mtyhali, 2011).

5.3.3 SWH impact on human lives

SWH impact on human lives should be treated with great care, because SWHs are utilised not only to address hot water access for many, but to ensure the reduction of $C0_2$ emissions that escalated by 38% between 1990 and 2009, and which affects climate change. Climate change results in very high temperatures, severe weather experiences, drought and little rain, water scarcity, rising sea levels, and food insecurity. Fast global population growth leads to constrained natural resources, with 85% of all fish stock being depleted and over 20 million people being undernourished globally (Engineering News, 2012). All the above-mentioned challenges are extremely serious and affect poor communities more negatively than they do to others. In Kenya, the University of Nairobi hosted a Sustainable Water Conference in August 2009 to exchange expertise around the importance of sustainable water supply for all and to discuss challenges regarding water supply quality, management and efficient usage. The people of Stellenbosch, Kuyasa, Mfuleni and Wallacedene form a small fraction of the vast African population. In 2009, the population of Africa exceeded 1 billion, and it continues to increase by 2.4% yearly. In Africa, 341 million lack access to clean drinking water and 589 million have no access to adequate sanitation. The population growth does not keep pace with demand, and we are unlikely to meet the MDGs to halve poverty and joblessness (PACN, 2009: 7). SWH benefits and SWH impact on human lives should be constructed in locally spoken languages to promote the understanding of main SWH benefits and purposes. Table 5.1 above showed the link of SWH impact on human lives to energy use and $C0_2$ emissions.

5.3.4 Sustainable SWH benefits

The degree of political will and commitment has the determining effect on how each local municipality will respond to harnessing sustainable SWH benefits beyond the few temporary green jobs that are created during the lifespan of a given project. Although South Africa is contributing more than 1% of $C0_2$ emissions, and Africa combined contributed just over 3% of total global $C0_2$ pollutions (Engineering News, 2011; Govender & Naidoo, 2011), the scale of opportunities springing from embarking on the transition to sustainable energy is massive. The Kuyasa energy efficiency initiative has received acclaimed international recognition. The Kuyasa Project has developed a model that could be replicated countrywide. In subsection 2.11.1 above it was stated that 5.3 million have no electric geysers and an estimated 4.2 million with varying income levels have an electric geyser, with all such facts reflecting the vast potential that exists for SWHs. Kuyasa Project was part of the CCT SWH rollout target for the installing of 10% of SWHs in 80 000 households by 2010 and for a further 10% savings as a sustainable energy generation target by 2020, amounting to 1.4 MWh per household. Few municipalities have, as yet, put SWH targets in place. “Replication across all low-income housing in South Africa would also assist municipalities in achieving their renewable energy targets” (ESMAP, 2012: 11).

After having assessed the potential of local sustainable benefits, weaknesses, and opportunities of the SWH industry, and having concluded that, while importing SWH was required to satisfy demand, the realisation is that sustainable jobs will emanate from the manufacturing sector in the Western Cape and across South Africa (Du Toit, 2010: 49). One of the best approaches to stimulating uptake of sustainable SWH benefits is integrated planning. The National Energy Act 34 of 2008 aims to enhance the development of integrated resources plan, and commits to promoting the distribution of sustainable energy systems to improve quality of life, and the enforcement of energy price increments, compliance with some energy efficiency measures through mandatory building laws, local manufacturing sector, research and sustainable development, and skills development (RSA, 2009: 21-22). Language is key. Available research vividly shows that there may be positive benefits on the investment for the total economy. "But the value added at the level of the economy as a whole cannot be denied. Moreover jobs created in the tourism sector as a result of these investment benefit the local economy" (European Union & South East Europe, 2012: 12).

5.3.5 SWH and language

When people are asked to share their thoughts on aspects leading to improved and improving the quality of life, they always mention access to decent income, generative work, proper shelter, acceptable living conditions and the restoration of human dignity (Doda, 2011). It always perplexed Nombulelo Doda from Khayamandi, a single mother over 60 years old, and a home owner staying with one young woman to hear people being called over loudspeaker to go to the community hall or Khayamandi Corridor to register for a SWH that heats water when the sunshines. Doda argues, "I am an ordinary domestic worker working for a very nice white family. My experience over many years is most black communities are poor and do not have as many energy consuming appliances as white communities do. Despite the fact that they use more electricity, I never heard the people in the white communities being called to go out and register for SWHs to save electricity. I still do not really understand this, why are we still being treated differently like in apartheid years?"

Further, Doda (2011) asked "What will happen when there is not enough sunshine and during rainy cold winter seasons?" Doda's concerns are pertinent questions raised by someone who needs to obtain more insight into SWH benefits and into the rational answers behind their promotion and into why the SWH rollout happened as it did. The above-mentioned incident reveals the importance of using various modes of reaching out to people. It is increasingly clear that improving quality of life can never be reduced to a narrow aspect that meets one element of human living conditions, while excluding the usage of spoken languages to unpack complexity of poverty and disturbing gap challenges to get supportive community understanding. Improving the people's living conditions results in the elevation of core human pride, and can contribute to the restoration of human dignity, because language builds deeper connections and an understanding of what needs to be done to build rapport (Couper & Pfaff, 2009). Communication is enhanced through cross-human interaction as part of cultural functions (Watermeyer, 2009: 5) and "words act as guides to the interpretation of social reality and invariably affect every aspect of a people's spirituality and material civilization and socio-cultural life" (Okolo, 2005: 4).

5.4 STELLENBOSCH MUNICIPALITY (SM)

Stellenbosch Municipality (SM) has legislative powers to create enabling policy regulation to ensure conducive markets to build sustainable energy and SWH industry. "Although South Africa is viewed economically as a developing country, it is a significant carbon polluter and emitter of greenhouse gases (GHGs), mainly due to its coal-fired electricity generation facilities and industries" (ESMAP, 2012: 2). "The technology presents a sustainable systems intervention that can reduce environmental degradation, create employment opportunities, reduce household energy consumption and provide valuable service to poor households" (Du Toit, 2010: 47). The SWH rollout should be aligned with the provision of new housing, old replacements and renovations. The local authorities should support SWH rollout and avoid doing it just for the sake of spending allocated funding without a careful feasibility study, as has been the case with the current R25m initiative to provide 100-L SWHs to 2400 families.

5.4.1 Shortfall between promises and reality

Seeking to do more with less undermines integrity of any aim. Enshrined in the Constitution of South Africa and subsequent legislative policies is the promise that energy services shall be extended to all, along with ecological safety (DME, 2003: 6). However, the rhetoric has always been short of tangible plans and pragmatic implantation, with the result that:

- Without enabling sustainable energy policy principles and incentives, nothing occurs.
- The government built millions of RDP houses without enforcing good thermal performance measures and installation of energy efficiencies and insulated ceilings.
- Delivery of services is poor, and housing delivers 300 units a year (Carolisen, 2009).
- Many poor communities have accepted the imposition of small poor-quality SWHs.

5.4.2 Lack of coordinated vision and action

Doda's utterances in subsection 5.3.5 above represent a long-standing understanding that Stellenbosch remains a racially divided town. According to Du Toit (2010), in this regard, "solar water heating can play a central role in the achievement of further development amongst the rich and the poor of the world. It can reduce the intensity and ecological footprint of rich households that currently use electrical and gas heaters, and it can allow poor households without water heaters to improve their quality of life with only a marginal increase in their resource use levels and their ecological footprint." Although the aspect of improving quality of life remains a matter of serious debate, overrated SWH savings remains unresolved, as stated in subsection 2.10.5. Reasonable savings are achievable, as was shown in the case of the family that reduced its monthly electricity consumption from as high as 1100 kWh to 760 kWh (Skinner, 2011).

The SM area, like many other local municipalities, is afflicted by a lack of coordinated vision and action to explore various opportunities attached to the requirement to switch to sustainable energy consumption over a period of time. Different political and ideological views may be held as to why embracing SWH systems is necessary or not, but the evidence presented above indicates that the bulk of developed and emerging economies, such as the European Union countries, Germany, and New Zealand, China, and India, as shown in subsection 2.9.1, have approved SWH targets for SWH installations, $C0_2$ reductions, financing and green jobs. In an area like greater Stellenbosch, with the majority of poor and rich communities espousing very strong religious convictions, the involvement of a broader diversity of community becomes a prerequisite for a successful SWH awareness and implementation drive across communities.

In the Stellenbosch Transformation Research Project of 2005 that was conducted by Cindy Jacobs, Gerbrand Mans and Johannes Erasmus, 88.1% of the total population professed to be of the Christian faith and 2.1% of the Islam faith. Jacobs et al (2005: 5, 11) state that, "in rating South African social institutions, the HSRC (2000) found that the public's view of the church received the highest percentage of trust (74% in 2000). Second to the church was the Electoral Commission at 50%. This signifies that churches enjoy significant credibility." The German Evangelical Church was key in promoting energy efficiency (Huber, 2007: 15-17). In Stellenbosch, attempts to meet with a collective body of religious leaders failed. The Rev. Leon Cronje of the Dutch Reformed Church (Uniting Reformed Church), Stellenbosch Welgelegen, stated that meeting with the other religious leaders of Stellenbosch would not be possible. Cronje (2009) reasoned that "I would have had SWH at my home already if it was not for the high upfront cost and I am not owning the home I live in. I do think that sustainable energy must be exploited and SWH in SA is a must. If government and local government can help every home to employ SWH and subsidise the cost it would be best. In short – I am all for it – but one must also investigate other sources of sustainable energy to reduce the carbon footprint we leave behind.” Cronje reveals lack of a collective religious structure in Stellenbosch, property ownership and a need to create working partnership and programmes to enforce an integrated response to the challenges of historical racial divisions and sustainability purposes. The integration of social, economic, environmental and institutional support is a prerequisite to build sustainable responsive actions. Cross (2008: 2), quoting the government discussion paper, Toward an anti-poverty strategy for South Africa, states: “Alongside various measures to invest in human capital and service infrastructure, the strategy document identifies the housing asset as indispensable to economic participation for the poor. Access to assets – particularly housing, land and capital including public infrastructure, both to improve economic and social security and to provide the basis for economic engagement in the longer run (GCIS 2008).”

5.5 POLITICAL WILL AND LOCAL MUNICIPAL LEADERSHIP

SWH systems alone cannot improve the quality of life, especially if small poor-quality units continue to be imposed on the households concerned, as has been done with the RDP houses. The 2012 UN Report reported that the global community was behind the schedule to ensure food security, water and energy supply to meet the needs of a fast increasing population to avoid subjecting up to 3 billion people to poverty. Endeavours towards sustainable developments are inadequate and lack the necessary political will (Reuters, 2012).

5.5.1 Economic investment benefits

Strong political will has the potential to open new opportunities for local and foreign direct investments in SWH manufacturing, installation, educative marketing and financing. The SWH project of Stellenbosch missed opportunities. Such opportunities include the following: Enabling policy regulation and incentives can, and will, lead to new emerging SWH manufacturing facilities to induce, and stimulate, strong competitive SWH industry. Solardome SA has already indicated intentions to halt its manufacturing sector, and to deprive more than 20 employees and families of an opportunity to improve their lives. Solardome SA indicated that enabling policy was very key to enhance SWH markets. SWH market estimated growth is R1.5bn to R2bn per year over the next four years, and it will create about 100 skilled manufacturing employment and 50 to 100 green sustainable jobs in the distribution and consumer support sectors (Creamer, 2010a). Some municipalities that managed to stimulate great innovation and local economic development through integrated strategic approaches internationally, have established local economic development agencies (LEDAs). Some South African municipalities have followed suit to stimulate economic growth, jobs and SMMEs advancement (Blaauw, & Pretorius, 2005). The local Economic Development Unit of Stellenbosch Municipality is starting to move towards embracing the need to have Local Economic Development Partnership (LEDP) that will be helpful in coordinating and enhance investments opportunities in the greater Stellenbosch (Gosa, 2011)

The above stated developments actually need to marry SWHs with housing. Trevor Manuel the former Minister of Finance of South Africa who became the Minister in the Presidency after 2009 national elections and now is heading the National Planning Commission under President Gedleyihlekisa, Jacob Zuma administration had this to say during the 2008 energy crisis. “We have an opportunity over the decade ahead to shift the structure of our economy towards greater energy efficiency, and more responsible use of our natural resources and relevant resource-based knowledge and expertise. Our economic growth over the next decade and beyond cannot be built on the same principles and technologies, the same energy systems and the same transport modes, that we are familiar with today” (Manuel, 2008: 14).

5.5.2 Winelands Economic Development Agency

The political leadership, relevant municipal departments and SU can mobilise resources to our LEDA to foster new sustainable interventions through designing and establishing a key economic development agency for improving the quality of life. The authorities may have to consider putting in place a broader scale green LEDA, and call it the Winelands Economic Development Agency (WEDA), which could pull together different LED officers, research and academic education institution experts, relevant private sector individuals, and civil society. The challenge to overcoming poverty and sustainable LED problems should not be left in the hands of fragmented entities. Instead, responding to such a challenge requires the performance of joint collaborative actions by a diversity of stakeholders, including research institutions and various stakeholders from the local communities, public and private sector. The WEDA or LEDP really refers to the same body required to transform the local economy. In October 2011, the Minister of the DTI, Rob Davies, stated that the Energy Efficiency regulations would be enforced for the first time in South Africa in terms of a requirement that all new buildings, including residential and industrial buildings, hotels and schools, should satisfy minimal energy efficiency requirements. After November 2011, all new buildings and refurbishments have had to comply with energy efficiency standards, as stipulated in SANS 10400 part XA. The DTI is of the view that the above green mandatory policy standards will stimulate the local content manufacturing sector and economic development to create 18 000 sustainable green jobs to alleviate poverty and to improve the quality of life (DTI, 2011).

5.5.3 SWH on LED

The evidence presented above does not seek to dispute the fact that SWH can, and has, a major role to play in contributing positively towards the improvement of quality of life, but highlights cases where some SWH promoters tend to overstate SWH benefits for narrow, profitable purposes. Essentially, the present thesis has noted that, although the majority of Stellenbosch residents have declared to trust the Church more than any other institution (Jacobs et al, 2005: 5, 11)**,** the reality is that the Church is equally fragmented, remains passive on many issues and seems to be incapable of assembling to reflect on common socio-economic challenges (Cronje, 2009).

In an ideal world, a strong collective religious structure should make its presence felt in most spheres of life. Table 5.2 below represented a typical of how community participation and LED workshops were handled in Stellenbosch. The SWH systems in terms of future LED strategy will become a matter of strategic plan consideration. Improving quality of life requires creative innovations and enhanced insights into how to ensure policy for the development of green economy. The LED feedback report in 2011 has acknowledged green economy as an opportunity with vast potential to enjoin SM with diversity of stakeholders to trigger transformative initiatives. SM (2011: 5-6) realised that “promoting robust and inclusive local economies requires the concerted, coordinated action of all spheres and sectors of government centred on the application and localisation of the principles espoused in the National Spatial Development Perspective (NSDP). “Locally owned appropriate solutions and strategies must emerge to support national frameworks in both rural and urban local spaces and should promote sustainable development and sustainable human settlements. Stellenbosch, like the rest of South Africa, competes in a global and increasingly integrated process whose threats must be minimised and whose opportunities must be exploited” (Stellenbosch Municipality, 2011: 5-6). Lynedoch is home to the SI and SU, who have worked as partners over the years to promote applied sustainability research and efficient resource usage Annecked & Swilling, 2006).

5.5.4 SWH life-improving business opportunities

Inaction in many instances leads to missed investment and economic opportunities that could stimulate new growth and some jobs to enhance unemployment reductions and some poverty relief. SWH life-improving business opportunities can be harnessed in the following areas:

- Local skills, engineering and semi-skilled artisans in various SWH manufacturing.
- SWH unit assembly and SWH installation with three to four people per installation.
- Accounting and administration, management, and SWH retail sales. Technical, maintenance functions and SWH benefits for local hotels including commercial buildings, hospitals and schools, more businesses could emerge due to substantial financial savings achieved. Enhancement of tourism, hotels and resorts in hot climates extend swimming- pool seasons or tourists visitation (Kaufmann & Milton, 2005: 15).

Table 5.2: Researcher involvement and participation, 2010–2011

Participation	**LED**	**Outcomes**
Municipal budget draft meetings are driven by compliance with Municipal Systems Act and Public Finance Management Act, requiring designing of IDPs and budget drafts. Three Khayamandi wards were combined to meet on 18 May 2010 in the very small Legacy Hall, which was overcrowded. The meeting was chaotic and broke out into a number of fights. The SM budget allocation for SWH installations and what plans were in place to implement the green industrial economy were considered. On 20 May 2010, in the Town Hall, it was stated that the SWH rollout was Eskom's responsibility, and not that of the Municipality (Zwane 2010). In June 2009, Unilever and WWF organised a stakeholder meeting to highlight that Africa was a water-scarce continent and that sustainable interventions to manage both water and energy supply were important for business growth. The discussion conducted was also enhanced during the three-day Sustainable Water Conference in August 2009, Nairobi, Kenya. Source: Author, 2011.	The LED unit coordinated stakeholder workshops in 15-17 March 2011 and held a Conference on 15 April 2011 to formulate the LED Strategy for Stellenbosch. The researcher attended the stakeholder workshop for business and finance which was held on 16 March 2011 at the Stellenbosch Lodge.	A group of people was identified, the researcher was one, to assist in the process to ensure that all critical points were well captured in the LED Strategy. *Supporting Local Economic Development In The Greater Stellenbosch Area, Feedback Report of Stakeholders Engagement Workshops, March–April 2011* was released in July 2011.

Stimulating local economic development (LED) involves practical programmes and action plans, our local SWH rollout programme lacks strategic public awareness. The government of Brazil introduced a national programme called "Minha Casa Minha Vida" which means in English "My Home My Life" and it means in isiXhosa "Ikhaya Lam Ubomi Bam". In most SWH projects promoters of SWH installations have no mind capturing slogans. The Western Cape housing backlog of 400 000 units captures socio-economic imbalances. "Before 1994 the apartheid government dictated that black people have a homeland where they would own land and houses, and would only temporarily live in Cape Town to provide labor to white owned businesses" (ESMAP, 2012: 2). In ESMAP, (2012) isiXhosa is viewed as dominant language of the Eastern Cape overlooking the fact it is the second dominant language in the Cape. Tables 5.2 & 5.3 shows joint gatherings that could result to transformative programmes of action just like the strategic stakeholders collaborations captured above and below.

Table 5.3: Municipal areas with active SWH programmes, 2011	
• Nelson Mandela Bay Metropolitan • Tshwane • City of Cape Town (Kuyasa Project) • City of Johannesburg (Cosmo City) • Saldanha Bay Municipality has created an environment to induce private sector driven investment worthy of R83bn on SWH, wind-turbine manufacturing, on Smart town, and creation of 40 000 jobs over 20 years investments (Van der Merwe, 2010c). • Mossel Bay and Theewaterskloof • EThekwini and Ekurhuleni	
Municipality	**SWH target 2015**
Nelson Mandela Bay (NMBM)	60 000 SWH
Kuyasa Project	2039 (completed in September 2010)
City of Cape Town (CCT)	300 000
City of Johannesburg	150 000
Saldanha	6000 (low- to middle-income households)
eThekwini	60 000 (Low- to high-income households)
Ekurhuleni	7000 by 2011 (R500 million allocated)
Source: SWH Targets & Funding – South Africa.	

The above-stated municipalities have understood that SWH industry has increasingly become a major focal point of investment, and any local government that is serious about improving the quality of life and sustainable job creation should have a policy design framework to enhance the market. Saldanha Bay Municipality represents such a profound potential of sustainable energy industry through its 20 years envisaged R83bn investment on SWH and wind turbine manufacturing, smart town and 40 000 jobs creation (Van der Merwe, 2010c).

5.5.5 Logical approach for SWH municipality-led action

The most logical approach for SWH municipality-led action is first starting with identifying capable research personnel or institution to undertake careful energy audit to identify holistic potential for energy efficiency measures, and put action plans. The rationale behind such an undertaking should be to assess patterns of energy consumption and energy inefficiency, with a view to recommending primary sustainable energy targets to help reduce inefficiency while addressing serious discrepancies on energy consumption patterns and enhancing job creation. An average middle-income household consumes about 774 kWh per month, compared to most low-income households that tend to consume 274 kWh per month, as was stated in subsection 2.12.3 above. Energy is no longer only to be viewed in terms of access, but also in terms of consumption to improve quality of life. Those responsible for devising the free basic electricity policy of 2000 have been accused of deliberately keeping poor communities indigent by limiting the energy supply. Low-income communities easily become targets for abusive and self-centred profit makers, because there is always a need for transformative programmes to improve human life quality. The experiences of those involved in the Kuyasa, Zanemvula and Winterveld SWH Projects reflect both the progress and setbacks made in the South Africa SWH rollout programme, and isolated SWH rollout projects. Kuyasa Project has resulted in partial documentation of the history of apartheid, and new democratic South Africa under the auspices of African National Congress (ANC) led government before and after 1994. The apartheid regime placed Africans in the homeland reserves. “Since 1994, the African National Congress (ANC) government in promised South Africans a “better life for all” that included adequate housing, access to water, electricity, sanitation, education, health care, decent transportation and economic opportunities (ESMAP, 2012: 2) and access to land.

5.6 RECOMMENDATIONS

It is clear that SWH interventions have correctly or wrongly drawn attention of a diversity of people to pave the way for a transition to enhance real growth of sustainable energy systems. In a world characterized by inequality, poverty, unemployment, and ever increasing concerns regarding climate change, sustainable energy is seen as means to enhance sustainability goals. It is widely understood with shared consensus that fossil fuels are finite resources and action is necessary to trigger an integrated approach adopt renewables and cut our carbon emissions. The examples of international solar ordinances and other renewable energy policies that were stated to earlier included SWH projects in Winterveld in Pretoria, Wallacedene, Mfuleni, and Kuyasa in Cape Town, and Zanemvula in Port Elizabeth are all very symbolic interventions. It is through symbolic interventions that we come to get a mirror through which we can start reflecting and critically engage our minds to appreciate their beauty and mammoth problems. Although not so very perfectly as some would have wanted them to be, all these above SWH projects represent in their respective ways a proud initiative before or following 2002 WSSD. They represent an element of a rare unity of purpose to trigger a knowledge building activity. It's fair to acknowledge that without all imperfect SWH projects there would be no basis for arguments advocating for more contextualized realistic and less exaggerated SWH benefits.

For SWH market demand to grow municipalities must lead actively. Our recommendations are outlined below to reducing exploitation and enhance interest by means of the following:

- Demonstrating political will and leadership to promote SWH rollout in Stellenbosch and unleash its vast opportunities for a green economy (Stellenbosch Municipality, 2008a: 39). What is lacking is a well-designed and coordinated implementation plan.
- Energy service Companies (ESCOs) can be appointed to facilitate the implementation of energy-efficiency in partnership with local authorities (Fakir & Nicol, 2008: 13).
- New Growth Path is premised on promoting sustainable energy and energy efficiency measures must become part of all municipalities integrated development plans (IDPs).
- Any municipality that embraces a visionary LED in mind should start to consider very seriously the establishment of a Local Economic Development agency. In the present case, such an entity could be called the Winelands Economic Development Agency.
- The joint action with communities can lead to SWH revolution as in Saldanha Bay.
- The appointed service provider should be mandated to make sure that among many other important things they must do, relevant and basic information on SWH systems, and energy efficiency is provided in local spoken languages to various communities.
- Making SWH information available in local spoken languages means among other things translating English material into, and producing it in Afrikaans, and isiXhosa.
- Building human capacity and infrastructural capability requires skills and finances.
- SWH savings are not the only incentives and SA is putting mandates on the agenda.

It worth reiterating again what Manuel said during his last February 2008 Budget Speech as Minister of Finance of South Africa, when the country grappled with its severe energy crisis. "We have an opportunity over the decade ahead to shift the structure of our economy towards greater energy efficiency, and more responsible use of our natural resources and relevant resource-based knowledge and expertise. Our economic growth over the next decade and beyond cannot be built on the same principles and technologies, the same energy systems and the same transport modes, that we are familiar with today". Surely such a profound shift from conventional fossil fuels to renewables and efficient resource usage will not only depend on political will, but on joint will of stakeholders to drive Stellenbosch Renaissance by actions. SWHs and a need for improved sustainable shelters can be used to effect its transformation.

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APPENDIX 1: THE LIST OF INTERVIEWED KEY STAKEHOLDERS IN 2009

	INTERVIEWEE	PLACE	DATE	ORGANISATION
1.	Rev. David Hunter (Presbyterian Church)	Stellenbosch	04-02-2009	United Stellenbosch Church
2.	Rev. Jan Van Zyl (DRC)	Stellenbosch	16-03-2009	Mother Church
3.	Rev. Charles Ndlebe (Anglican Church)	Khayamandi (Stellenbosch)	02-09-2009	Ministers' Fraternity
4.	Rev. Leon Cronje (e-mail)	Stellenbosch	08-09-2009	Mother Church (DRC Stellenbosch Welgelegen)
5.	Imam Shaakier Vermeulen	Stellenbosch	09-02-2009	Gujjatul Islam Jamaat Stellenbosch
6.	Yeki Msomothane	Stellenbosch (delegated by Municipal Manager Office)	07-07-2009	Municipality (Manager: Stakeholder Relations)
7.	Andrew Crouzer	Stellenbosch	21-07-2009	Municipality (Building Development Manager)
8.	Bernabie de la Bat	Stellenbosch	21-07-2009	Municipality
9.	Riaan Honeyborn	Somerset Western	31-03- 2009	ITS
10.	Franz Kahle (Deputy Mayor)	Germany (Marburg)	27-05-2009	Marburg Municipality
11.	Andrew Janisch	Westlake (Cape Town)	07-04-2009	Sustainable Energy Africa (SEA)
12.	Riaan Meyer (e-mail)	Stellenbosch	26-02-2009	Centre for Renewable and Sustainable Energy Studies (CRSES)
13.	Duncan Palmer (e-mail)	Stellenbosch	03-03-2009	CRSES
14.	Krige Dolf	Stellenbosch	27-10-2009	SU (Property Services)
15.	Nombulelo Zwane (delegated by manager: Joseph Hames)	Stellenbosch	26-02-2009	Municipality (manager of operations and electricity planning)
16.	Leon Jansen (e-mail)	Cape Town	06-08-2009	(Building Developer)
17.	Derek Moss	Stellenbosch	16-09-2009	Denis Moss Partnership (Developer)
18.	Dawie Thirion	Paarl	01-10-2009	Xtreme Hot Water

				Cylinders
19.	Frank Spencer	Stellenbosch	20-03-2009	Cape Town (Alte Technologies)
20.	Thembani Bukula (Nersa)	Johannesburg	11-03-2009	Nersa
21.	Carl Wesselink (Kayasa CDM Project)	Khayelitsha (Cape Town)	30-03-2009	South South North (SSN)
22.	Jim Hickey	Pretoria	13-03-2009	Solahart
23.	Nuriel Hurwitz	Pretoria	11-30-2009	Suntank
24.	Brennen February	Stellenbosch	23-09-2009	Solardome
25.	Wouter Roggen	Cape Town	07-04-2009	CCT
26.	Jan Vivier	Stellenbosch	29-10-2009	Khayamandi (Resident)
27.	JC Anthony (ANC Councillor, Mayco member)	Stellenbosch (Klapmuts)	09-09-2009	Ward 19 (attended by 26 community members)
28.	Widmark Moses	LED	27-09-2011	Stellenbosch Municipality
29.	Dr Anna Pegels (Germany, Bonn)	Pretoria and Bonn	12-03-2009 & 29-05-2009	German Development Institute (GDI)
30.	Dr Andreas Stamm (Germany)	Pretoria and Bonn	13-03-2009 & 27-05-2009	German Development Institute (GDI)
31.	William de Villiers	Blackheath (Cape Town)	11-09-2009	Mellon Housing Initiative (MHI)
32.	David Carolissen (housing)	Stellenbosch	22-06-2009	Municipality(director: integrated human settlements)
33.	Prof Dieter Holm	University of Pretoria, Pretoria	04-03-2009	Sustainable Energy of Southern Africa (SESSA)
34.	Stefan Wagner (e-mail)	Bonn (Germany)	06-06-2009	City of Bonn (International Affairs and Protocol Department)
35.	Dawid Botha (DA councillor: e-mail)	Stellenbosch (Ward 06)	05-08-2009	Municipality
36.	Riaan Honeyborne	Somerset West (Cape Town)	31-04-2009	International Technology Sourcing (ITS) Solar Division
37.	Fred Brown	George	03-12-2009	
38.	Martin Albertus	Cape Winelands District Municipality,	29-09-2011	Represented the Department of Environmental

		Stellenbosch		Affairs official at the Cape Winelands District Municipality (CWDM)

TABLE A1: SWH ROLE-PLAYERS

Which SWH role-players were actively involved in the SWH industry and what kind of obstacles prevented SWH market growth in South Africa, and necessary solutions?		
SWH Company interviews	Places	Responses
Solardome SA (Brennen, February 2009) Anthony Adriaans of Sunflare Renewable Systems also believes that the SESSA is biased in favour of SWHs and neglects the serious promotion of PV Systems (Andriaans, 2009).	Stellenbosch, Western Cape	Solardome SA has over 40 years in the SWH industry. Competes with the Solartech in Somerset West, Xtreme Geysers in Paarl, Cape Town based Suntank distributors, and Solar Heat Exchangers. Mainly importers from Australia, China, and the UK. Local manufacturer of high-quality copper-made solar flat-plate products, costing as little as R15 000 per unit. Sizes range: 100 L, 150 L, 200 L, 300 L and 500 L (per request). Lifespan of each solar unit: 25-30 years, with five-year guarantee. Over 30 employees. R3000 per month for SESSA membership. SABS charges about R100 000 to test each unit, and systems cost about R400 000 to test. The testing process takes too long, due to limited capacity and testing facilities. An accredited Eskom supplier with SABS approval mark, which takes 18 months of waiting to acquire. Chinese low-cost solar products are tarnishing the SWH industry due to poor performance. Positive about the creation of SWH market demand through a SWH by-law.
Xtreme Geysers (Dawie Thirion, 2009)	Paarl Stellenbosch, Western Cape	More than three years' experience in the SWH industry. Produce solar storage and absorbent panel systems to supply various customers, including Kuyasa Project. Produce as small as 55 L up per unit at R6000, with five-year guarantee. Lifespan of solar storage is 15 years. Employees: 32 permanent and 22 casual workers. An accredited Eskom supplier with all the necessary requirements. Not positive about a SWH by-law, considering it a waste of resources. "While you people are busy wasting money on research and talk shows, we are doing it." Need more control over Chinese imports, through SABS & increased import tariffs. SESSA is dominated by business import interests at the expense of local products.
Suntank (Neriel Hurwitz, 2009)	Pretoria, Gauteng	Over 17 years in the SWH industry. Produce flat-plate solar panels that cost R14 500 up. Some

		distributors in Cape Town. Over the years, mainly relied on exports to keep the business going, e.g. Namibia, Botswana. It has 35 employees, unskilled and skilled workforce, and research and development (R&D) department. National mandatory policy is lacking and is required to expand the SWH markets.
Solahart (Jim Hickey, 2009)	Johannesburg, Gauteng	More than 26 years of high-quality flat-plates importing from Australia. Lifespan from 15 to more than 20 years. Distributing agents in Cape Town and in countries like Namibia and Botswana. Each SWH costs R17 000 to R35 000, depending on size. Solahart is an accredited Eskom supplier.
International Technology Sourcing (Riaan Honeyborne, 2009)	Somerset West, Western Cape	Importing quality material, mainly evacuated tubes, from China, which have assembled in South Africa from 2006. Ten-year guarantee. Each SWH costs: R6000 – R8300 upwards. Various sizes. Accredited Eskom supplier and member of SSESA.
Common features SWH experts agree with most of the information provided here, adding that financing aid, an integrative incentive system and flanking measures will help to address the shortfalls (Janisch et al. 2009).	All SSESA affiliates. Local SWH manufacturers, including some importers, are concerned about Chinese cheap solar panel imports. Such imports do not last long enough, and their poor performance gives the SWH industry a bad name and compromises the trust of most customers. Negative effects of the global financial crisis were also shared, because the crisis made business slow down. They mainly advertised their products electronically, with some doing so in local newspapers. Payback period depends on customer choice and use of SWHs, and could be longer than five years. All concerned about the skills shortage, and provided training to some plumbers to become distributors and SWH installers and maintenance services after installation. Explained that SWHs are divided into two main systems: direct systems, which are suitable for freeze-free areas, such as Cape Town, and indirect systems, which are suitable for such areas as Gauteng that are subject to frost. It is better to design and to pla SWH use from the beginning of building structures to ensure that they are north-facing to harness optimum sunshine. The performance of SWH unit also depends on proper roof-pitch orientation and installation. All felt that mandatory policy and increased financial incentive can help (Honeyborne *et al*, 2009).	

Does Stellenbosch community know about the benefits of using the renewables and availability of locally produced solar panels? Yes & No (Hunter *et al*, 2009). Partially yes, a few people do know, although the majority of community members might not know.

TABLE A2: INTERVIEWS WITH KEY COMMUNITY LEADERS

Individual Interviewee	Responses	Solutions
Jan Vivier, 2009, Interview	Yes	Require political stability and firm policy incentives: tax relief for those using green systems. Penalise excessive use of coal-fired electricity: more tax or a fine. Inspired Evolution investors raised R1bn to buy 25% of shares for existing renewables businesses. Targets: 40% or 50% must come from renewables, like wind energy and solar thermal system, e.g. SWHs.
David Hunter, 2009, Interview	Yes	Renewables are not part of my expertise, but the Church is blessed with skilled and unskilled people. Various academics, professionals and unskilled people can support green programmes. There is potential to enhance holistic stewardship to balance caring for povertystricken and all human needs, as well as ecological safety.
Jan van Zyl, 2009, Interview	Yes	Renewables fall outside the area of my expertise, but some people, who can afford to stay in homes valued at millions of rands, can afford SWHs. There should be financial incentives to help the poor, including middle- to low-income households. SWHs should be used to bring hope and joy to the people of God. “May the God of hope fill you with all joy and peace as you trust in him so that you may overflow with hope by the power of the Holy Spirit” (Romans 15: 13). Then he stated that, in this context, reference is made to “a theology of the God of green hope”.
Shaakier Vermeulen, 2009, Interview	Yes	Admitted knowing little about renewables. Even though energy crisis remains problematic, there is nothing much happening to raise awareness about energy efficiency by local authorities. Anything that could help to reduce electricity costs and to help reduce electricity consumption is welcomed. But, seeing that SWHs are seen as expensive, a policy provision should ensure that the poor and middle income will be assisted to be able to install them. SWH material should be provided in Afrikaans (69.4%) and IsiXhosa (19.8%) to

		ensure that locals read and know of its benefits.
Charles Ndlebe, 2009, Interview	Yes	The main concern is the Church is fragmented and fails to make interdenominational structures work. Talks about reducing climate change, including use of SWHs, but we still have limited knowledge of it. We all need alternatives to help reduce costs in all walks of life. Hence, the SWH by-law should make financial provisions for all to benefit from using SWHs. It should ensure that the SWH information material is distributed in local vernacular languages as well.

APPENDIX 2: THE CITY OF MARBURG SOLAR ORDINANCE

The German Development Institute (GDI) conducts research in the developing countries, and delegated five young professionals, led by Dr Andreas Stamm, to visit South Africa in 2009. The purpose was to conduct research into South Africa's innovative system and its contribution to more sustainable development patterns. Case studies have been conducted on the forestry/wood value chain, renewable energies, and hydrogen/fuel cells technologies. In February 2009, they arrived in Stellenbosch and met four students from the Sustainability Institute, of which I was one, whose masters theses were in a similar area, renewables, and discussed ways of cooperating, where possible.

Opportunity to Visit Germany

The bulk of the GDI's research was conducted in Gauteng, the Western Cape, the Eastern Cape and the North West. They interviewed and contacted other key stakeholders in the energy and renewable energy sector via Prof. Wikus Van Niekerk, the director of the Centre for Renewable and Sustainable Energy Studies (CRSES) from Stellenbosch University (SU). They spent three months in South Africa. Sasha le Granje and I managed to join the team in Pretoria to assist with the interviews, and I spent five days taking part in such interviews. As an incentive for cooperation and for maximising the benefit to be gained from a learning opportunity in relation to their experience of promoting renewables, an invitation was extended to two students to visit Bonn, Germany. Sacrificing time to visit Germany, Bonn, I had the chance to visit the City of Marburg, Germany to hear about its solar ordinance. I initially saw information regarding the adoption and approval of a solar obligation by Vellmar Municipality on the Internet,. When the opportunity to visit Germany arose, I was keen to visit Vellmar, but efforts to secure an appointment were fruitless. However, Stamm successfully secured me an appointment in Marburg.

City of Marburg

The Solar Ordinance of the City of Marburg, which is home to about 80 000 inhabitants and which is one of the oldest cities in Germany, has drawn some global attention as being a typical model for environmentally active politicians. The city lies "halfway between Frankfurt on the Main and Kasel in the German state of Hesse. The city has origins dating back to the first millennium" (Lepsto, 2008). An appointment to interview the deputy mayor of Marburg, Dr Franz Kahle, a member of the Green Party, was secured on 27 May 2009 in Marburg, Germany. Dr Andreas Stamm from GDI and I met him in his office. The Solar Ordinance copy was available in German only, and hence I did not access it.

1. Main Driving Forces

The main driving forces of the Solar Ordinance include environmental security and a cutting dependence on imported energy, oil and gas from Norway and Scotland, costing €120m per annum. The deployment of solar panels could save up to €40m, stated Kahle. Mitigation of rising fuel prices should ease the pressure caused by the fuel price on most low- and middle-income citizens to avoid social uprisings and riots. Above all, in the light of the depletion of oil and nuclear resources and global climate change, the Council asked: "How will we get energy for heating and cooling in the next 50 to 100 years?" But, due to vehement opposition, the Solar Ordinance was suspended.

2. Target Buildings
The local City Council in June 2008 resolved to institute a solar ordinance, making it compulsory to install solar panels, initially targeting new buildings and later including existing buildings undergoing major renovations. However, Marburg City is an old rural town, and no more buildings are being developed. Therefore, the decision to enforce solar panels had to includethe existing buildings in order to be able to make a significant impact, in terms of reducing energy consumption and mitigating domestic fuel imports from Norway, Scotland and other places, stated Kahle. "If the Marburg City Council gets its way, Marburg will be the first city in Germany to legally require solar collectors on rooftops of private and commercial buildings. The goal of Franz Kahle, Green Deputy Mayor of Marburg: No south-facing roof shall be left unused" (Lepsto, 2008).

3. Implementation Mechanisms
The environmental resources department, under the auspices of Kahle, is responsible for ensuring that the ordinance is enforced and that implementation mechanisms are in place. The developer must show, during the tender application process, that solar panels will be installed for both water heating and space cooling needs. When the developer fails to show conformity with the solar ordinance, the application shall not be approved. The construction industry and plumbing sectors are the main implementers of the deployment of solar panels and continuous compliance assessment is done by qualified building inspectors.

4. Quality Assurance and Payback Period
All solar panel product producers and importers should conform with Keymark Voluntary Certification, requiring acceptable European standards. The payback period depends on how each household uses its solar panels, and could be more or less than six years.

5. Price and Incentives
The price for solar panels, for heating and cooling is estimated at €4000 to €8000 per SWH unit. The local manufacturing companies have special incentives for their own clients, while solar rebates are made available from as little as €250 to €3000. Initially, there was no local incentive allocated and later the standard local council incentive was added, offering €250 to enhance compliance.

6. Penalty for Non-compliance
Penalty for non-compliance ranges between €1 000 and €1 500, when and if the perpetrator is found guilty. However, the aim is not to take money from the people unnecessarily, but to enforce compliance with the ordinance. The person in question receives a six-week warning period, after which inspectors return to check the situation, and, if nothing has changed, without valid reasons for non-compliance being given in writing, the City Council installs the unit, for which it claims payment.

7. Green Dictatorship
The solar ordinance was meant to be effected on 1 October 2008, but was stopped by the district municipality in Giessen, because some claimed that it was infringing on the owners' property rights.The regional government prohibited the enforcement of the solar ordinance policy for legal reasons. They charged that there was no legal basis for the solar ordinance. "Marburg is already a leader when it comes to the use of solar energy" achieved on a voluntary basis, and should not become a "green dictatorship" (New York Times, 2008). The ordinance became politically contentious and created a platform for playing out a strong legal

battle between the Green Party (Marburg City Council) and the opposition, supported by the district municipality. Kahle stated that, if need be, the matter would go to the courts.

APPENDIX 3: THE CITY OF BARCELONA SOLAR ORDINANCE

The City of Barcelona, which is the capital city of Catalonia and home to more than 1. 6 million people, is known as the second largest city in Spain (Pujol, 2008: 2). According to Droege (2008: 447), "The City of Barcelona Solar Ordinance is a product of many role players, who include local NGOs working on energy efficiency, interested local companies, willing political force, experts and affected citizens, architects and the municipal decision-makers. The municipal elections of 1995 in Barcelona resulted in a new coalition and a Green Party candidate was appointed for the first time in the city's history. The new government was based on a political agreement that included the creation of a new post, the Sustainable City Councillor and the commitment to push programmes for the development and diffusion of renewable energies. Also the 1996-1999 Municipal Plan included a series of concrete measures to make possible the use of the solar energy in the city."

The Barcelona Solar Ordinance was approved in July 1999 and was enforced in August 2000. It was revised, amended and approved in February 2006. It turned out to have a positive impact on international sustainability. It inspired other municipalities in Spain, the r est of Europe and worldwide (Pujol, 2008: 2). "The ordinance was prepared and approved thanks to the political will of the local administration to promote solar thermal energy in Barcelona" (Pujol, 2008: 2). It was designed to harness Barcelona's 28 000 average hours of radiations per annum. The legal framework differs from one city to the next and should be informed by context and local needs (Pujol, 2008: 2).

1. Solar Ordinance's Initial Target

The Solar Ordinance required that all new buildings and buildings undergoing major renovations using more than 0.8 MW a day to heat water must meet 60% of their hot water needs by means of solar thermal collectors. The Ordinance, which was revised and approved in February 2006 so as to abolish the 60% limitation, was applied to the above-stated buildings, regardless of their use and size. The 55 projects included policy regulations, financial incentives, training and public awareness, as well as education programmes (Lipschutz, 2009; Pujol 2008: 2).

2. Solar Ordinance Management

The Barcelona Energy Improvement Plan (BEIP) and the Barcelona Energy Agency (BEA) were two key management mechanisms to ensure proper and effective implementation. The BEIP reflects on energy policy regulations, assesses necessary interventions and their implications for a sustainable environment to advise the City Council and that the BEA ensures the planning and implementation of projects (Lipschutz, 2009).

3. Regulation Scope

The regulation scope applies to: a) new buildings or constructions; b) buildings with major renovations; c) building or buildings whose use shall be transformed. It needed to reduce reliance on the following fuels; oil, propane and natural gas. The regulation mainly applies to the following buildings: sport and health facilities, residential and commercial buildings in special situations, and industrial buildings, if hot water is required and used. It implies any other use of hot water like bathroom, kitchen and collective laundries (Pujol, 2008: 4). It is managed by the Barcelona Energy Agency. Solar usage is an integral part of the education system, with children being taught about greenies (CRM, 2009: 10; Lipschutz, 2009).

4. Minimum Requirements

The design and planning phase must ensure that the orientation of buildings is prepared for solar thermal use. The building companies and architects were required to include solar thermal from the earliest stages of planning, to reduce the costs and the amount of time to be spent on installing them later (ESTIF, 2007: 38), if the use of buildings entails supplying hot water for homes, swimming-pools or the industrial sector. At least 30% of covered swimming-pools must meet hot water needs by means of solar thermal energy. Industrial sector needs must be met from an average temperature of 60°C, while open swimming-pools will only be permitted to meet their hot water needs by means of solar energy collectors. The households will meet their hot water needs, subject to demand of not less than 60%, with temperature levels of 60°C (Pujol, 2008).

5.Enforcement Measures

Before building activity can commence, all the building plans must comply with the ordinance to obtain approval. After that, the building inspectors will make continuous inspections until the building or buildings are completed to ensure true compliance with the ordinance. WEC (2007b: 26) cited Stirzaker (2004) as pointing out that any project owner, developer or building owner who failed to comply with the requirements of the ordinance might be liable to sanctions with penalties that may reach €3m (Pujol 2008). To conform with the European-crafted Keymark Voluntary Certification, the assurance must be given that the solar thermal products produced are of good-quality standard in order to curb the manufacture of substandard products. The ordinance is recognised by most European nations and facilitates the distribution of products and access to financial incentives without conforming to national standards (WEC, 2007a: 10-11).

6. Financial Assistance

Financial assistance, in the form of direct subsidies, was extended to the users of solar thermal, solar energy and PV systems. The assistance covered up to 25% of total installation costs (Droege, 2008: 447). It provided interest-free credits via the Public Credit Institute, which could cover up to 70% of the total investment and of European Investment Bank loans (EIB, 2010; WEC, 2007b: 20).

7. Exemption and Commencement of Enforcement

When it is proven that it is technically impossible to comply with the ordinance, such buildings will be exempted (Pujol, 2008).The solar ordinance was approved in July 1999 and enforced in August 2000. It gave an 18-month moratorium period for all stakeholders to abide with it (WEC, 2007a: 26).

9. Maintenance and Flanking Mechanisms

The SWH company that is responsible for installation is required to ensure that the maintenance is conducted in the first two years to monitor the performance of the solar collectors and to undertake some necessary repairs (Weiss, 2009: 9). Vast numbers of SWH installers, engineers, and architects were trained and gained practical experience with solar thermal technologies. The level of public education and awareness was raised to inform the local citizens and potential users about SWH systems. The solar ordinance was published in

Spanish and Catalan, accompanied by a short version in English (ESTIF, 2007: 36, 38). Publication of the ordinance resulted in SWH market growth in the first few years after its official application to all new buildings. The ordinance saw market penetration increased from 1.1 m^2 per 1000 citizens in Summer 2000 to 20.7 m^2 per 1000 citizens in December 2005, roughly equivalent to a 2 000% growth in more than 5 years (Barcelona, 2009: 4).

APPENDIX 4: DENMARK CASE STUDY	**APPENDIX 5: CALIFORNIA CASE STUDY**
KOLDING MUNICIPALITY	**CLEAN ENERGY FINANCING**
Kolding Municipality (KM) is home to about 88 519 people in Denmark. The total population of Denmark is 5.5 million. In 2001 the KM population was 62 245 and was growing faster than the total Danish national average. In 2008, the number of KM citizens reached 88 519. KM is found in the southern part of Jutland in Denmark, and employs 6000. The KM Plan of 1998–2009 incorporates obligations to abide by environmental considerations across a full range of initiatives, including municipal procurement, mostly enhancing its environmental efforts by means of environmental management, green planning and purchasing, and environmental monitoring measures (KM, 2004, 2008). The green procurement policy is focused on sole suppliers, in order to achieve the best results. All employees of the KM must comply with the green procurement policy. “Equally, the suppliers are expected to respect the intentions of the green procurement policy and agreements” (KM, 2004).	In California in the US, the approved Solar Water Heating and Efficiency Act of 2007 was meant to create a mainstream market for SWH technologies. It allocated US$250m of rebates to California consumers over the following ten years. The benefits to the state included the reduction of global warming and air pollution, the stabilisation of energy costs and the cutting of utility bills (http://www.environmentcalifornia.org, 21 June 2009). In 2009, the Berkeley Municipal Council approved a Clean Energy Financing system to give loans for property owners to install solar panels. The loans will be repaid over 20 years through the owners’ property-tax account. When the property is sold, the bond will be transferred to a new owner. Many have agreed that doing so will eliminate one of the main barriers to implementing energy-efficient systems: the upfront cost. The Council will raise US$1.5m for a pilot programme in about 50 homes and, if it is successful, it will be replicated in many hundreds and thousands of other households around the City of Berkeley (New York Times, 2008).

APPENDIX 6: CONSUMERS’ EXPERIENCES AND PERSPECTIVES ON SWH BENEFITS

The current appendix provides another view on SWH benefits from various consumers’ experiences and perspectives with a special focus on above low-income households. All three respondents interviewed occupied households that earned more than R3500 a month, and stayed in Stellenbosch suburbs, with one household from Hermanus. Michael Ravenscroft is involved in three split installations: (1) a flat-plate offline, feeding a shower, basin and kitchen at a holiday house; (b) a vacuum-tube collector online, feeding a bath, two showers, two basins and a kitchen at a holiday cottage, for three owners; and (c) a flat-plate online feeding bath, a shower, two basins and a kitchen in a retirement cottage (Ravenscroft, 2011).

SURVEY QUESTIONS	**HOUSEHOLD 1** Michael Ravenscroft	**HOUSEHOLD 2** *Julia Cain*	**HOUSEHOLD 3** *Esma Skinner*
1. When did you install SWH system at your home?	1992 (a), 2010 (b), 2011 (c)	November 2009	In October 2010 - we are 6 in our family
2. Is your SWH size 200 L or more, with an electric backup?	200-L offline (a), 150-L, with electric backup (b), 150-L electric backup (c)	150-L, with electric backup	We have 2 × 200-L, with electrical backup

3. Where and how did you get SWH installers? How can we improve SWH awareness?	Solardome, did own installation (a). Sonpower Hermanus (b) Atlantic Solar (c). Sad to say – increasing cost of straight electric heating, hitting the pocket, [solar heating] seems to be the only way.	Phillip heard Helmut, from Atlantic Solar, speak at a professional workshop at STIAS. Legislation can improve awareness of SWH.	We heard from our neighbours who used the same firm and we knew the owner personally. You see advertisements regularly in newspapers.
4. What is lifespan of SWHs and warranty?	Yes.	Not aware of lifespan and its warranty offhand - but probably have it somewhere!	Yes - we are.
5. What has been the main reason for family to decide to buy SWH system?	Economy and fear of consequences of alternative.	Because of both environmental reasons (bringing down family's carbon footprint) and because of rising costs of electricity.	To save electricity, as the prices per unit increased.
6. Can you still recall what was your average electricity consumption before your SWH? How much electricity reduction can you attribute to using SWH today?	No previous records.	We are a family of 4+. We have an outside room with its own normal electric geyser (that had a tenant in it but not now) + swimming- pool - so difficult to gauge ... If I look at electricity bills for Jan, Feb before and after the SWH - then following applies: - 2008 (Jan/Feb before SWH): 1021 per month (32.93 daily average) -2010 (Jan/Feb with SWH): 809 per month (24.51 daily average) -2011 (Feb/March with SWH): 969 per month (28.5 daily average)	We previously used around 1100 kWh per month and now around 760 kWh. I think all of the savings can be attributed to using the SWH.

7. How much financial savings are you achieving per month as the result of using a SWH system?	Significant, but difficult to give figures in the above cases.	With rising costs of electricity: 2008: R543 (summer) 2010: R723 (summer) 2011: R1040 (late summer month)	Around R400 p.m. at current unit prices
8. How much does your system contribute to improving quality of life in your household and sustainability in the broader context?	Peace of mind.	Improves awareness / appreciation of use of electricity; feel positively about using sun energy for water heating.	Because we have so many sunny days, it is really good to know that, especially in the summer, we use very little electricity to heat water.
9. Would you support approval of SWH by-law to enforce installation of SWHs in new buildings, and major renovations requiring hot water in the Greater Stellenbosch Municipal Area?	Yes.	Yes.	Yes.
10. Does promotion of SWHs have potential to stimulate LED through enhanced local manufacturing, distribution, marketing and installation and more within the greater Stellenbosch Municipal Area?	Yes, if import duty is added to products from overseas.	Definitely - yes.	Yes, definitely - we do have the expertise to do it ourselves and also to bring prices of the SWHs down

APPENDIX 7: INTERVIEWS WITH COMMUNITY RESPONDENTS

The questions asked ranged from wanting to establish how and when the SWH project in Mfuleni took place, to how many family members there were per household, the household income, their electricity costs, how they heated their water before they received SWHs, what difference using SWH made, how they paid for their SWHs, how often they cleaned the units, the size, the guarantee, and the lifespan of their SWHs, their involvement in the project, and how the SWH contributed to improving their quality of life. A similar mode of questions was followed and was altered to suit each unique community context. The list of ten or more households below indicates those households that were visited by prior arrangement, which worked out well in the case of the Kuyasa community, with Zuko Ndamane as the contact person, but did not work with other communities, to whom I decided to pay unexpected visits on the dates specified below. Initially, the plan was to organise ten principal household representatives at same venue, and to engage in collective discussions, but the arrangement did not work out as well as was initially planned. However, random visits worked well. The number of household family members was listed next to each respondent, and where the interviewees felt comfortable enough to share their average household income, such information was provided, with the same applying to electricity costs or savings. Some people felt more comfortable about sharing how much they were saving than they were about stating their average electricity consumption and costs. Some were simple not sure about the costs or savings involved.

MFULENI COMMUNITY RESPONDENTS @EXTENSION SIX, NKQUBELANI STREET, DATE: 4 SEPTEMBER 2011

	RESPONDENT'S NAME	COMMUNITY NAME	ADDRESS
1.	**Valencia Xhono**	**Mfuleni community** (5)	**6569 Nkqubelani Street**
2.	**Albert Mkatu**	**Mfuleni community (**4)	**6568 Nkqubelani Street**
3.	**Thembisa Mpuluseni**	**Mfuleni community**	**8866 Nkqubelani Street**
4.	**Nosive Mnquma**	**Mfuleni community**	**8868 Nkqubelani Street**
5.	**Xolile Mpokeli**	**Mfuleni community**	**8869 Nkqubelani Street**
6.	**Nowakhe Manyathi**	**Mfuleni community**	**8870 Nkqubelani Street**
7.	**Nomawethu Jonase**	**Mfuleni community**	**6838 Kwelerha Street**
8.	**Sylvia Saula**	**Mfuleni community**	**6449 Geba Street**
9.	**Thembinkosi Bomvana**	**Mfuleni community** (4)	**8877 Nkqubelani Street**
10.	**Lizo Velaphi**	**Mfuleni community**	**6399 Nkqubelani Street**

HOUSEHOLDS WITH SWHs: MFULENI COMMUNITY

The ten households with SWHs in Mfuleni community were mainly found in Nkqubelani Street. The bulk of the households had Xtream SWHs that had been installed with the help of Nail Mellon Township Trust's Mellon Housing Initiative (MHI) that is aimed at providing decent homes to those who were previously staying in shacks, some of whom had had access to electricity and others not. The Initiative was mainly driven by Irish people, working together with South Africans, including William de Villiers in Blackheath, and local and international volunteers building houses in Mfuleni. Since 2003, those concerned have helped to create new townships in Wallacedene in Kraaifontein, and in Polarpark in Paarl eMbekweni. The houses concerned are much better built than are most low-cost houses in the Western Cape. Their roofs are covered with red tiles and are fitted with ceilings, SWHs and insulation. The homeowners also have the option of choosing the paint colour for their own home. The combination of all the above helped to improve the thermal performance of the houses, and reduce the need for heating (De Williams, 2009; Nail Mellon Town Trust).

In Mfuleni, **Valencia Xhono** lives with her husband and three children. Her husband earns less than R3500 per month, and, on average, they spend about R150 on electricity per month. The realisation was immediate that asking Xhono, and any other homeowner in Mfuleni, when their SWH was installed would be inappropriate. “The entire house was built by Sibanye Project and when it was completed it was furnished with SWH, and ceiling free of charge in June 2011 ... Sibanye Project was also busy working in Site C near Khayelitsha township, building similar houses” (Xhono, 2011). Xhono explained that SWHs did not work efficiently on overcast and rainy days or in winter. “The installation of SWHs is not a new thing, Kuyasa community started using SWHs long before Mfuleni community” (Xhono, 2011).

The Lizo Velaphi household consists of 3 members, and they live in 6399 Nkqubelani Street, Extension 6, Mfuleni. The house was built and furnished with a SWH in July 2011. The single mother is jobless, and lives off selling chips, sweets and fruit. They spend about R200 on electricity per month. Their SWH is an evacuated tube, which works more efficiently in comparison to the Xtream SWHs, because it helps to provide some fairly hot water, even on overcast days. They used hot water for bathing and dishwashing. Velaphi did not know how much they were saving on electricity, and were unsure as to what role the municipality played in the development of their home. Further details about SWHs were not really explained. “We are happy, and grateful to have a decent home” (Velaphi, 2011).

The SWH systems of Valencia Xhono, Lizo Velaphi and **Thembinkosi Bomvana** were found to differ from one another, despite them all being evacuated tubes and having been installed in June and July 2011, respectively. The Bomvanas were about to take occupation of their new home, and they did not have much to share about how the SWH system contributed to their lives at the time of the visit, and during the interview. Bomvana stated that, on average, they spent about R200 on electricity per month, and in summer they would save about R50 or more per month.

Albert Mkatu, who lives with his wife and two children, received and occupied their house in 2007. According to Mkatu (2011), “[i]f the sun shines, the SWH works better, but today, because it is cloudy, the water is lukewarm. When it is not working, we resort to using electric kettle to heat water, and paraffin heater for space heating. We stayed in the shack, we spent R100 on our prepaid electricity, but now on average we spend R200 on it.” It was only the Mkatu family who stated that they used gas for cooking, and not electricity. Mkatu did not know much about the Nail Melon Township Trust or about the Melon Housing Initiative (MHI). All he knew was that he had a house that was built by Chicago Project, which is the name by which the MHI is known locally, probably in reference to some of the United States partners and volunteers who supported the MHI. “The main biggest problem inhibiting improvement in quality of life is lack of jobs, and education” (Mkatu, 2011).

The **Thembisa Mpuluseni** household consists of 6 people, including three children. The mother, who is the breadwinner, earns less than R3500 per month. They occupied the house in 2007 and spent about R100, on average, per month on electricity, and received 50 kWh for free. The SWH was found to not be working properly, as it had a leak. Mpuluseni did not recall being told about the lifespan of her SWH, its warranty, how often she should clean it, the size of the SWH. The electric kettles or stoves, or paraffin stoves or heaters were kept closeby, because they remained very useful for water and space heating on overcast days (Mpuluseni et al., 2011). “In summer SWH makes difference, because even if you do not have money for electricity, you still get hot water to wash yourself. Although the SWH helps to reduce electricity consumption in summer, and thus cut expenses on electricity, it does not deliver the hot water at the time we need it most, during cold, cloudy and rainy winter season” (Mpuluseni, 2011).

Nosive Mnquma is a breadwinner, and a single parent of two children, who earns less than R3500 per month. Her house was built and fully furnished, as well as equipped with a SWH, in 2007. She did not know who had built the house. Her Xstream SWH was working, except on overcast days, and they had to resort to using an electric kettle to heat water. One person poured in cold water and boiled two kettles for bathing purposes. Mnquma made it very clear that she did not believe that a SWH could improve their quality of life. For her, access to income-enhancing opportunities, electricity, education, and transformation could do so (Mnquma, 2011).

Xolile Mphokeli’s family consists of four, including two children, who stay at 8869 Nkqubelani Street, eMflulen Extension 6. Mphokeli is the father and breadwinner of the household, earning R3500 per month and, at times, a fluctuating salary. The family occupied the house in 2006, and the SWH is still working, but has leakage problems. The SWH is inefficient on cloudy or rainy days. “However, when the sun shines strongly, the plastic valves tend to be overcome by very hot water, and start leaking. The recent houses to receive similar SWHs, their SWHs have been equipped with copper valves, and do not leak” (Mphokeli, 2011). Mphokeli spent R150, on average, per month on electricity during the winter, whereas during summer his electricity costs decreased to R80 per month. The other details of SWH use had not been explained to them. Mphokeli (2011) remained unsure about the contribution made by the SWH to improving quality of life. “The greatest challenge facing people was getting decent employment” (Mphokeli, 2011).

Nowakhe Manyathi’s household is located at 8870 Nkqubelani Street, Extension 6 Mfuleni, and she is a single mother with two children. Manyathi occupied the house in 2006, which she was granted free of charge. She stated that no further details had been given to them about how the SWHs worked, and what to do or not do. “The Irish people and South Africans helped to build these decent houses, and pulled us out the misery of shacks. We were and are still very grateful, and had no time ask many too questions about this and that. We were happy to have proper and decent shelters to call home” (Manyathi, 2011). The SWH works efficiently when it is hot, but, if there is no sunshine, there is no hot water supply. The family spend R150, on average, per month on electricity. Manyathi stated that she did not know how much money they saved by using a SWH.

Nomawethu Jonasi lives at Kwelerha Street 6838 in Extension 6, Mfuleni. Her SWH no longer worked. It started to leak continuously, and eventually burst. In summer, it used to help to reduce electricity usage, and to save some money, but she was also not sure how much money she had saved by using it. The latest housing beneficiaries had obtained good SWHs, and most of the previous SWH systems no longer worked. “Their most common problem is leakage, and there is coordinated effort to resolve this problem. Each person should take a responsibility to repair her or his SWH systems, and the difficult is that many people still remain unemployed, and we face daily struggle to survive all our lives" (Jonasi, 2011).

Slyvia Saula lives with her husband at 6449 Geba Street, Extension 6, Mfuleni. They occupied the house in 2006, earn less than R3500 per month, and spend about R200 per month on electricity. The SWH was still working, and they spent about R120 per month on electricity during summer. Saula agreed that SWH use could improve quality of life. However, the situation was complicated by the fact that SWHs do not work efficiently in winter or on overcast days. In many instances, during the bulk of cold and rainy winters, the SWHs made little impact on improving the quality of life, because more hot water was required in winter than in summer. The municipality was mainly involved with providing land, water and electricity (Saula, 2011).

In Mfuleni, all respondents with Xtream SWH systems had nearly similar complaints, with those from Wallacedene and Kuyasa stating that the plastic valves used could not cope with water that was boiling hot. On cold and rainy winter days, or on overcast days throughout the year, people used their electric kettles and paraffin stoves or heaters for dual purpose heating (Mpuluseni et al, 2011). At Kuyasa, they had decided to replace the plastic valves with copper valves to solve the problem (Ngayi et al, 2011).

10.	**Dorcas Siziba**	**Wallacedene community** (6)	**30394 Fukuse Street**
11.	**Nothemba Pauli**	**Wallacedene community** (7)	**30418 Fukuse Street**
12.	**Mphumzeni Manzoyiya**	**Wallacedene community** (5)	**30416 Fukuse Street**
13.	**Thembakazi Lamani**	**Wallacedene community** (6)	**30596 Fukuse Street**
14.	**Zolisa Rutyu**	**Wallacedene community** (4)	**30414 Fukuse Street**
15.	**Zukiswa Jafta**	**Wallacedene community** (5)	**30419 Fukuse Street**
16.	**Ntozakhe Ntantiso**	**Wallacedene community**	**30589 Fukuse Street**
17.	**Xolani Ngwanyaza**	**Wallacedene community** (5)	**30591 Fukuse Street**
18.	**Sakhise Tayo**	**Wallacedene community** (8)	**30593 Fukuse Street**
19.	**Nceba Mpophoma**	**Wallacedene community** (7)	**30417 Fukuse Street**
20.	**Dorcas Siziba**	**Wallacedene community** (6)	**30394 Fukuse Street**
21.	**Nothemba Pauli**	**Wallacedene community** (9)	**30418 Fukuse Street**
22.	**Mphumzeni Manzoyiya**	**Wallacedene community** (5)	**30416 Fukuse Street**
23.	**N.V. Lephunya**	**Wallacedene community (6)**	**30412 Fukuse Street**

WALLACEDENE COMMUNITY RESPONSES

In Wallacedene, **Zukiswa Jafta** is a single unemployed parent of four children who receives a social grant for two children. Jafta occupied her house in 2007, and only knew that the Masizakhele Project had built her house. During the construction phase, local people and labourers from Khayelitsha had been employed to build the houses. Her SWH had not been working since 2010, and she could not afford to pay for the maintenance costs. There was no maintenance office or specifically identified official to whom one could go when the units required servicing or repairs. Every house owner was responsible for his or her own house, and for SWH system repairs. Zukiswa was currently using her own electric kettle to heat water. “We were told that SWH will provide hot water, nothing more than that. The houses, including ceilings, red tiles and SWHs, were provided free of charge to us” (Jafta, 2011). Due to leakage problems, her SWH was not working, and it could no longer provide hot water. The lifespan of the unit, the necessity to clean solar collectors, and the size of the SWH was never properly explained. There was no mention of own contribution towards SWHs. Everything was said to be free. “We would not say it improved the quality of life, because it only worked for a very short period and stopped working” (Jafta, 2011).

Ntozakhe Ntantiso’s family does not live very far from Jafta, and he is also unemployed. They occupied the house in 2007, and the main local worker was Jwarha, a man only known by his clan name. The SWH of Ntantiso had not been operational since November 2010. They used the electric kettle to heat their water. The SWH used to work only on sunny days, and he used to spend R70 on his prepaid electricity. At the time of the interview, he was spending R100, on average, per month on electricity. SWH lifespan, the cleaning of solar collectors, and maintenance were not catered for when the houses were built. No maintenance servicepeople were trained, no explanation was provided on how to maintain SWH systems, and no monetary contribution was required from home beneficiaries. Every household is responsible for repairs and maintenance to its SWH. “When a man is unemployed the confidence declines, quality of life remains extremely poor and human dignity is compromised” (Ntantiso, 2011).

At 30591 Fukuse Street in Wallacedene, **Xolani Ngwanyaza** and his wife live with his brother and sister-in-law and their child (i.e. there are five family members). They occupied their house in 2007, and the housing project was supervised by Jwarha. Ngwanyaza spends R400 per month on electricity, and he does not see the benefit of having a SWH that only works when the sun shines. At the time of the interview, their SWH did not work. Ngwanyaza had changed the plastic valve more than three times, but it could not withstand the temperature of hot water, so that water overflowed onto the roof. “There is no maintenance or repairs office or designated people whom we can approach when there is problem” Ngwanyaza (2011). As Jafta stated, Ngwanyaza also mentioned that for repairs you have to approach people who used to work on this project to install SWHs, and pay them. For him “many people he knows do not need hot water in Summer because the weather is very hot and cold water shower is always good to cool down the body, and keep it fresh again” (Ngwanyaza, 2011). Furthermore, Ngwanyaza “does not really believe that SWHs can help improve quality of life”. The Ngwanyaza household uses electric kettles for water heating, and paraffin heaters for spacing heating.

Sakhise Tayo’s family of four and four backyard residents stay at 30593 Fukuse Street in Wallacedene, Kraaifontein. Tayo does not agree with the view that SWHs can help to improve quality of life. The SWH has a leakage problem, and does not work properly. She has approached and asked people to repair it, and had paid for repair services, but the repairs did not last long, before the leak started again. Tayo spends R230, on average, per month on electricity costs, and uses the electric kettle to heat water for bathing purposes. Nobody was informed of the need to clean the solar collectors, of a guarantee, or of the lifespan of SWHs. "The SWH does not really make a difference because in [sic] cloudy cold, and rainy winter days or overcast days it does not work" (Tayo, 2011).

Nceba Mphopoma's family consists of seven people, who live at 30417Fukuse Street. Mphopoma lives with his wife and their child. They occupied the house in 2007 with a SWH . The other four family members occupy the backyard, and are responsible for maintaining their own livelihood. The Mphopoma household spends R300, on average, per month on electricity. At the time of the study, the SWH was not working. No informaton regarding the SWH lifespan, guarantee, and the necessity to clean solar collectors was shared with the household. When the SWH system worked, the water, heating electricity and related costs decreased. The SWH was found to help with saving some money during summer time. Mphopoma was the only interviewee to state that, although the SWH was installed free of charge, if the homeowner wanted it to be connected to the electricity, an extra R100 was required. At the time of installation, no member of the household was prepared to pay the extra. The major problem was leakage. "The plastic valve rubbers that prevent water from leaking cannot stand hot water and do not last longer [sic], and are major cause for leakage" (Mphopoma, 2011).

Mphopoma would recommend SWHs for those who need access to hot water, but channels of communication and the right information should be made available for people to be able to know about SWHs and take well-informed decisions. There should be proper supervision and maintenance provisions. "There should be people who will ensure that everything is properly and correctly installed. The project did not really put in place mechanisms to ensure good SWH life after installation. This is very important" (Mphopoma, 2011).

At 30594 Fukuse Street, **Dorcas Siziba** stays with her husband, three children, and one brother. They have been renting the house for the past two years. The household income is more than R3500 per month, and they spend R800, on average, per month on electricity. "The SWH is currently not working. When it worked we used to save on electricity costs about R180 per month. The SWH was leaking and hot water was overflowing uncontrollably, and we decided to switch it off. We use electric jug for heating water and use nothing for space warming" (Siziba).

Nothemba Pauli's household occupies 30418 Fukuse Street in Wallacedene, and consists of 9 family members, including 7 children. Pauli's family occupied the house in 2008. At the time of the interview, the SWH was still working and did not leak. It worked more efficiently when the sun shines in summer time. They spend R150, on average, per month on electricity, and received 50 kWh of electricity for free. "In winter we use [an] electric kettle to heat water for bathing and washing dishes. We know nothing about the SWH size, lifespan, solar collector cleaning, and guarantee. Similarly, we know very little about SWH benefits and we also never asked any questions. All we know is that SWHs help us to use less electricity in summer and save money" (Pauli, 2011).

Mphumzeni Manzoyiya's family occupied 30416 Fukuse Street in Wallacedene in 2008. The house consists of five members, a husband and wife, and three backyard tenants. The houses were built by the Masizakhele Project. The SWH had not been working for over a year. The major problem was leakage. The three-month guarantee had expired, and there was no maintenance. When it was working, it used to work well on sunny days, provided hot water for bathing purposes and saved electricity. “We spend R350 on average [per month] for electricity, and when it worked very efficiently we used to spend less on electricity, at R200 or R250 depending on [how] we used it. Our own municipality involvement was provision of land to build houses, access to clean water and electricity” (Manzoyiya, 2011).

N.V. Lephunya’s household is found at 30412 Fukuse Street, and consists of six family members, including four children. They spend about R150, on average, per month for electricity costs. The SWH had not worked since the previous year, 2010. The main problem was leakage. When asked about savings when the SWH worked, Lephunya stated that he was unsure, and, like many others, had never heard about the necessity to keep solar collectors clean, the SWH lifespan, or the size of his SWH, except knowing that it reduced electricity usage in summer. “We remain unsure about the ability of SWH to improve quality of life” (Lephunya, 2011).

Thembakazi Lamani’s household lives at 30596 Fukuse Street in Wallacedene, and is home to six people, three members of whom stay in the main house, and another three who occupy the backyard. The house was occupied in 2007, and was built by Masizakhele Project. The SWH had not worked since 2010. It was leaking, and the water burst out, and since then they had decided to use cold water. Electricity cost R340, on average, per month and when the SWH was working more efficiently in summer, they spent R260 per month on electricity. The SWH lifespan, size, guarantee, and maintenance of solar collectors had not been explained to them. “We can hardly see how would SWH contribute to improving quality of life because it is currently not working and even when it is working, many people remain unemployed and live in poverty. The municipality has helped to supply water and electricity” (Lamani, 2011).

Zolisa Rutyu’s household lived in 30414Fukuse Street, and consisted of four people. They spend R300, on average, per month on electricity. During winter and on cloudy days, the SWH did not work well. However, it had not been operational since March 2011. All the SWHs were experiencing similar problems, with the main one being leakage, and overflowing when the sun was very hot. “The plastic valves cannot withstand the hot water. All we were told was that the solar water heaters will help reduce electricity, and help us to save some money related to electricity costs. Nothing further was stated to us” (Rutyu, 2011).

STELLENBOSCH: SMART TOWN AND TENNANTVILLE IN CLOETESVILLE, 27–28 AUGUST & 3 SEPTEMBER 2011

RESPONDENT’S NAME		COMMUNITY NAME	ADDRESS
24.	**Brian Bergstedt, Tennantville**	**Cloetesville** (4)	**2 Madeliefie Street**
25.	**Peter Balley, Tennantville**	**Cloetesville** (5)	**59 Azalia Street**
26.	**Eric van Niekerk**	**Cloetesville** (5)	**45 Tennant Street**
27.	**Elizabeth Susan September**	**Cloetesville** (6)	**48 Hoek Street**
28.	**Katherina Daniels**	**Cloetesville** (5)	**9 Beta Street**
29.	**Jan Skeppers**	**Cloetesville** (8)	**7 Beta Street**
30.	**Christine Williams**	**Cloetesville** (4)	**26 Harnold Street**
31.	**Valerie Fernandez**	**Cloetesville** (7)	**150 Curry Street**
32.	**Patrick Kannemeyer**	**Cloetesville** (6)	**7 Fontein Street**

33.	**Attie Johnson**	**Cloetesville** (8)	**12 Philander Street**
34.	**Martha Smith**	**Cloetesville** (3)	**1 Short Street**
1.	**Nombulelo Doda Crescent**	**Khayamandi (2)**	**350 Mgabadeli**
2.	**Masillo Stona Watergang**	**Khayamandi (10)**	**2872 Luyolo-**
3.	**Nosection Ndada**	**Khayamandi (7)**	**2697 Watergang**
4.	**DannySwarts**	**Khayamandi (2)**	**1 Luyolo Street**

PERSONAL, AND TELEPHONIC INTERVIEW WITH COUNCILLOR VALERIE FERNANDEZ (HOUSING) AND ROBERT ISAACS (MARINE ARCHITECT) RESPECTIVELY

VENUE: FERNANDEZ HOME

DATE: SUNDAY AFTERNOON, 11 SEPTEMBER 2011

1. **When and how did SWH start in Cloetesville?**

It started between August and September 2010, after learning of the Eskom SWH rebate in the newspapers. Fernandez, together with Kent Morkel and Robert Isaacs, started to talk and organised a series of public meetings in the Eikestad Hall in Cloetesville to inform the community about SWH benefits, such as electricity and water heating cost savings. With Eskom rebate assistance, we installed more than 767 SWHs for senior citizens. The installation started shortly before the local government elections (Bergstedt, 2011; Fernandez, 2011). Robert Isaacs is the director of Lakeside City Trading 246 (Pty) Ltd, a company that will be installing 2400 SWH units in greater Stellenbosch (Kannemeyer, 2011). Lakeside City Trading has just entered the SWH industry in 2009 (Isaacs, 2011).

2. **After having spoken with ten of the above listed beneficiaries, including Patrick Kannemeyer and Valerie Fernandez, it became clear that some people were not happy and unaware as to who was really installing SWHs in Cloetesville.**

Attie Johnson's household lives at 12 Philander Street in Tennantville. The entire electric geyser had been allegedly been disconnected by the SWH installers since June 2011, and the installation of their SWH was left incomplete, depriving the eight family members, including husband, wife, and three children, of easily accessible hot water that they used to enjoy from their electric geyser (Johnson, 2011). One person had visited them on 9 September 2011, had looked outside, and then left. Their new SWH or old electric geyser was still not working when the interview was conducted with Johnson on 11 September 2011.

Eric van Niekerk's family, consisting of husband, wife, and three daughters, lives at 45 Tennant Street in Cloetesville. Van Niekerk is a SU employee, who earns more than R3500 per month. He applied to have his low-pressure 100-L SWH unit installed, but not without having his electric geyser burst, and then rendered inactive by SWH installers. However, it was quickly fixed, after he reported the matter to Kannemeyer. They were not informed about the lifespan of the SWH, or of the need to keep the solar collectors clean (Van Niekerk, 2011).Van Niekerk was more optimistic, and very eager to switch completely from use of the electric geyser to a SWH system, but remained unaware of some recommendable options by means of which to do so. SWHs help to reduce electricity consumption and costs, and created job opportunities.

Brian Bergstedt's family of four members, which lives at 2 Madeliefie Street in Tennantville, stated that SWHs are installed free of charge. Brian was more positive, and stated that their SWH was working, but that they were informed that it had been incorrectly installed, because it did not face in the direction of the sun. In summer, he hoped to save more than R100 on his prepaid electricity cost. While the interviewer was conducting the interview, the SWH installers came to change the orientation of a SWH from south-facing to north-facing (Bergstedt, 2011; Gosa, 2011).

Elizabeth Susan September's household lives at 48 Hoek Street in Smartie Town, Cloetesville. The household consisted of the grandmother, who lives on an aged social grant, together with her great-granddaughter and daughter, who had just recently started working. The SWH was installed in June 2011. She does not know how much do they spend on electricity, but she knows that she is also receives 60 kWh of electricity for free. September is a senior resident of Cloetesville, and she was involved in community work. During her time, she was passionate about community development, and used to play a key leadership role in the community (September, 2011). Sadly, today she is wheelchair bound, and struggles to report her escalating water bill. The interviewer passed on her concern to Councillor Fernandez, who immediately called, and promised to send a community worker to help her. September was not working properly, and few details were provided about SWH benefits. "The SWH does not work properly, and could not help to improve the quality of our lives. We are forced to still use our electric kettle to warm water" (September, 2011). Nothing had apparently been explained to the household regarding SWH use. No meeting had been held. They were only asked to come and fill in forms if they were interested in having a SWH system installed.

Katherina Daniels' household, which lives at 9 Beta Street, had their SWH installed in 2011 by Patrick Kannemeyer. "We called into a meeting to explain about SWHs end of 2010, and I attended the meeting at Eikestad Hall, Cloetesville. They told us that when the sun shines, the SWHs will provide hot water. They put demonstration SWH outside the hall and the water was hot." Daniels, who is a senior member of the Cloetesville community, said that her SWH was not working well. The reason that they had been told that the SWHs were not installed correctly was that they did not face in the direction of the sun, meaning that they could not harness maximum sunshine to heat the water inside the SWH tank. "I have reported the matter to councillor Valerie Fernandez, because she is the one who introduced SWHs to us last year, 2010. No further SWH details were explained, and we were later invited to come with proof of residential address, marriage paper, and ID copy to fill in the forms if we are interested to have SWHs" (Daniels, 2011). Daniels' household is home to six people, a grandmother, a son and his wife, and three grandchildren. With regard to SWH impact on improving the quality of life, Daniels (2011) stated, "I do not know, that is what they say, but from my experience I do not know."

Jan Skeppers' household live at 7 Beta Street in Cloetesville, Smartie Town. The Skeppers family consists of 10 people: the parents, with two married daughters, and their own children, who stay in the backyard. Their SWH, which was installed in July 2011, was working at the time of the interview. There was no problem with the SWH system. Although Jan is a senior citizen, he is also working. When the hot water was exhausted, SWH made a “terrible noise”. Use of a SWH helps to reduce electricity usage. The children were still using electric kettles in the backyard to heat their water for bathing purposes. The Skeppers family spends about R700, on average, per month on electricity, and on cold winter days their electricity bill increases, because they use an electric heater for space warming. After acquiring a SWH, Jan is not sure how much savings is achieved per month (Skeppers, 2011). “The SWH helps to reduce electricity consumption when the sun shines, but I am not in a position to say it improves the quality of life or not. Valerie Fernandez is the one who invited pensioners and everyone interested to SWH systems to attend meeting at Eikestad Hall, Cloetesville. It is free of charge and we were not asked to contribute something” (Skeppers, 2011).

Peter Bailey of Tennantville, owner of 59 Azalia Street, is unemployed. The installation of his SWH was incomplete at the time of the interview, and it did not work. He knew of a range of people, some of who were plumbers and some who were not, who install SWHs,. The electric geyser was still switched on, but he Bailey stated that he did not understand why the plumbers told him that, when his SWH was up and running, the shower would not work. “Every man needs to enjoy shower in his household, and these people (installers) are coming here with lots of stories. They keep changing the companies, and tend to leave many of their SWH installation work incomplete and go away for a very long time without informing us of the reasons” (Bailey, 2011).

Christine Williams’ family household is located at 26 Harnold Street, and is home to five people, including two children. The SWH was installed in June 2011. Williams is also a senior citizen of Cloetesville, and, although she is not absolutely sure, she believes that the DA installed the SWH systems for them. “We went to apply at Eikestad Hall to have SWHs installed in our homes, but it does not work yet.” The SWH was installed free of charge to save electricity and money for pensioners. Williams spends about R400, on average, per month on electricity, and hopes to cut the amount spent when her SWH is up and running. No further details were given about SWH systems. At the time of the interview, the SWH was not working, because the installation was incomplete. Regarding SWH impact on improving the quality of life, she remained unsure, because many people were complaining that the SWH did not work on cloudy days (Williams, 2011).

The first SWH installation company, Solar Distributors Africa (SDA), of which Patrick Kannemeyer was SWH installation project manager, was replaced by Lakeside City Trading in August 2011. SDA is blamed for many of the complaints regarding installations, such as for installing SWHs that faced southwards, instead of northwards, disconnecting the entire electric geyser, and leaving incomplete SWH installations, forgetting to open the main water switch, which results in a water burst, lack of communication, and information for SWH beneficiaries, and the inactivity of many SWHs (Kannemeyer & Lawrence, 2011). All the people who were interviewed in Cloetesville, except Kannemeyer, were not aware of which company exactly had installed the SWH for their household. Contrary to what Fernandez and Isaacs stated, they initially installed 767 or 769 SWHs, as both respectively, Bergstedt stated that he was informed by his wife, who heard it from a community worker, that they planned to install 170 SWHs (Bergstedt, 2011)

3. **What processes did you follow leading up to the installation of SWHs in 769 houses in Cloetesville, and how did you identify your initial beneficiaries?** The main primary target was helping some of the senior residents who previously did not have any geysers, and who lived for many years without instant access to hot water services. Later on, we opened it up to everyone and invited people through the loudspeaker, community workers, and local newspaper to come to the office in the Eikestad Hall with proof of identity, and residential address to apply for a SWH (Fernandez, 2011).

4. **Do you have a SWH in your house and how does it contribute to improving the quality of your household life?** Fernandez's SWH system is working. Prior to its installation, she used to spend R900 on electricity and, after having installed a 100-L low-pressure SWH, she saved R280 on her monthly electricity costs. "I have been saving this money, and will be going on holiday to the Garden Route in October 2011" (Fernandez, 2011).

   At 45 Tennant Street, on average, they consume about 471 kWh and spend R500 per month on electricity. The SWH is not yet working, but it will cut down on electricity use, and related costs. Most importantly, this SWH installation was necessary because Eskom needed to manage energy demand, and to avoid recurrence of the 2008 power shortages. The local unemployed are employed to assemble the stuff, piping, and SWH installations. When there is a problem it is easy to find them (Van Niekerk, 2011). The SWH project is scheduled to run for 18 months, and will provide temporary jobs to 155 people who were previously unemployed, of whom details were retrieved from the SM database. We have put them through installation training and a skills development programme for various areas. These include artisan works, such as learner SWH installers working with plumbers, driving licences, a computer course, writing business plans, advanced business course, and community ambassadors to interact with local communities (Isaacs, 2011; Lawrence & Kannemeyer, 2011).

   The intention is to empower them with skills to be able to secure employment, and also to enable them to start their own businesses one day. The beneficiaries' access to hot water will help to restore human dignity, as many of them had no access to electric geyser services for many years (Fernandez, 2011; Isaacs, 2011). We need to contribute towards poverty alleviation, and to the creation of small businesses, and employment opportunities for local people. We need to enhance the upliftment of local skills. We need to improve communication with SWH beneficiaries (Lawrence, 2011). With regard to SWH contributing to improving the quality of life, they responded that they were not sure about its ability to improve quality, but all that they were told was that it will provide hot water without using electricity and that it would help reduce their electricity costs. The Skeppers' household spend more than R750 per month on electricity, and they hope to achieve savings on this (Daniels, 2011; September, 2011; Skeppers, 2011).

5. **What kind of SWH systems were they using and what was their lifespan?** They were mainly using imported evacuated-tube SWHs. The first company installed Pacific solars, and the new company, Lakeside City Trading would install Hudu solar products to distinguish itself from SDA performance. Their lifespan is about 20 years (Lawrence, 2011).

6. **What role did the SM play in the initial steps of your SWH project?**
Nothing. Many people in Cloetesville lived for over 40 years without access to a geyser or to easily accessible hot water services. Later, the National Department of Environmental Affairs became involved and allocated R25m to install 2400 SWH units within these SM areas, namely Cloetesville, Khayamandi, Klapmuts, and Franschhoek. The local municipality's environmental affairs department is part of the SWH project and plays a supportive role (Fernandez, 2011; Isaacs, 2011).

7. **Did you extend an invitation to various local stakeholders, including the relevant role-players in the private sector, as well as to members of the business community, learning and research institutions, relevant municipalities and communities, to participate in SWH project planning and decision-making?**
No, the focus community was Cloetesville, and meetings were held with local people to inform them about SWH benefits, namely electricity use reduction, and financial savings, as well as associated job creation opportunities (Fernandez, 2011).

8. **Did you visit and conduct research in communities where SWH projects, such as Kuyasa Project, have been established and successful to learn their best SWH implementation strategy, and challenges, and how they dealt with them?**
"No, there was no such visit or research done, because I am used to starting and running community projects. It is like cake to me. I am a very positive person. Many people have expressed great joy for having access to instant hot water in their own houses" (Fernandez, 2011). After having shared some of the above-stated not so joyful and less positive side of her SWH project stories, Fernandez (2011) stated that "most of [the] complaints come from the people who had electric geysers. They want to pay less for electricity, but they do not want [to] change their lifestyles." However, the interviewer's first experience with those people with whom he interacted told a different story. The two people who had electric geysers did not complain about having to change their lifestyles, but rather about specific problems, such as the electric geyser bursting, and geyser disconnection.

9. **Does your SWH project implementation have a long-term planning view in mind to stimulate local manufacturing sector and to enhance sustainable LED, and more?**
Not necessarily. The SWH project is scheduled to run for 18 months, and there are no plans to install more than 2400 SWH units. However, more people are showing a great interest in this SWH project. The SM council will hold a meeting on 12 September 2011 to identify a councillor who will be responsible for helping to take this SWH programme forward. Many other people and councillors are more interested in learning about this project. There are calls from Boutersville, Drakenstein Municipality, and Swartland (councillor Zain Abrahams) are enquiring about SWHs to Gerald Eso, who works for the SM Environmental Affairs division (Fernandez, 2011). The Advisory Committee shall be constituted and hold bimonthly meetings about the implementation of the SWH project (Isaacs, 2011).

RESPONDENT's NAME		COMMUNITY NAME	ADDRESS NO
35.	Zamile Bhambatha	Kuyasa Community	
36.	Vathiswa Bula	Kuyasa Community	54 610
37.	Nokemet Bula	Kuyasa Community	54 610
38.	Nokwakha Ndinisa	Kuyasa Community	54 658
39.	Mziyanda Ndinisa	Kuyasa Community	54 658
40.	Nomangesi Matiwane	Kuyasa Community	54 946
41.	Ncumisa Sidumo	Kuyasa Community	54 760
42.	Nolandile Taluvana	Kuyasa Community	55 019
43.	Nonkonzo Tshwela	Kuyasa Community	55 035
44.	Zuzeka Guzi	Kuyasa Community	55 080
45.	Nontombizakhe Lababa	Kuyasa Community	55 031
46.	Thembisa Kulana	Kuyasa Community	54 510
47.	Bhabha Kwaaiman	Kuyasa Community	54 890
48.	Vuyiseka Ngamile	Kuyasa Community	54 608
49.	Maphelo Ngqayimbana	Kuyasa Community	54 604
50.	Ningi Dalubuhle	Kuyasa Community	54 659
51.	Nkosifikile Macingwana	Kuyasa Community	54 879
52.	Lukhanyiso Ngayi	Kuyasa Community	54 609
53.	Nokwakha Mtyhali	Kuyasa Community	54 612
54.	Malwande Mtyhali	Kuyasa Community	54 612
55.	Nyameka Ngamile	Kuyasa Community	54 587

1. **WHEN DID THE KUYASA PROJECT START?** Early in 2008.
2. **WHAT PROCESSES WERE FOLLOWED TO START THE SWH ROLLOUT IN THE KUYASA PROJECT IN KHAYELITSHA?**
   Local community leaders, including Zuko Ndamane and Cape Town Municipality, introduced the idea of SWH rollout as early as 2002 with a pilot project. They started the SWH rollout with a sample of ten pensioners' households, as identified by the Kuyasa community members. Lack of funding and obtaining the right SWH implementers delayed SWH rollout till 2008 (Ngamile, 2011).

3. **WHAT WAS THE INTENTION BEHIND THE INSTALLATION OF SWHS, CFLS AND CEILINGS IN YOUR HOMES?**
   The Kuyasa Project was designed to deliver integrated SWH services, which entailed the installation of SWHs, compact fluorescent lights (CFLs), and ceilings. The intention of SWH rollout was to help achieve the following goals, and interventions:
   - To reduce electricity consumption, and thus support mitigation of $C0_2$ emissions.
   - To reduce electricity expenses and associated financial stress.
   - To allow access to SWHs for those who did not have access to electric geysers.
   - To improve the thermal performance of poorly-built low-income households.
   - To establish technology and skills transfer, and some job opportunities.

4. **DOES THE SWH PROVIDE HOT WATER ALL THE TIME, SUCH AS DURING CLOUDY DAYS, EARLY IN THE MORNINGS AND EVENINGS?**
   During cloudy, rainy and cold winter days, the SWH provides lukewarm water. On rainy and cold cloudy days we resort to using electric kettles or stoves to heat water.

In the mornings and evenings, the availability of hot water depends on how large the family is, how you utilise your SWH, and the proper supervision of your children (Ngayi, 2011). Zuzeka Guzi (2011) agreed with Ngayi by stating that, from May to September, the SWH performs poorly. The water becomes lukewarm, and she uses the electric kettle to again heat water. Most people use electric heaters or paraffin heaters for both space warming and water heating. For instance, a family of 14 members, with many tenants, has a pessimistic view of SWHs. On cold and rainy winter days, the SWH does not work, and we use an electric kettle to heat water for bathing and a paraffin heater for space warming (Mtyhali, 2011).

5. **WHAT IS THE SIZE OF YOUR SWH UNITS? HOW OFTEN DO YOU CLEAN YOUR SOLAR COLLECTORS?** Kuyasa Project has installed 120-L (Xtream geysers) to 125-L SWHs. None of us know about the need to clean solar collectors, and we do not clean them.

6. **HOW DOES THE SWH CONTRIBUTE TO IMPROVING THE QUALITY OF YOUR LIFE?** Some people find it hard to admit, or reject, the fact that a SWH can improve quality of life. Men and women were trained and employed to install SWHs, CFLs, and piping and to fit proper electric wires and ceilings. A SWH helps to save electricity (Ngamile, 2011). Macingwana's family consists of five members (including a man whose age is in the mid- to late-30s) and spends R150 per month on electricity. The SWH saves R50 per month on electricity costs in summer. Bhambatha (aged between late 40s and early 50s) is father and husband in a family of six members, including four children. In summer, as a result of the SWH, they use less than R100 per month on electricity. It helps to save the time taken to heat water by means of the electric kettle or stove and reduces the risk of children burning as a result of the electric stove or kettle (Ngayi, 2011).

7. IN YOUR EXPERIENCE, WHAT MEASURES ARE IN PLACE TO ENSURE THAT THE SWH SYSTEMS WORK PROPERLY AND EFFICIENTLY?
Local technical SWH maintenance officers were trained and provide maintenance services whenever such a need arises. There are four of them, and they work on a part-time basis. The person who experiences problems with his or her system comes to report to the office and the office administrator calls the technical SWH officers to go and fix the problem. The community are also guardians of the SWH systems' safety to enhance sustainable services.

8. WHAT DOES THE BENEFICIARY CONTRIBUTE TO THE SWH SERVICES OF KUYASA PROJECT?
Each beneficiary is expected to contribute R30 per month. While they develop better ways to collect such contributions, the Department of Public Works has offered to pay R30 for all beneficiaries for two years. The two years start to count from the day your SWH started to operate (Ngamile, 2011).

9. Does the SWH really help to save electricity and associated expenses per month? The SWH helps to reduce electricity usage and costs, mainly in summer (Guzi, 2011).

10. **How does the SWH installation contribute to cutting poverty and improving quality of life?** It provides ample opportunity: short-term job opportunities for unemployed people, and access to skills development (Ngamile, 2011).

APPENDIX 8: THE GREATEST CHALLENGE

The greatest challenge facing the university now is sustainability

The Rector and Vice-chancellor of Stellenbosch University (SU), Professor Russel Botman has reportedly put sustainable development in the centre of his agenda on his second five-year term as a head of SU. Hope Times, A Special Edition of Kampusnuus, 2012 noted that "the University Council has reappointed Botman for a second five-year term. He says the greatest challenge facing the university now is sustainability". Furthermore Hope Times 2012 stated that Botman argued that "in the 21st century, serious efforts are needed worldwide to rectify the damage caused in the 20th century. Energy savings, water security and climate change will have to receive the attention of our best academics and researchers. This challenge will also have to be reflected in the further development of the University. New sustainable buildings will have to be erected and our carbon footprint will have to be smaller. We also want to inculcate critical thinking in our students about green as the new maroon. To achieve this we will have to enter into very strong partnerships with foundations and companies and individuals who share our outlook. Sustainability will become SU's trademark and we will forge strong bonds with others who also have this trademark" (Hope Times, 2012). This sustainability trademark falls within the framework of The Hope Project that was launched on July 21, 2010 by SU to position the SU to help in replacing despair with hope through aligning its teaching, learning and research with national, Africa and the Millennium Development Goals (MDGs) agenda (Hope Times, 2012).

On August 03, 2012 during the meeting that the researcher has attended together with Luthando Mxesibe on behalf of IMBADU Ma-Afrika Development Consortium (IMBADU), Prof Mark Solms of Solms Delta Wine Esate from Franchhoek Valley, and Prof Botman with his team, Botman stated that SU is committed to enhance sustainable development through efficient resource use and collective efforts to make our carbon footprint smaller. The purpose of the meeting was ask SU to consider partnering with IMBADU and Solms Delta to do research about the Khayamandi history and African cultural heritage with a view to among other things build Khayamandi African cultural heritage centre and the SU agreed to enter this partnership. The African cultural heritage centre if it will be based on new building the building design should be ecological friendly, and will be equipped with good quality SWH systems, photovoltaics (PVs) and water recycling systems as well as general waste material recycling systems, green grass, and trees with disability friendly access. The process is currently underway to get started with actions around such a research (Gosa, 2012).

This initiative mainly involves multiple stakeholders including Khayamandi community, Khayamandi Development Forum (KDF) which came into being on August 26, 2012 consisting of Khayamandi councillors, two representatives from each of the four ward committee structures, two representatives from local South African National Civic Organization (SANCO), diversity of experts and students with various fields research interests, private and public sector as well foreign friends. The main purpose of such a research is generating comprehensive study about Khayamandi and establish strong basis for meaningful access to enough land for sustainable development. IMBADU Ma-Afrika Development Consortium (IMBADU) is a non-profit organization that was founde in November 2010 in Khayamandi in Stellenbosch to (1) promote our African cultural heritage through indigenous language literature readings, poetry, writing, storytelling and engaging learners from the local schools, and (2) economic development to advancing empowerment initiatives through focused commercial cooperatives to enhance entrepreneurships. IMBADU focus is purposefully not on promoting green development more than reinforcing self-consciousness, sharing knowledge to restore human dignity, self-confidence, and reconnect with African roots as means to enhance more informed understanding of why people should be supportive of sustainability initiatives (Gosa, 2012).

Thumake Gosa has been active and involved in development initiatives in Khayamandi as far back late 1990s through the then Khayamandi Reconstruction and Development Programme (KRDP) representing the learners of Khayamandi adult education training centre which was then led by Luthando Mxesibe. In 1999 to early 2000 the Church Youth from various churches and ordinary community members were the very first collective body of faith to organize voluntary cleaning campaigns on Saturdays to literally clean and sweep the streets of Khayamandi under the leadership of Rev Vuyani Vellem of the Uniting Presbyterian Church in Southern Africa (UPCSA). Vellem was then a minister of GG Ndzotyana Memorial Congregation in Khayamandi located at Bassi Street and there was no tender awared and payment made to Vellem and interdenominational youth to clean Khayamandi. Our collective voluntarism was a success due to support given by its leadership, local councillors such as Ms Ntombelanga, Alicia Mgijima and Mbuyiselo William Kalazana, and Stellenbosch Municipality who gave us the tools. In July 2004, while completing a bachelor of theology degree at Stellenbosch University, Thumakele one was of the key organizers who facilitated the establishment of Sinomonde Committee in 2004 in Khayamandi largely made by people who had plots, but needed help to build their homes. In 2004 Thumakele approached and brought Habitat for Humanity in Mobrary to help starting savings towards building decent houses and to date 4 decent homes have been in Khayamandi (Cain n.d:14). There were still six more houses pending and in September 2012 preparation were at advance stage to start building and completing these long overdue housing initiative (Gosa, 2012).

IMBADU in partnership with SU and Solms Delta have met again on October 05, 2012 at Maties Community services, also known as the Old Luckhof School in Stellenbosch to meet and discuss with a team of diversely experienced researchers about the processes to follow to start the History and African Cultural Heritage Research in Khayamandi. The attendance of researchers was very encouraging as they came with expertise in sociology, history, business, anthropology, psychology, theology, farming, sustainability and interdisciplinary disciplines. After a considerable time of discussion and exchange of ideas it was agreed that researchers should visit Khayamandi on November 13, 2012, meet at 09h00, Old Luckhof School and drive to Khayamandi. Solms Delta offered to provide the transport for this township tour to go and see Khayamandi, meet the people and arrange for strategic leaders of Khayamandi to visit Solms Delta Museum as well. The idea is to expose the community leaders to the model of Solms Delta Museum because one of the tangible outcomes of this initiative should be to have Khayamandi history documented in a book form. In addition there should an African Cultural Heritage Centre erected to narrate and demonstrate the heritage of Khayamandi, and economic development centre to enhance local economy. The Khayamandi Economic Development Tourism Corridor is earmarked together with Old Khayamandi Administration Offices and two hostels as structures that could used as integrated resource facilities to drive transformation of Khayamandi. The main idea is to have some of these dilapidated buildings renovated, and equip them with renewable energy systems such as PVs and SWHs, planting trees, green grass, and introducing coordinated recycling of recyclable materials while also documenting and empowering people with information about the thinking behind the idea of renewable energy sources. The information should be made available in both Afrikaans and isiXhosa as well as English, and any other local language that is spoken by the people.