THE CHANGE IN LIVED EXPERIENCES OF MPAME VILLAGE HOUSEHOLDS USING SOLAR PHOTOVOLTAIC ELECTRICITY.

The Graduate School of Governance (WSG)

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Master's in Management: Public and Development Management

By

Ola Tokosi (S.O.B)

(Person No: 337580)

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Supervisor: Murray Cairns

ABSTRACT

Electricity and the ability to access it enables heating and lighting for domestic use, and for mechanical, electrochemical and electronic requirements. The purpose of this study was primarily to assess and understand the changes in lived experiences of Mpame village residents after solar photo-voltaic (PV) electricity installations in 2014. The study problem sought was to identify and understand the inability of residents to access electricity from the national grid after twenty-five years of democratic government in South Africa. The constitution guarantees electricity access as a human right for all citizens and all who live within its borders. The government had in 1994, as part of its political campaign promises, suggested 'Free' electricity as a dividend of democracy if voted into power. Electricity access using solar photo-voltaic (PV) installations was achieved in 2014, that incidentally was an election year. By October 2019 when this study was undertaken, Mpame village literally had returned to darkness, as a result of non-replacement of the batteries at their end-of-life stage.

The secondary purpose of this study was to ascertain who takes responsibility for the project's sustainability. Battery replacement is essential and pivotal to the success of this strategy and, also ensures the sustainability of electricity access as a human right. A qualitative research methodology approach was used. Data was collected by conducting face-to-face interviews with household heads or representatives who have resided in Mpame village at least two years before and two years after the installations were completed and commissioned. The findings indicate that the residents have a positive perception of government's effort at enabling electricity access and the upholding of their human rights. The implication of the state of non-functionality is that the village is now in darkness, with concerns raised about the sustainability of the strategy to support sustainable livelihoods strategy. The true intentions of government is under question, creating suspicion and worry about service delivery, an increased fear of vulnerability, a decreased sense of safety and security and a concern of losing out on development opportunities. Considering that there is a strong correlation between electricity access and development, no modern activity like industrialization, daily life, transportation, communication, cooking, heating the home and benefits from cultural activities can occur in Mpame.

Based on the findings of this study, it is recommended that government should assume responsibility to replace the solar batteries at their end-of-life stage or else get grid electricity installed in Mpame village for the residents to enjoy their constitutional human rights.

DECLARATION

I, Sunday Olakonipekun Babajide TOKOSI, declare that "The Change in Lived Experiences of Mpame Village Households Using Solar Photovoltaic Electricity" is my own unaided work. It is submitted in partial fulfilment of the requirements of the degree of master's in management at the University of the Witwatersrand, Johannesburg, in South Africa. I confirm that the dissertation has not been submitted before for another degree or examination in any other University.

(Assumed to be signed if assignment submitted electronically)

16th April 2020.

ACKNOWLEDGEMENTS

I use this opportunity to extend my most sincere gratitude to the following people for their individual support, assistance and input in putting this research study report together. Firstly, Murray Cairns, my academic supervisor, for his patience, stretching, testing and enlightening my thought and writing processes. Secondly, Dr. Temitope Tokosi, Terfa Gbahabo and Kennedy Manduna, for their guidance in structuring, aligning, shaping and fine-tuning my thoughts and writing processes. Thirdly, my immediate family members like Sifiso Tokosi, Morenike Tokosi, Didintle Tokosi and Atinuke Tokosi for their patience, understanding, cooperation and support during this period. Their understanding of the sacrifice required is highly appreciated.

DEDICATION

I dedicate this research report to my late father, wing commander S.B Tokosi (Retired), who unfortunately did not live long enough to see how far all his children have pushed in life and achieved academic pursuits regardless of the challenges we experienced along the way. He supported and encouraged academic aspirations and accomplishments as he believed that education is one thing nobody could take away from someone, no matter how powerful they could be.

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CHAPTER 1: INTRODUCTION

Electricity is an important and strategic energy carrier with critical relevance in the modern lifestyle and economy. Most of the current technologies that enable modern livelihoods, lifestyles and economies cannot be powered by other alternative energy sources. The latest digital economy, the fourth industrial revolution (4IR), is a typical example (Walwyn, 2017).

Electricity access, its sustainability and affordability is a strategic factor in the development of human capital, social, economic, educational and gender equity with regards to the national development plan (NDP) in South Africa. The concept motivating this study was to assess the changes in the lived experiences of Mpame village residents after the solar photo-voltaic (PV) electricity installations executed in 2014 by the government as a means of enabling electricity access. Electricity access, is a guaranteed human right for all citizens living within the borders of South Africa in the 1996 constitution as non-negotiable, in order to address economic, social and gender inequalities that exist within the society. This is regardless location, physical ability, socio-economic status, gender or race (SA Constitution, 1996). Mpame village households had never experienced nor benefited from electricity access before 1994 when the new democratic dispensation and constitution came into existence.

1.0 Background of the study

The main consideration for this study is the strategic importance and relevance of electricity access. The ease of use, sustainability and affordability of electricity is relevant if the development indices, policies and strategies in place are to be adequately and effectively measured. This is because electricity access enables the achievement and ability to live a modern basic lifestyle and experience personal, economic and social development anywhere in the world (Shoaib and Ariaratnam, 2016).

Electricity access is a critical requirement for millions of people to meet basic living standards because it is essential and strategic to accessing other basic services like clean water, security, education, health, sewerage and housing. The benefits that come with available and accessible electricity are clean environments, cooking, lighting, communication and safe environments. These benefits facilitate and contribute to improved living standards, facilitates the realization of socio-economic development that

take the form of national economic growth, human development, social empowerment, environmental sustainability and gender equity (Action, 2012).

The availability, reliability, affordability and accessibility to electricity, creates cleaner, safer homes, and supports poverty alleviation programs by enabling people to live lives of less drudgery that in turn, promotes economic, social and gender equity thereby enabling greater personal dignity (Bilgic, 2017). The flipside of this is that lack of electricity access leads to inability for people to achieve modern basic living standards. Rural women and children bear the harshest and fiercest negative consequences which in turn, increases vulnerability, gender inequality, poor living standards, exposure to life-threatening diseases and household pollution. Inevitably, these consequences reduce the levels of the 'human living index'-HLI (Rahman, Hasan, Paatero and Lahdelma, 2014). Of note in this report, is that the words 'electricity' and 'energy' are used interchangeably to mean the same thing.

A current reality globally, is that conventional electricity-generation technologies that use coal and water (i.e. hydroelectricity and thermal power stations) have depleted natural fossil and water reserves. This situation threatens many livelihoods and hampers productivity levels of various companies and industries. There are evident negative effects on land use like water contamination, disruption of the ecosystems and environmental disruptions by fuel-cycle-related accidents. Two cases that come to mind immediately as examples, are the 1980 Chernobyl nuclear power station accident in Russia and the 2011 Fukushima nuclear disaster in Japan (Fthenakis and Kim, 2009). Women and children, notably those in the rural areas, are the primary victims of these hazards and pollution as they are the ones who do the cooking and collection of wood and biomass.

The consequences of such vulnerabilities and exposures include long-term health diseases like tuberculosis, cancer, breathing problems, and the children deprived of school time thus challenging their educational standards. Of critical importance is that other important criteria for survival and better living standards like security, entertainment, leisure, communication and space cooling (fan) also need electricity. Paraffin, also referred to as kerosene, candles and lanterns emit smoke, produce poor lighting intensity per unit of consumed wattage and cause associated risks like fires or the paraffin being drunk by children. These circumstances emphasize therefore, that the provision of clean, safe and sustainable energy sources is imperative and strategic to development and modern living standards (Rahman et al., 2014).

Limited reserves of water and fossil fuels like coal, create sustainability and environmental challenges like climate change and air pollution (Thom, 2010). Excessive use of wood, for example in the Sahel region, has created considerable environmental damage because households use conventional wood fire, charcoal, coal cook-stoves and wet solid biomass as fuel for cooking and heating purposes. This significantly degrades quality of life as the stoves have low energy efficiency; the wet solid biomass produces high levels of hazardous smoke, carcinogens (cancer causing substances in living tissue) and air pollution that is dangerous to human health (Bugaje, 2006). Since the energy sector contributes at least 40% of greenhouse gases, its contribution to climate change is negatively enormous. Its effects are evidenced by negative consequences like low agricultural output, activities, in-migration patterns, environmental pollution, health, safety and security concerns, threatening human existence on the planet (Duim and Caalders, 2012).

Building new energy infrastructures for generation, distribution and maintenance, is very expensive. Renewable or non-conventional energy sources are therefore, the most appropriate, alternative options for consideration. The primary reason is that natural resources have low carbon outputs and footprint as regards greenhouse emissions. They are continuously, consistently and reliably replenished by natural processes (Thabethe, 2010). The advantages of reliable, renewable and smart sources of energy justify the focus of this research that is on solar photovoltaic (PV) electricity generation in South Africa's Mpame Village in the Eastern Cape province.

Economic and social development for any developing country is dependent on energy consumption due to the strong correlation between energy access and development. Put succinctly, no meaningful social and economic activity can occur without electricity (Bilgic, 2017). Important and mandatory services for poverty alleviation are most cost-effectively delivered by lower carbon technologies like sea/ocean/tidal, wind, shale gas, fuel cells, waste, biofuels, hydrogen, geothermal, natural gas, nuclear, photovoltaics and biomass (Hogarth and Granoff, 2015). A study by Khan and Salek (2019), estimates that up to one billion people of the world's population, have no electricity nor access. Most of these people are resident in Africa and constitute 13% of the world's population. It is the argument of this study that if these groups of low-income, off-grid and vulnerable households can access solar electricity-compatible appliances, there will be no need for grid connection and its associated exorbitant costs of generation, distribution and maintenance.

Electricity will become readily available and accessible thereby making smart, renewable energy sources like solar electricity, the best and most suitable alternative. Its minimal voltage, regulation and battery backup are efficient and enough for use simply by plugging into a solar setup in the day with no extra infrastructure needed or costs incurred (Kebede, Kagochi and Jolly, 2010). It has been noted that solar configurations and direct-solar efficient appliances would make millions of people access cheap and smart electricity to meet their basic needs and have better living conditions at low expense. Direct-use solar electricity is that whose output is directly from a solar panel with little or no intervening storage, minimal electronic conversion and control (Schwartz and Buskirk, 2019).

1.1 The South African context

During apartheid-era South Africa, development policy and strategy located all socio-economic infrastructure and activities like housing, mining, manufacturing, industry and financial services to the advantage of the minority European population. The logic of all these apartheid policies disadvantaged the majority African Black population. Dispersed, poor, off-grid and vulnerable Black communities were created by the apartheid system. It is against this background that alternative, environmentally friendly, smarter and safer energy technologies are essential in post-apartheid South Africa, to address and accelerate development in these previously disadvantaged Black communities (Baker, 2016). This approach and strategy of course, should be supported by focused, deliberate and sustainable policies to effect needed changes in the structural, systemic, financial and socio-economic discrepancies currently evident within the South African society (Grins, Rothman and Schot, 2010).

1.2 Description of the Study Location (Mpame village)

Mpame village is one of the eight villages within the Dutywa district under the jurisdiction of the Mbhaishe municipality in the Eastern Cape province of South Africa. It is 300km from Dutywa, the nearest big town after Vrieges and Mqandulli. It is 10km from Coffee bay, where the affluent reside, and lies parallel to the Atlantic Ocean. Two private lodges (taverns), patronized by foreign backpacking tourists, are the visible economic activity points in the area. There is a primary school with no chairs and tables, and a tin shack in front that serves as an early childhood learning center. A junior secondary school is lies across the road but there is no high school. Teachers come from Dutywa on Sundays,

stay over in rented rondavels (mud huts) and leave on Fridays. Mpame has no pipe-borne water, electricity and sanitation infrastructure. The pit latrine system is common sight from Dutywa while the access road is untarred, rugged, winding, gravel and steep with no drainage or lighting.

To access Mpame village requires a drive through a thick forest and past a clinic that is linked to the grid. The clinic is managed during weekdays by two nurses between 9am and 3pm. Dutywa as the closest town to Mpame village, is a Xhosa name meaning 'a place of disorder' and an Eastern Cape outpost town constituted under the amended municipal structures act no. 117. The village has steep, undulating terrain, sparse development infrastructure, population and limited economic activity (Statistics South Africa, 2011). It is North East of Amatole district of the Eastern Cape province, 90km from Mthatha, and part of the 31 wards covering 20.83 km2 land mass with population density of 531.67 per km2. The 11076 largely Black African population is 99.4% of isiXhosa speaking origin. They are largely indigent, unskilled, uneducated and vulnerable (Census, 2011). Mpame village is unassuming, calm and peaceful with the sea flowing meters away. Government grants and remitted funds from relatives working in big towns are the primary sources of income. Animal farming (donkey, cows, pigs, goats, sheep and chickens) is the popular agricultural activity noticed in the village. Farming is non-existent though there is arable land. Retail stores like Shoprite, regal hyper, boxers, PEP and independently-owned stores provide jobs for a few people along the Dutywa, Vrieges and Mqandulli road axis towards Mpame village.

1.3 Problem statement

Central to the study, is that 25 years into democracy, Mpame village households still do not have access to electricity. This is regardless of the new, democratic and constitutional requirement that stipulates electricity access as a human right for every citizen living in South Africa. The main challenge with the provision and access to electricity, water, sanitation and development infrastructure for the majority of Black South Africans is a historical problem fundamentally due to the apartheid-era segregation government policy (Bond, 1999). Mpame village households are no exception. To make matters worse, the national development plan (NDP) for economic, human and social development remains electricity intensive (Westhuizen and De Bryun, 2016).

The rolling out of solar electricity since 1991 was a strategy to enable previously disadvantaged Black South Africans with no access to the electricity grid, benefit from the constitutional provisions of electricity access. If this policy and strategy was to be successfully implemented, it would address and effect necessary changes in the socio-economic design, status and livelihoods of Black people still struggling without electricity service (Gumede and Dipholo, 2014). The lack of focused studies into the lived experiences of a limited number of beneficiaries of solar electricity at household level in a designated area, is the knowledge gap this research explores.

1.4 Research purpose statement

The purpose of this study was to assess the lived experiences of Mpame village residents in South Africa's Eastern Cape province, with regards to the sustainable livelihoods theory at household level.

1.5 Research question(s)

1 What are the changes in lived experiences of Mpame households with solar electricity?
2 How does the solar electricity strategy support the sustainable livelihoods model?
3 To what extent has solar electricity helped to sustain forests, gender and social equity?

1.6 Organization/structure of study

Chapter 1: Introduction: This chapter presents the background of the study, description of the study location, problem statement, research objectives, research questions, the significance of the study and its relevance to development and the sustainable livelihoods theory.

Chapter 2: Literature review and analytical framework: This chapter presents varied literature on the research topic and the analytical framework discussed.

Chapter 3: Methodology: This chapter discusses sample, validity, data collection, research design, ethical considerations, challenges faced during fieldwork and limitations.

Chapter 4: Data presentation: This chapter presents the raw content of the data from the study.

Chapter 5: Data Analysis: This chapter analyzes the data, generates findings and discusses themes.

Chapter 6: Conclusions and recommendations: This chapter derives conclusions, makes personal commentary and observations, recommends and suggests areas for further study.

1.7 Conclusion

Electricity access is a constitutional right in South Africa. It is a strategic criterion to facilitate economic development. Mpame village households are unable to access electricity so, the challenges highlighted justify the sourcing of alternative, sustainable and cheaper energy sources due to costs, reserve and negative environmental challenges. The study location, problem and purpose statements, and the research questions are listed.

The next chapter discusses literature on sustainable livelihoods theory (SLA), history of solar electricity, energy policies, and the challenges of electricity generation, transmission and distribution in South Africa. The impact and benefits of renewable and sustainable electricity globally in relation to rural households in South Africa is discussed. This study and report is expected to be of interest to energy industry practitioners, energy studies students and scholars of energy policy, politics, environmental economics and sustainable development (Bischof-Niemz and Creamer, 2019).

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

Industrial, state-owned enterprises (SOE's) and private consumers, find it difficult to keep up with increasing energy costs for modern cooking, household lighting, communications, appliances, micro or small enterprises, schools, health and industrialization (Hogarth and Granoff, 2015). Renewable energy from continuous or recurring currents in the natural environment (Chaar and Zein, 2011) are needed for improved livelihoods, economic activity and wellbeing (Shoaib and Ariaratnam, 2016). Literature indicates that Africa has all the potential to solve its energy challenges, if appropriate infrastructural support is provided for harnessing the abundant renewable resources in the continent, and if skills and experiences are effectively pooled and shared to address the key issues (Bugaje, 2006).

Development literature on modernization, dependency and globalization theories, suggests that solar electricity results in positive outcomes like improved economic status, social capability, functionality, capacity and wellbeing. This is critical for enabling poor, off-grid and vulnerable people to prioritize choices that improve lifestyle and social connectivity without the need of resorting to costly conventional sources of energy like hydro and thermal electricity (Pieterse, 2010).

Gauche, Backstrom and Brent (2013), argue that the rapidly declining price trends of solar modules, decentralized direct-use of solar electricity as part of an energy mix strategy will by a wide margin, provide the most pragmatic and least capital-intensive means of electricity access for Sub Sahara African households. Development policies and strategies in post-apartheid South Africa resulted in solar PV rollout projects in several rural and public areas between 1991 and 2002. The first phase of the 'renewable energy independent power producer procurement program' (REIPPP), required the provision of 5-6 kilowatt per hour (kwH) of electricity to the poor, remote, off-grid and vulnerable areas such as Vhembe, Welvercheind, Bushbuckridge, Xanthial, Athol, Rolle and Okkerneutboom.

The second phase of REIPPP in 2014, with the support of local private companies, the British and German Governments, required provision of solar PV electricity to rural and off-grid areas like Dutywa, the study location, and public areas like the Two Oceans Aquarium in Cape Town, the Johannesburg and Pretoria Zoos (Eberhard, 2014). Installations to save 200 tons of CO_2 emission per year at non-governmental organizations and institutions like the Tom Burke solar PV plant in Limpopo (160MV), the Paleisheuwel PV plant in the Western Cape (82,5MV), the Upington and Kwazulu Natal (10MV each) PV plants exist among many others (Kretzmann, 2010).

2.1 History of post-apartheid development strategies in South Africa

The government of national unity (GNU) came into existence in South Africa, after the first democratic elections in April 1994. The African National Congress (ANC), won the majority vote and headed the administration. The reconstruction and development program (RDP), was the primary socio-economic program adopted to rebuild and transform the economy different from the apartheid system's segregated economic and financial system. The broader aim was to establish societal equity and a just society through reconstruction and development while concurrently strengthening democracy (SAHO, 2015).

RDP had five policy criteria outlined in its 1995 White Paper. Firstly, create a strong, dynamic and balanced economy. Secondly, develop human resource capacity across South African and thirdly, ensure that no one suffers racial or gender discrimination in hiring, promotion or training. Fourthly, develop an inclusive, prosperous**,** balanced regional economy in Southern Africa and lastly, democratize the state and society. In principle, it was designed to address and redress the inherited gross inequalities of apartheid socially, economically and spatially. The government sought to mobilize all its people and the country's resources towards the final eradication of apartheid and the building of a democratic, non-racial and non-sexist future (SAHO, 2014)

The RDP program was successful on the social security system aspect. The government successfully and effectively established an extensive welfare system that catered for the aged, disabled, children in need, foster parents and many of the poor that were unable to meet their basic social needs. Free health care programs were introduced for pregnant women and children. Free meals were provided for up to 5 million school children. RDP however, failed and was unable to deliver in terms of economic growth. This was a major negative aspect of the program (Lundahl and Petersson, 2009).

The government experienced challenges in implementation of RDP like fiscal constraint due to the poor fiscal and economic legacy it inherited from the apartheid era and 20 years of the 'total strategy'. It experienced organizational constraints due to the lack of an efficient public service as a result of its inability to build the necessary state capacity and the inability to prioritize RDP as the guiding principle of its socio-economic policies. In summary, RDP was unable to effectively enable the collection of new taxes, had too much focus on financial probity, economic stability and the redistribution of existing revenues (SAHO, 2015; Lundahl and Petersson, 2009).

The government lacked sufficiently skilled and experienced managers, thus was unable to coordinate and effectively implement and execute successfully. A new macroeconomic policy framework, the Growth, Employment and Redistribution (GEAR) strategy was introduced in 1996 due to the constraints of RDP GEAR was intended to stimulate faster economic growth and provide resources to meet social investment needs. This policy had many of the social objectives of RDP, but was particular about reducing fiscal deficits, reduce inflation and maintain exchange rate stability. It also intended to reduce barriers to trade and liberalize capital investment. Some of GEAR's goals like fiscal deficit, inflation and government consumption targets were met. Reported figures were 2.2%, 5.4% and 18% respectively by the end of 2000. Increased macroeconomic stability, efficient reporting and improved accountability was reported (Schneider, 2018).

Public finance management improved drastically with positive GDP. The monetary policy was tightened and, restructuring at all government levels led to a reduction in government expenditure. This policy was largely criticized by unions especially the main workers' union, Congress of South Africa's Trade Unions (COSATU) for its neo-liberal approach. It was suggested that improved fiscal and monetary controls were reported but, there was decreased private investment, job creation and gross domestic product (GDP) growth. The low levels of economic growth and investments were insufficient to reduce unemployment so, there was little success with wealth re-distribution. GEAR strategy achieved some macroeconomic objectives but, did not resolve nor contribute to the social and economic inequalities of the country (Schneider, 2018). These was notable poverty reduction and employment creation but it was unsustainable and thus was replaced in 2005 by the Accelerated and Shared Growth Initiative for South Africa (ASGISA).

ASGISA was an improved version of the first two strategies of post 1994. It acknowledged the challenges of prolonged poverty driven by increased unemployment, low earnings, and the jobless nature of economic growth. ASGISA aimed to reduce poverty by 2010 and halve unemployment by 2014 from the 28% in 2004 to 14% by 2012 (Lundahl and Petersson, 2009). It recognized policy needed to address these issues and placed them at the forefront of economic policy decision making. ASGISA built on RDP's goals of building a united, democratic, non-sexist and non-racial society, and a single integrated economy. There were some degrees of success acknowledged but, the level of implementation and the future of the program was uncertain because the government did not have an official statement regarding the sustainability and continuity of the program (SAHO, 2015).

After president Thabo Mbeki's term, the New Growth Path (NGP) plan was announced by the new Jacob Zuma-led government. NGP recognized that structural unemployment remained high; levels of poverty continued to increase and afflict millions. Workers continue to be oppressed and the reality of socio-economic inequalities were more evident than ever before. The NGP was thought to be able to enable accelerated growth in the South African economy in order to rapidly reduce poverty, unemployment, economic and gender inequality. The concept was to overcome these structural challenges and contribute to the achievement of higher levels of economic growth. With hindsight however, not much progress was achieved in this regard as to its goals (SAHO, 2015).

The National Development Plan (NDP), was introduced in 2013 to prepare South Africa's long-term socio-economic development roadmap. It became the blueprint for a future economic and socio-economic development strategy and was aimed at eliminating poverty and reducing inequality by 2030. NDP identified key constraints to faster growth and presented a roadmap to an inclusive economy (Schneider, 2018). Four broad objectives were identified namely; provide overarching goals to be achieved by 2030; build consensus on the key obstacles and solutions to overcome them; provide a long-term strategic framework with detailed plans to advance the long-term goals, create a basis for making choices and how best to use limited resources (SAHO, 2014 and 2015).

2.2 History of solar photo-voltaic (PV) electricity in South Africa

The surge in the need for generation, distribution and access for the previously disadvantaged Black communities, necessitated the 1998 energy policy white paper (Maluta, Mulaudzi and Sankaran, 2014). Renewable energy projects are a key part of the South African government's R1, 2BN-a-year electrification drive aimed at providing electricity access as one of its poverty alleviation initiatives. Since 1994, 7.5 million new households were connected to the national grid equating to 4 million new connections occurred (Thabethe, 2010).

Solar (PV) roll-outs between 1991 and 2002 in rural, off-grid and public areas like Vhembe, Welvercheind, Bushbuckridge, Xanthial, Athol, Rolle and Okkerneutboom, provided 5-6 kilowatt per hour (kWh). The second phase, the 'renewable energy independent power producer procurement program' (REI4P) in 2014, with the support of the British and German Governments, and private

companies enabled electricity access to communities like Dutywa and public areas like the Two Oceans Aquarium in Cape Town, the Johannesburg and Pretoria Zoos.

Non-governmental institutions like the Tom Burke solar PV plant in Limpopo (160MV); the Paleisheuwel PV plant in Western Cape (82,5MV); the Upington and the Kwazulu Natal (10MV) PV plants benefitted by saving 200 tons of CO_2 per year (Marquard, 2006). 64 active projects, US$14BN private sector funded investments and 3922 megawatt (MW) of renewable power was generated (Kretzmann, 2010). It is the most successful public-private partnership program in Africa, amongst the top ten privately funded renewable energy programs in the last 20 years', (Eberhard, 2014).

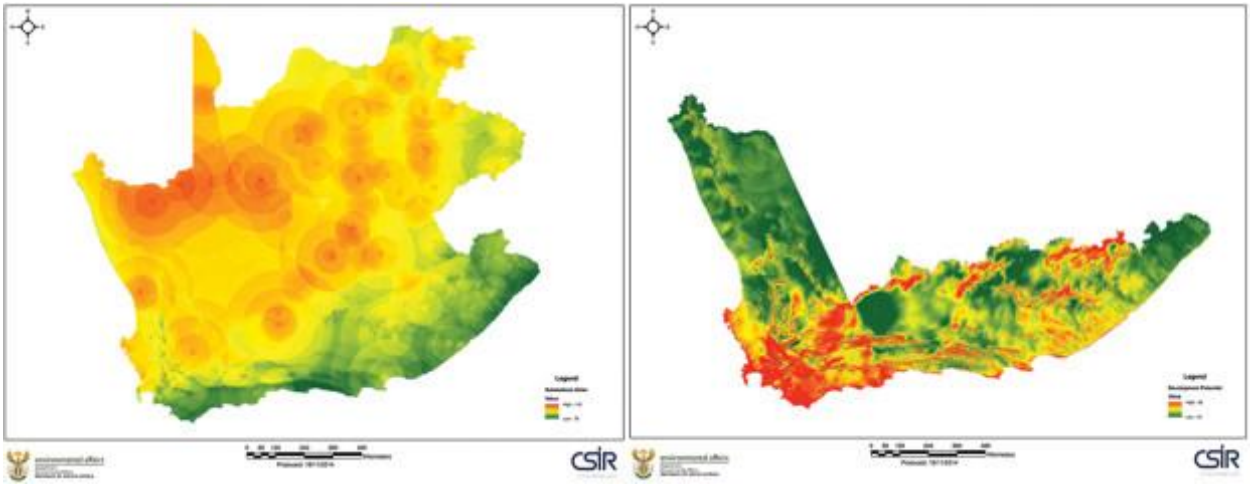

Figure 1: Solar PV (left) and Wind (right) potential for South Africa (CSIR, 2015).

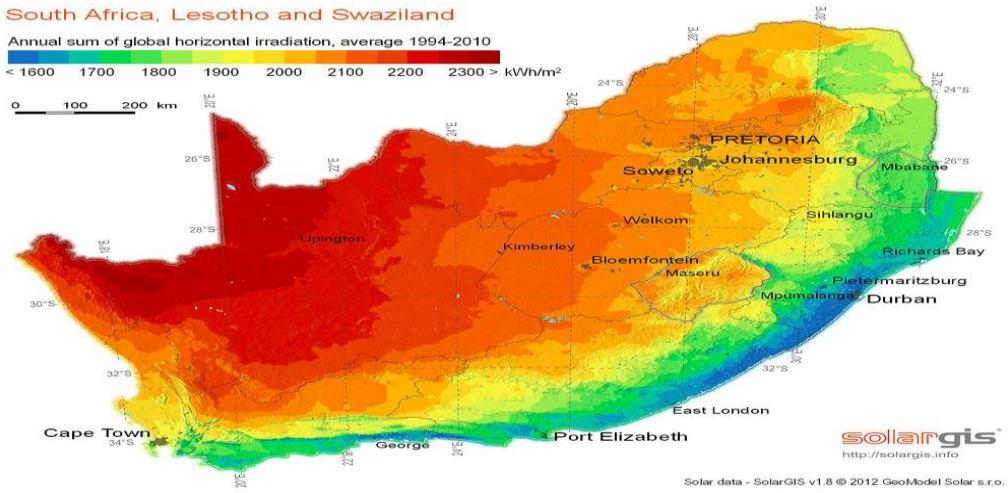

Figure 2: Solar Intensity potential for South Africa, Lesotho and Swaziland (Walwyn & Brent, 2015).

2.3 Impact and benefits of renewable and sustainable electricity

The impact of "green", non-conventional or smart energy was researched for human sustenance, existence and industrialization. This was with the intention to generate cleaner, cheaper, reliable and safer electricity (Kakwani and Pernia, 2000). A cross-sectional data analysis for 20 countries over 25 years, indicated that wood fuel accounts for 70% of energy consumption, then petroleum, with most industrial activities utilizing some form of wood fuel. The findings indicated that energy demand is inversely proportional to petroleum price, industrial development, but positively related to GDP, population growth rate, and agricultural expansion, with price elasticity less than one. Regional differences in energy demand, use and consumption, influence the interaction between population growth rates and GDP growth. The findings further suggested that countries should diversify their energy sources, introduce energy-efficient devices and equipment at all levels of their economies to improve GDP growth rate and GDP per capita (Fthenakis and Kim, 2009).

This will create a decarbonized, eco-friendly, inclusive and progressive economy, society and infrastructure system (Madubansi and Shackleton, 2007) that enables an environment and ability for poor, vulnerable and off-grid people to access a self-propelling cycle of economic emancipation, increased industrial and technological development, women empowerment, social, economic and gender equity (Kotir, 2009).

The core benefit of the sun is that it is a natural, consistent, universally accessible, available, eco-friendly and energy-efficient resource with positive environmental benefits on communities and economies (Ayodele, Jimoh, Munda and Agee, 2012). Studies conducted in the United Kingdom identify five categories of benefits like political, environmental (health, safety and security), social, economic (new jobs, technical skills and localized business) and 'wider impact' on agriculture, spatial and land use patterns (Abdelaziz, Saidur and Mekhilef, 2011).

Firstly, due to its 1,700-2,700kWp design, there is lowered carbon dioxide (CO_2) emission. A ton of CO_2 is saved annually making it 25 to 30 tons over forty-five-years. 650 tons of carbon emission savings is envisaged annually (16, 350 tons) over three years (Abdelaziz, Saidur and Mekhilef, 2011). The conception was that within the European Union and the United Kingdom, there would be more supply generated with the excess exported back into the grid using tie-grid version solar inverters, and the benefit been reduced domestic bills of up to 50%. Individual property owners with the systems would then receive monetary credits from the government but this is no longer the case according to

latest developments and policies (Faruqui, Sergici and Sharif, 2010). There is lastly storage ability for no-sunlight days and nil maintenance costs (Kabir, Mishra and Ledwich, 2014).

New, localized jobs, economic, technical, supply chain and business opportunities are created. It is clean, safe and non-combustible with no negative environmental impact as the sun is a free, natural energy resource (Khan, 2006). Financially, indications of a threefold return on investment exist (in the United Kingdom) as for every Euro (£1) invested, a three Euro (£3) cashable benefit was realized (Kerste, 2011). New management, installation, repair and maintenance jobs and technical skills transfer opportunities are created with positive knock-on effect in the local economy. This contributes to energy security, attracts investments in renewable energy and enhances property values. The evidence of savings supports carbon reduction targets and income generation, as consumers and communities contribute directly and positively to climate change.

There is reduced loss compared to centralized electricity generation, transmission and distribution that influences financial incentive strategies (Khan, 2006). From a development perspective, it is a positive, strategic and catalytic hybrid energy source for developing economies (Thom, 2000), enabling improved communication and connectivity strategy, economic growth, gender equity, child development, women empowerment and social inclusion (Fukuyama, 2017).

Benefits of solar PV electricity to development at household level in South Africa include that renewable energy sources are the core of the 1996 minerals energy complex (MEC) strategy designed by Fine and Rustomjee (Marquard, 2006). It is a distributive and re-distributive strategy for socio-economic change and a means to access other basic services (Pieterse, 2009). There is substantial welfare and income benefits of basic electricity access at household level. Low levels of electricity consumption improve the welfare of low-income households by powering lighting and other energy services like mobile phones, fans, radios, televisions, refrigerators and water pumps (Hogarth and Granoff, 2015).

Diversified energy sources will meet local demand as natural and 'free' sunshine suggests no negative economic, social, physical and environmental effects (Chu and Majumdar, 2012). My preferred definition of development is the struggle by developing nations to equal advanced and industrialized countries (Reyes, 2010). A basic solar photo-voltaic (PV) infrastructure consists of cells or modules built into nine or twelve panels per household, converting natural sunlight to electricity, producing 2000 units (kWh) per annum with twenty-five-year warranty.

The sun's intensity directly determines the amount of electricity generated hence, the more intense the sunlight, the more electricity generated for direct and immediate use or storage for no-sunlight days. The sun (solar PV), sea (ocean), wind, waste and small-scale hydropower, are viable energy alternatives for rural and off-grid households as they supplied 12.4% or 62.4 ExaJoules in 2011, estimated to be 15% by 2040. Considering the United Nations' Development Program (UNDP) 'Human Development' report that defined development as 'the enlargement of people's choices and freedoms', battery storage ability is an added benefit to its effectiveness as a sustainable energy alternative (Boyle, 2012).

Development indicators associated with renewable energy suggests positive impact on gender equity, women empowerment, economic growth, information dissemination, health, child and educational development (Duflo, 2015). In Chile, energy poverty was effectively addressed by promoting access to affordable, adequate and secure electricity for disadvantaged households, small businesses, farms and rural communities (Rodriguez-Serrano, 2016). This promoted integration planning across all government spheres, generating and incorporating sustainable development from Integrated Development Plans (Bergasse, 2013). Focused climate change initiatives through environmental impact studies to ameliorate negative health impacts from use and dependency on fossil fuels and coal were noted. Development, establishing targets for the reduction of harmful emissions, strengthened government capacity to pursue supply security through supply diversification and varied energy carriers (IRENA, 2014).

Within the Southern African Development Community (SADC), increased regional integration of energy resources, systems, skills and technologies by fostering alliances and collaborations through power pooling was indicated thus encouraged inter regional energy trade and security. In Afghanistan, economic development and equity in accessibility was stimulated by encouraging fair competition in the energy markets using targeted interventions and mechanisms. Restrictive trade barriers, subsidies and constraints on renewable energy products were reduced, improving socio-economic standards of communities and households (Shoaib and Ariaratnam, 2016).

Evidence suggests that large-scale renewable technologies assist in closing the industrial energy gap (Hogarth and Granoff, 2015). Development is the general transformation, destruction and manipulation of the natural environment, resources and social relations to increase production and consumption of goods and services by means of exchange for profit. In the South African context therefore, the energy policy-making process needs to increase the contribution of renewable energy

into the energy mix strategy and needs to be consistently reviewed due to technological advancements, efficiency, ease of deployment and low maintenance costs (Peet and Hartwick, 2015).

Critiques of solar energy

Firstly, in comparison to the cost of the energy outputs from a conventional power plant considering design, construction, installation and maintenance costs, the cost of solar energy has declined rapidly. The output cost of power to the end-user though, remains much higher than the cost of conventional energy technologies (Lesourd, 2001). Secondly, solar energy benefits from fiscal and regulatory incentives, government tax credits, exemptions, feed-in-tariff, preferential interest rates, renewable portfolio standards and voluntary green power programs stimulate its market penetration against the emission and environmental effects of coal and water electricity. Lastly, the continuation of policy supports might be necessary for several decades to maintain and enhance the growth of solar energy in both developed and developing countries (Timilsina, Kurdgelashvili and Narbe, 2012).

2.4 Sustainability

Sustainability is the long-term view taken on issues related to sufficiency, reliance and dependency as it affects future generations (Chambers and Conway, 1991). The Brundtland commission during the 1992 United Nations Conference on environment and development, introduced the sustainable livelihoods approach, expanded its understanding and scope. It is an alternative development practice with insights that enable the achievement of Millennium Development Goals (MDGs) after limited progress with the original development concepts to eradicate global poverty and accelerate integrated rural development (Gbahabo, 2011).

Chambers and Conway (1991), conceptualized an accepted definition applicable at household level. Livelihood comprises of people, defined needs, capabilities, assets and activities or means for basic living. It is considered sustainable when it can manage and recover from stress and shocks, maintain or enhance capabilities or assets, provide livelihoods for future generations, have short and long term net benefits to other livelihoods at local, national and global levels, be flexible and empowering (Krantz, 2001) at economic, environmental, institutional and social levels (Carney, 1998). It must not

undermine the natural resource base (Scoones, 1998). Assets are where people construct a living using both tangible (stores, food) resources (land) and intangibles like claims or demands and access. Electricity access and sustainable livelihoods are the study focus.

Energy supply to indigent, rural, off-grid and vulnerable populations is a complex activity transcending the simple selection of best technology. Despite economic progress within 'Third World' and developing countries, 20% to 50% of its population remain excluded (De Haan, 2000). Correlation in the 21st century between policy and practice, requires alternative ways of multiplying sustainable livelihoods by increasing natural resource-use intensity to diversify the complexity of livelihood systems. This is to improve economic synergy, productivity, environmental and social sustainability since conventional approaches undervalue future livelihoods and natural resources (Chambers and Conway, 1991). The United Nations Development Program, 'CARE' and Department for International development are major international development agencies using this approach but adapt its practice to their separate core mandates (Satge, 2002).

The UNDP uses it as a programming framework to devise sets of integrated support activities that improve sustainable livelihoods, using improved technologies, social and economic investments. 'CARE' emphasizes empowerment and capacity-building to help poor, vulnerable and non-mainstream people take initiatives to secure livelihoods through regular development programs or relief work using the 'household livelihood security (HLS) model'. Its programs are operational at community level unlike UNDP and DFID who consider policy making, macro-economic reforms and legislative processes (Morse and McNamara, 2013). DFID uses a two-pronged principle and perspective to reduce poverty; people-centric, responsive, participatory, multi-faceted/level, partnership modelled, sustainable and dynamic. Solutions are holistic, relevant and directed to the areas of concern (Carney, 1998). Fundamentally an analytical framework and not for project planning as with UNDP and CARE (Krantz, 2001).

2.5 Sustainable Livelihoods theory

Sustainable livelihoods theory approach has five indicators or themes, namely contextual conditions and trends, livelihood resources, institutional processes and organizational structures, livelihood strategies and sustainable outcomes. It recognizes the capability of the indigent and vulnerable to take

advantage of economic and technological opportunities, acknowledges other dimensions of poverty status like bad health, lack of access to basic social services, infrastructure, illiteracy, a feeling of lack (poverty mentality), vulnerability and powerlessness (Krantz, 2001).

The people must be involved in the design, implementation and execution of policies intended to improve their living conditions and standards. It has a unique implementation strategy in comparison to other development concepts that requires a holistic and strategic perspective important at local and/or policy making level (Krantz, 2001). The focus is on the points of priority for policy and research because of its implications for the 'better-offs', to create a personal environmental balance sheet, and for the poor and vulnerable groups to enhance capabilities, improve equity and increase social sustainability (Chambers and Conway, 1991).

2.5.1 Strengths and weaknesses of the sustainable livelihoods' theory (SLA)

Its strengths include that it is a holistic view of physical and natural resources (or combinations), supported with human and social capital. It focuses on the factors and realities directly or indirectly influencing or restricting access to services, assets and resources. It is a multi-dimensional assessment of direct and indirect effects and outcomes at individual, household, village, regional or national levels (Krantz, 2001).

Its weaknesses include an inability to identify the poor. Resource distribution and opportunities are influenced by existing local structures of social dominance, gender relations and power. Gender inequality and inflexibility of planning exists, making it remain the initiative of donors and consultants because of constrained municipal budgets (Scoones, 1998). The sustainable livelihoods approach is discussed in detail around its five indicators, with solar electricity access as focus.

2.5.2 Contextual analysis, conditions and trends

The contextual analysis, conditions and trends, suggest positive future economic, human and social development in South Africa remains electricity intensive (Westhuizen and De Bryun, 2016). Since electricity access, water and sanitation for the majority remains the challenge due to apartheid policy of racial segregation (Bond, 1999), the post-apartheid-era model of an inclusive development model using new technology to increase electricity access, allows for further studies to be conducted to

ascertain benefits and lived experiences at household level (Gumede and Dipholo, 2014), so as to contribute to development literature. The primary resource is the sun, a natural and consistently occurring energy resource that mitigates sustainability concerns compared to coal and water reserves. Reduced environmental damage, improved human and social capital, new economic and technical opportunities are created. Reduced generation, transmission, distribution and maintenance costs, levels of poverty, vulnerability and feelings of wellbeing will improve (Scoones, 2015).

2.5.3 Livelihood Strategies

Livelihood strategies include agricultural diversity, intensification and extension increases with the benefit of preservation. Increased economic activity like aquaculture, poultry farming, and technical upskilling through sales, repairs and maintenance of solar panels, inverters and batteries exist. Reduced migration to larger towns and cities due to increased localized economic and rural development. Safety and security improve due to lighting at night, increasing feelings of wellbeing and social connectivity (Chambers and Conway, 2001).

2.5.4 Institutions and Organizations

Institutions and organizations include the government through the department of energy and mineral resources (DMR), its sole electricity generation and distribution enterprise (Eskom), and its technology partner (CSIR), realized new approaches are required for increased access using new technologies for safer energy generation, distribution, supply, sustainability and affordability. New, independent and professional energy producers are now involved within the energy mix strategy to meet future needs. Analysis of sustainable livelihoods approach outcomes indicate positive development outcomes expected to be achieved at household levels along two areas namely livelihoods and sustainability (Marquard, 2006).

2.5.5 Livelihood Outcomes

Increased productive hours for educational, recreational and economic activity for Dutywa residents is envisaged. More work and economic activity hours reduce poverty levels thus creating increased feelings of wellbeing, functionality and capability. Increased levels of gender equity, women empowerment, safety, security and self-esteem is expected to develop. Stress and vulnerability will

decrease within households thereby increasing the levels of happiness and inclusivity. Households will be capable of designing sustainable livelihoods according to the social, human and financial capital at their disposal in conjunction with individual capabilities and resources, be they tangible or intangible (Scoones, 2015). Sustainability of the natural energy resource is supported because the Sun is an environmentally friendly, sustainable energy resource with no evidence of environmental damage or pollution. With the added benefit of battery storage, the levels of reliability is increased. This scenario is expected to assist households enhance resilience, adapt and experience progress in the short and long term (Chambers and Conway, 1991).

2.6 Uses, values and critiques of the sustainable livelihood approach

It is suitable for national level strategic research, teaching purposes, development of large-scale poverty alleviation strategies, living standards' surveys, emergency response plans, profiling of indigent groups, development of multinational sectoral partnerships, project planning, monitoring and evaluation, project reviews, institutional and policy process analysis and sectoral reforms. The values include that it assists in understanding the complexities and substance of poor and vulnerable people, differentiate between groups of poor and vulnerable people**,** recognize the relevance of technical issues like transport and information to livelihoods, facilitates discussions about existing power dynamics that underlie poverty, acknowledges and recognizes the importance of sourcing inputs from indigent people to develop responsive solutions and strategies (Krantz, 2001).

It increases levels of people-oriented solutions, rigorous and multi-dimensional analysis of participatory poverty assessments, provides data to macro-processes and has a meaningful understanding of multi-dimensional crisis like HIV/AIDS, increase links between policy advocacy, policy making and structures and lastly improve synergy between international development agencies. The critiques include that it relies on existing analytical tools and cannot act as a replacement or alternative. It also underplays one or more critical factors like vulnerability, household financial flows, gender and markets, dependent on the users' viewpoints. There is no emphasis on the power and rights of poor people to stimulate changes in social relations, while governance and institutions are hierarchical and extractive. This means that information sourced and processed from the people, dislocates them from the decision-making process and institutions. It thus, does not explain how and why change strategies are needed, reducing support and effectiveness (Scoones, 2015).

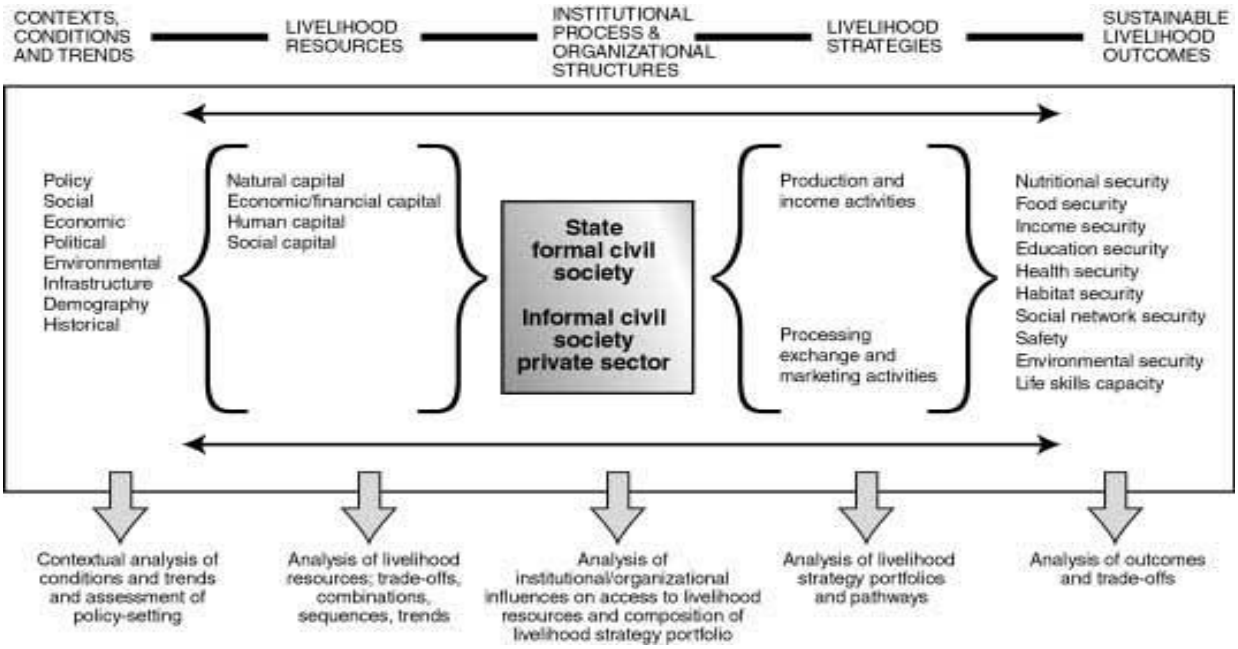

Figure 3. Sustainable Livelihoods approach framework: (Scoones, 1998; Scoones 2015. p36).

Sustainable livelihoods theory is the academic and analytical framework used in relation to this study. Its core centers on the development objectives, scope and priorities for the beneficiaries, from the perspective of the poor and vulnerable. It requires a committed probe beyond the technical, political and institutional issues in order to develop a realistic understanding of the livelihoods of the poor and vulnerable populations. It wants to understand how improvements can be identified, developed, implemented and monitored while encompassing concepts that act as a means and an end in themselves. These concepts are capability, functionality, equity and sustainability (Carney, 1998).

Capability is the ability to achieve a given function (doing or being). For example, a person can eat and avoid hunger but chooses to fast, go on hunger strike or not eat at all. Function is the ability to achieve a set goal or desire by taking and/or using a specific action, resource or service at their disposal without lack or hindrance. It reflects the state of mind, wellbeing, freedom and choice. Equity is a concept of unequal distribution of assets, opportunities and capabilities, in proportion to the most deprived groups in society like women, children, minorities, the disabled, weak, aged and rural communities (Sen, 2013).

Commentary

The themes to be explored within the sustainable livelihoods theory are contexts, livelihood resources, institutional and organizational structures and livelihood strategies (Scoones, 1998).

Data gathered regarding these themes are policy, social, economic, political, environmental, infrastructure, demography and historical under the contexts and trends criteria. Under the livelihood resource criteria, the natural, economic/financial, human and social capital data is sourced from the interview participants. As regards the institutional and organizational structures, the data sourced and confirmed is for state/civil society, informal civil society and the private sector. The information sourced regarding livelihood strategies is around the production and income generating activities, and the means of exchange and marketing activities (Scoones, 2015).

These four themes are processed to derive the sustainable livelihood outcomes to ascertain if the sustainable livelihoods theory is functioning properly. The outcomes are to be understood as security from the nutritional, food, income, education, health, habitat, social network, safety, environmental perspective. The life skills capacity is also considered to understand the efficacy of the theory under the circumstances. All the relevant information to understand the themes described was gathered from the Mpame village respondents during the face-to-face interviews conducted in September 2019.

2.7 History of South Africa's Energy Policies

Coal remains the cornerstone of the South African energy policy making process. The stakeholders in the policy making, design and implementation processes include the Department of Mineral and Energy Affairs (DMR), Sasol (state oil company), Eskom (state's sole electricity provider), and the Council for Scientific and Industrial Research (CSIR). South Africa since the 1920s, had an evolving energy policy framework spread over three epochs (Marquard, 2006).

Firstly, was the 1920s and 1930 period that focused on secure, surplus and self-reliant energy to the railway, mining, manufacturing industries, exports and the domestic, minority European population. Secondly, the 1940s and 1960s period that focused on reducing government involvement and influence, introducing price controls and de-regulating the energy sector. A study between 1973 and 1979 sourced for a comprehensive and inclusive energy strategy, indicating demand, consumption, future projections and analysis. This was as a result of the influence and pressure of the combination

of the international oil crisis and the imposed economic sanctions because of the apartheid political system at that time. This actions increased violent social unrests, changed the political landscape and with crude oil becoming a dominant, alternative and reliable energy source, a change in policy was required. All alternative sources (indigenous and imported) were identified, analyzed, and recommendations made on the costs and optimization (Marquard, 2006).

A new 1980 policy with seven stages and four core activity areas was developed. The activity areas were namely coal, electricity, nuclear and liquid fuels. Thirdly by 2005, a combination of stagnant local markets, dwindling economic growth, non-payment, finite natural reserves, decreased international coal prices and rapid industrial electrification created a renewable energy policy outlook. A voluntary target of 10 000 giga Watts per hour (GWh) contribution to energy consumption by 2013 was suggested (Marquard, 2006). This meant electricity production would include a mix of biomass, wind, solar, waste, small-scale hydro and biofuels from power and non-power generation technologies, to make up approximately four percent of projected electricity demand by 2013 (Cape and Westhuizen, 2015).

In post-apartheid South Africa, insufficient capital investments, overcapacity, rapid economic growth, massive rural electrification, increased demand, lack of regular maintenance and limited financial resources led to a deficit in generation, transmission and distribution resulting to load shedding in 2006 and 2008 (Thabethe, 2010). By 2010, the Integrated Resource Plan (IRP 2010) strategy to cover up to 2030 was released.

The recommendations were an energy mix strategy with generation allocation from diverse renewable energy sources enabled by competitive bidding using the REIPPP (RE14P) program. Strategic investments and an energy mix strategy for grid optimization, estimated a R1BN net benefit to the economy The CSIR indicated a 600 mega volts (MV) of wind and 1000MV of solar PV would contribute R5.3BN or R2.42 per kWh of renewable energy. This was against R4.5BN or R2.07 per kWh from conventional energy generation plants. South Africa is currently a leading renewable energy investment destination (Cape and Westhuizen, 2015).

2.8 Challenges of electricity generation, transmission and distribution

Traditional generation, transmission and distribution methods are expensive, unsafe, unattractive and unsustainable (Babbie, 2015). Firstly, natural coal and water reserves are finite and shrinking. The two

are expensive, unreliable and insufficient for the rapidly growing population as their demand outstrips supply (Gauche, Backstrom and Brent, 2013). Furthermore, construction of new and maintenance of existing infrastructure for both thermal and hydro power are expensive. Decreased investment, dwindling income due to illegal connections (theft), ineffective revenue collection, non-payment/inability to pay by businesses, domestic consumers and municipalities (for example Soweto in Gauteng province of South Africa owing R18BN), financial mismanagement compound the challenges (Jaglin, 2016; Tyabashe, 2018 and Fjeldstad, 2004).

Nuclear power station accidents like the 1980 Russian Chernobyl incident, create long term negative environmental and health effects. Global warming and climate change phenomena exacerbate air and environmental pollution. Lastly, inconsistent maintenance schedules, increased diesel costs and low economic activity results in infrastructure break downs leading to load shedding as was experienced in South Africa between 2006 and 2008 (Kakwani and Pernia, 2000).

2.9 Procurement challenges

Key stakeholders within the procurement cycle are national government, project sponsors, advisors, financiers, multilateral development banks, engineering, procurement and construction (EPC) contractors and equipment suppliers. The ad-hoc character, non-departmental, institutional setting, off-budget funding and program sustainability risks of these rollouts, stand to be negatively compounded by the long supply chain management procurement process of national departments and state-owned enterprises which is compounded by the corrupt tendencies of officials. Uniquely trained, skilled and experienced specialists are needed to unbundle and allow for independent system and market operators (Eberhard, 2014).

An affordable, small wind turbine or low wattage solar photo-voltaic (PV) system or configuration with battery storage, will make a significant difference in the lives of a billion rural, off-grid, poor and vulnerable households with limited or no access to any electricity infrastructure or service (Nkwetta, Smyth, Thong, Driesen and Belmans, 2010).

Renewable or non-conventional energy sources are dispersed and difficult to collect because they require substantial land resources in comparison to conventional sources. Estimates vary with regional and technological conditions though suggestions indicate that the solar cycle requires the least amount

of land while the biomass cycle requires the largest amount. Ground-mounted solar PV systems in areas of high insolation transform less land than the coal-fuel and surface-mining cycle (Kebede, Kagochi and Jolly, 2010). Solar electricity is considered safe, eco-friendly, sustainable and a high job creation potential as the sun is its primary source. Solar solutions create between 8 and 10 times more jobs for every gigawatt hour (GWh) generated than electricity from coal or natural gas (Hogarth and Granoff, 2015).

The ease of deployment, minimal maintenance costs, adaptability and flexibility to be incorporated into varied and multi-purpose built environments is irrefutable. The state is responsible to provide basic services to all households thus, access to renewable energy options is a necessary and effective political and policy strategy to enable access to healthcare, education, information, social and micro-enterprise finance so as to improve lived experiences, accelerate development and actualize social and gender equity (Chabott and Ramirez, 2010). Livelihoods in rural, remote and off-grid areas with majority of the population, is central to national development, poverty alleviation, social and gender equity, women empowerment and the environmental management debate (Scoones, 1998).

2.10 Conclusion

The success of sustainable development in Africa lies in addressing the imminent energy crisis within the continent (Bugaje, 2006). Many of the services that are important for poverty reduction would be most cost-effectively fulfilled by lower carbon technologies (Hogarth and Granoff, 2015). Therefore, accessible, clean, safe, affordable and reliable electricity is an essential development catalyst and a good development indicator since it will facilitate and accelerate socio-economic and societal change, equity, personal wellbeing and freedom particularly within the rural, off-grid, poor and vulnerable populations (Bergasse, 2013). This is a practical manifestation of the capability approach as a holistic human development model which has the objective of creating an enabling environment for people to live long, healthy, happy, creative and productive lives they have reason to value, by having the free will to choose real and tangible opportunities to do whatever, whenever, wherever and with whoever, without restriction or lack thereof (Sen, 2013 and Nussbaum, 2013).

CHAPTER 3: METHODOLOGY

3.0 Introduction

This chapter presents the methodology used in sampling, sourcing, presenting and analyzing data. A case study approach was adopted with qualitative techniques used in data collection, presentation and analysis. All participants were informed prior to the commencement of interviews that they could stop at any time they desired with no requirement to explain reasons why.

3.1 Research approach

A qualitative method approach is justified due to its informal, flexible nature and structure. It allows for face-to-face interaction with respondents for in-depth information. Using multiple data sources like documentation, archival records and direct observation, enhances data credibility (Babbie, 2015). In-depth and personal description on a first hand basis, with the precise and most descriptive experiences in the words of the respondents was desired. Their personal perspectives and explanations on a face-to-face basis reflects as real as possible what the reality would be considering that the researcher would be meeting the respondents on their territory. A quantitative approach will summarize and assume many scenarios without capturing the most realistic scenario.

3.2 Research design

A case study approach was suitable as it explores an issue through one or more cases within a bounded location or system like Mpame village. It is an empirical inquiry to investigate a phenomenon in real-life context when the boundaries between phenomenon and context are not evident (Yin, 2017). The advantages of this design is that the researcher has direct access to the participants and can ask more questions outside the set questions and probe their responses for in-depth explanation and details. It is appropriate for reasons of lived experiences that can best be described by those living the experience in reality on a regular basis.

3.3 Data collection approach and instrument

A face-to-face, 45-minute per interview per respondent approach was used. Its advantage includes a qualitative, inductive and applicable nature as a result of close interaction, observation and proximity of researcher and respondent. Varied amounts of data by storytelling, perceptions, interpretations, experiences and significance of the roll-out was generated. A cell phone and laptop recorder was used with permission of the 22 respondents over two days, using a semi-structured open questionnaire.

3.4 Data Analysis

Pattern matching, explanation building, time-series analysis, logic models, and cross-case synthesis are available techniques. Thematic data analysis technique was used for the analysis of this study as it is a process of identifying patterns or themes within qualitative data that are important, relevant or interesting. This is because the study goes beyond summarization but rather, interprets and makes sense of the data to improve understanding. For this study, data analysis followed steps like firstly becoming familiar with the data, generate codes, search for themes, review themes, define themes and lastly, write-up a report (Maguire and Delahunt 2017). In terms of the literature, the analysis was from the perspective of sustainable livelihoods theory. The themes considered from sustainable livelihoods were contexts, conditions and trends; livelihood resources; institutional process and organizational structures and livelihood strategies

3.5 Demography of participants

Twenty-two (22) mother tongue, Xhosa-speaking participants were interviewed with their consent between the 22nd and 23rd of September 2019, using a female isiXhosa interpreter. 14 participants declined to have their pictures taken, and all interviews were recorded with a cell phone and laptop recorder. The seven males were coded as "1" and the females as "2". Pictures were taken of consenting participants as part of providing proof and evidence of conducting the interviews. The context and design of the study was explained to the interpreter, then the participants (through the interpreter) prior to the start of the interviews with clear understanding that no financial gratification was involved. Participation was on a voluntary basis and the respondents could stop at any time for any reason without having to explain why.

The individual interview was conducted in a private room to allow for free expression and easy interaction between the respondents and researcher. Introductions were conducted before the interview starts, permission sought to record the interview, questions asked in English language and the interpreter translates to isiXhosa. The participant would speak, then the interpreter translates into English Language. I would probe with more questions if I needed clarity and participant was free to also ask me questions.

3.6 Sampling strategy

Purposive sampling was ideal due to its principle of maximum variation. Samples represented a variety of perspectives and lived experiences. 22 adults, who were Mpame resident, either household heads (male or female) or representatives, participated on voluntary basis and/or at data saturation. The criterion for determining the household head was that this participant is responsible for the daily decision-making about the sustenance and livelihoods of their families. The participant could be either or both IsiXhosa or English language proficient and most importantly had resided at least two years prior and two years after the rollout, with no expectation of remuneration.

3.7 Validity in qualitative data

Credibility, transferability, dependability, and confirmability were considered. Credibility is established by direct translation of interviewee responses, devoid of language or grammar edits to restore confidence in the findings so that data reliability renders data valid. Dependability over time creates stability, while confirmability is reinforced by internal coherence of data in relation to the findings, interpretations and resulting recommendations. The recordings of the interviews and translations remain as evidence to prove credibility and data reliability. They have been stored and backed up for future reference to support dependability. The records reinforce confirmability and the data is the basis from where analysis was conducted to make findings, recommendations, personal commentary and suggested areas for further study.

3.8 Ethical considerations

A consent letter and information document were designed and translated to isiXhosa for explanation using a paid translator. The participants' rights, obligations and confidentiality of information obtained was explained and confirmed as well as the study purpose before obtaining signatures and permission. Voluntary interest was verified with full rights to withdraw any time to ensure no harm or adverse consequences as it involved uneducated and vulnerable human participants. An ethics clearance application was made to the University of Witwatersrand higher degrees' committee for approval prior to commencement of research study in Mpame village.

3.9 Challenges and experiences encountered while conducting Fieldwork

The study was conducted just after the most recent xenophobic riot. Xenophobic attacks in South Africa have become an annual, regular and unfortunate occurrence by members of the local Black communities across South Africa, who attack and kill Black foreign nationals, loot their business enterprises, steal and destroy property. As a naturalized citizen with distinguished West African physical features, there was an element of risk conducting the study in an Eastern Cape village in the hinterlands. The distance and non-proximity to any official emergency response service like the police or ambulance in the event of hostility raised the risk levels. The 16-hour road travel from Johannesburg to Dutywa, then 300 km onward to Mpame village in the forest, could easily expose me to hostility and endanger my life due to the xenophobic attitudes of some Black locals.

Arrangements were made in advance for a local escort to assist me find my way from Dutywa to Mpame village in a hired 2-ton 4 x 4 vehicle. The main contact was a local preacher who had an enterprise in the solar energy installation industry. The guide was an indigene of Mpame village; he met me on arrival in Dutywa town and assisted with guiding me to Mpame village**.** He was a young, unemployed local who attended church at the preacher′s congregation. Arrangements were also made for a local translator in Mpame village due to my limited vocabulary of the Xhosa language. As far as I could understand, the translator did a reasonable job in explaining the context of my study, why and on what conditions it was to be conducted to the participants.

The matter of translation and the psychological barrier between the respondents and the researcher however, created a challenge and affected the nature of the data collected. The translator would

synthesis the responses which tended towards short and brief English Language answers. That would not allow much probing as the full and intended meaning of the responses would have been lost somewhat during the translation process. Some data to enrich the data sufficiently would be lost therein for the study. Upon data saturation at participant 22, the study had to be stopped. This is when responses began to be the same from all respondents for all questions.

There was potential medical risk using the pit latrine system as it is not the most hygienic sanitary system. A short walk through nearby bushes to access the cubicle exposes one to potential snake bite. It was not an exercise to be conducted at night under any circumstances. The local clinic opens only during weekdays and the study was taking place over the weekend hence, in a case of medical emergency, there was no recourse to emergency service and/or assistance. One had to be acutely aware of the surroundings and be careful with interactions and movement within the village.

The water in the area is not suitable for consumption. 5 of 5-liter bottled water was purchased from Dutywa before the trip to Mpame village for drinking purposes. Deliberate effort was made to secure a reliable truck but, there remained a possibility of a motor breakdown during the onward and outward bound travel. A breakdown or an emergency would leave the researcher stranded for days before help would arrive due to the challenging state of the road into the village, which lied parallel to the sea, in between hills, valleys and steep terrain with a forest to go through. Cell phone communication was however excellent with good network reception. The researcher was located on a gradient, the host was a warm, welcoming and friendly, male, local ward committee member of the governing African National Congress (ANC), who spoke no English but assisted and supported the study in every way possible within his means, ability and capacity. He understood the context and conditions of the study.

3.10 Limitations

There was no support from industry, government, the university and my employer. This meant interviews were conducted within a limited time constraint and no possibility of follow-ups because of limited personal financial resources. There was potential travel and personal risks due to road travel between Butterworth and Johannesburg. As a naturalized South African citizen of West African origins, not fluent in the local isiXhosa language and conducting research study in a remote village just after a xenophobic crisis, there was potential personal risk with no rescue service in an emergency.

Gaining access to individual participants and receiving permission of individual household heads, the local chiefs and established local and political authorities to conduct the study required negotiations. Securing temporary accommodation in Dutywa town and Mpame village for the duration of the study coupled with the challenge of logistics between households within the village due to mountainous topography existed. There was the expectation for gratification by the residents due to their personal socio-economic and financial circumstances, vulnerability and need to get repairs and battery replacements done on damaged systems and other unplanned limitations that may arise. No one withdrew from the study because of non-gratification. Instead, there was need to explain why the study had to end without getting through the remaining people waiting outside as a result of data saturation. The interpreter had to explain the reasons to these group of people and disperse the group

CHAPTER 4. DATA PRESENTATION

4.0 Introduction

Thematic data analysis technique was used for the analysis of this research. It is a process of identifying patterns or themes within qualitative data. Identifying themes or patterns in the data is important because the study goes beyond summarization but rather, interprets and makes sense of the data thereby improving understanding (Maguire and Delahunt, 2017).

The contextual conditions and trends, livelihood resources, institutional process and organizational structures, livelihood strategies and sustainable livelihood outcomes are the themes for this study. They are derived from the sustainable livelihoods theory as explained later in this report. Lived experiences, sustainability, family/social dynamics, safety and security, communication and service delivery were sub-themes identified from the participants' responses. The themes are discussed in chapter 5 in relation to the research questions.

The context, conditions and trend was typically that of living in total darkness after sunset and having to buy matches, candles, paraffin and lanterns for lighting and cooking purposes.

> Three of the participants spoke about living in darkness as a norm where there is no income, and no relative working in the larger cities sending money back home. For instance, "There is no light where there is no money. I was born here in 1954 and have lived here since, and I am a ward committee member today. I know the history of this village well" (Participant A, September 2019).
>
> Five of the participants spoke about having to walk five kilometres to the local clinic to charge their cell phones for a five Rand fee. This was because this was the "closet place during the week that had grid electricity accessible to the villagers. The next best alternative was Coffee bay, a White dominated and affluent suburb, a 10km distance walk away" (Participant G, September 2019).

From the sample group of 22, two female participants did not furnish their ages because they did not know nor have birth records for veracity. The average age of the remaining participants became 50 years and 5 months. The average age of women participants was 48 years with the minimum at 24 years and the maximum at 70 years or older. The males average age was 55 years and 2 months with the minimum age at 43 years and the maximum at 65 years.

4.1 Demography (Household Heads/Representatives)

Fourteen (14) participants were household heads while seven were representatives. The seven representatives were female while another seven were single mothers'/household heads. One female acted as a representative because her 'husband works far'. One female did not respond to the household role question and the seven male participants were all household heads. There were more female-headed households than males, reflecting a link between the higher female population and the feminization of poverty for reasons of geography and history. The claim is that while African men were recruited to work in urban areas, their families were not allowed to join them. This allowed for large streams of male labour migration from rural homelands to urban townships, leaving the women as heads (Schatz, Madhavan and Williams, 2011).

4.2 Language Proficiency, Identity, Residency and Privacy

All 22 participants were mother tongue Xhosa-speaking adults, who had resided in Mpame village at least two years before and two years after the solar installation in 2014. The context, design and intention of the study was explained with clear understanding that there was no gratification of any type afterwards. Participation was on a voluntarily basis, with full consent and the respondents spoke directly to me through the local interpreter. It is important to note that some nuances of meanings would be lost in the translation process. My interpreter was a local female resident, who was born, bred and had her junior high school in Mpame village. She attended high school in Dutywa and returned to get married to a fellow Mpame resident. He now works in Mpumalanga province and she has two children living and schooling outside the village. She was unemployed, looking for opportunities outside to 'earn some money for herself'. She has previously assisted with Xhosa language translations in East London for researchers and was aware of how the research process and fieldwork operates.

Fourteen (14) female participants declined to have their pictures taken as they did not either feel comfortable with the idea or had reservations about the possibility of their husbands knowing and/or seeing their pictures later in public if the report was published. The interviews were conducted in a

private room to reduce the possibility of intimidation and/or influence of any kind from anybody within or outside the group. The males were coded '1' and the females coded '2'.

4.3 Interview recording, Transcripts and Confidentiality

All 22 interviews were recorded using a laptop and cell phone (for backup) as proof. This was with the consent of the participants prior to starting the interviews. The questionnaire comprised of four questions, to cover each section of the sustainable livelihoods theory, so as to generate an aggregate understanding of the theory. These questions contextualized the lived experiences, resources, strategies, institutions and organisations of the participants. Each participant was coded as an alphabet to avoid confusion and identify sub-themes.

4.4 Livelihood resources

Livelihood resources refer to natural, economic, financial, human and social capital. Daily livelihood is a constant struggle in Mpame village with limited to no economic activity in the area except for people on government grants or have a working relative in the bigger towns outside the village.

> There is potential for hair salon, sewing and retail business if there is solar electricity. Before 1994, there was no electricity at all but there is a lot of improvement now for anyone who knows this area well. Even the roads are under construction for R3M. Solar electricity has made a mark, changed the villagers' perspective and made a difference in peoples' lives (Participant S, September 2019). Things like houses burning down used to happen because our children were using candles to do their homework then falling asleep. That is now history and there is a definite difference". (Participant V, September 2019).

The people who are unable to replace their batteries because they cannot afford it have literally reverted back to the old lifestyle of living in darkness after sunset. Six respondents were despondent because the batteries had ceased to work. For instance, for participant G;

> I use batteries for my radio but have no TV. We could charge our cell phones while my children could access the internet and listen to radio. We have been unable to enjoy these things anymore since my system does not work anymore because the batteries are dead and I am unable to afford to replace it (Participant G, December 2019).

Service delivery challenges are real here. Villagers walk 10 km to Coffee bay, a predominantly White seaside suburb for groceries or the local clinic that opens only during the week for medical services.

> You should not have a medical emergency over the weekend as you will not receive medical assistance because the clinic would be closed. We can only buy our groceries when we go to Coffee Ba*y* (Participant R, September 2019).

The extent of despair experienced by the households in Mpame village is described thus;

> …...It was so bad that when we had funerals and there was no money available in the family, people slept in darkness (Participant T, September 2019).

> Access to solar electricity did help to change our lives for the better a little bit (Participant U, September 2019).

These statements suggest that the introduction of solar electricity in Mpame village created a positive perception of service delivery and safety to households.

4.5 Institutional process and organizational structures

The state as an institution is represented by the Mbaishe municipality and the ward councillor. The ward committee is the lowest organizational structure closest to the village and households. The two tourist lodges in the village, represent the presence of the private sector in the village.

With regards to the expectations of sustainability of the solar PV installation strategy, there were some negative attitude towards the government. These negative responses and attitudes were based on the length of time between when the installations were done in 2014, how long they lasted and how long the participants have been without solar electricity since the batteries reached their end-of-life stages from 2018 and relative to when the interviews were conducted in September 2019.

> I am unhappy and disappointed now as I expect government to replace the dead batteries so I can enjoy electricity again (Participant C, September 2019).

> It is negative perception now as the batteries have been dead for over a year and nobody is talking of replacing them; back to candle and paraffin (Participant M, September 2019).

All the participants suggested that the main democratic dividends gained as an outcome of the 1994 elections was represented by the "free" electricity in their responses. The villagers' understanding is that if it were not for the governing party they voted for in the elections, they would not have received the solar electricity installations in 2014. The local municipality and the provincial government structures represent the institutions and organizational structures who facilitated this project by allocating, budgeting and releasing the required funds to execute the project in 2014.

> Free electricity was available at home and communication was easier until the batteries stopped working one and a half years ago. Life got better especially at night as people could see each other, interact closely and have lighting outside (Participant E, September 2019).

Question 4 was asked with regards to user satisfaction and feedback about the installations. This question is important because of the regular and violent service delivery protests and accusations levelled that the South African government pays lip-service towards the needs of the poor and vulnerable especially women and children.

The participants' responses in summary were that of neutrality as

> ……solar electricity does not support cooking. This is a major need for all the households so, if solar electricity that supports cooking was made available, there would be a positive attitude towards government's service delivery efforts (Participant A, September 2019).

> There has been no after installation service so, beneficiaries are unable to access electricity anymore after the batteries started dying off. People are expecting, waiting and looking to government to replace the batteries as was promised before the elections in 2014 (Participant J, September 2019).

The issue of money, corruption and socio-economic status being the basis of ability to access grid electricity in Mpame village was raised. Considering the cost involved in connecting to the grid and the inability of these households to afford due to their socio-economic circumstances, it suggests that some corruption may be taking place within the municipality electrification structures. This is because there was no evidence of metering infrastructure sited within the village nor were the installations of the pre-paid technology noticed at the few homes having grid electricity access.

> People with money are able to connect to the national grid electricity infrastructure passing through the village (Participant D, September 2019).

In low-income and non-economic communities such as Mpame village, focus is primarily on the provision of the most basic services such as, lighting, phone charging and communication. With grid electricity, households are able to do more like cook and refrigerate for preservation. Having access and not having to pay for it then puts a question mark on how these few households are able to access the national grid while the majority are unable to? (Ulsrud, Winther, Palit and Rohracher, 2015).

4.6 Sustainable Livelihood outcomes

To understand the outcomes, the nutritional, food availability, income, education, health, habitat, social network, safety and environmental security and life skills capacity need to be examined. Meat is provided by breeding local chickens, wild pigs, goats and cows. Food is limited as there is no active farming of the land going on though there is arable land. Foodstuff is purchased from the retail stores in Dutywa. Bottled water is a privileged commodity in the village as most people are unable to afford it. They rely on drinking water pumped into the village periodically from coffee bay or boiling water sourced from the nearby stream.

Income generation opportunity is non-existent as there is limited economic activity in the village while the nearest local market is 300 km away in Dutywa town. The local clinic is a five kilometre walk from the village. Life skills capacity is low as most residents are illiterate, unemployed, unskilled and unemployable. Any natural entrepreneurial capacity is stifled by the environment. This is why some of the respondents who could conceive the idea of entrepreneurship expressed reservation.

> I do not know of any economic activity in Mpame village because the batteries do not last. There could be possible economic opportunities but I would not know how to start out of fear (Participant A, September 2019).

This fear is probably due to the low esteem and self-confidence of the interested participants as a result of illiteracy and inability to access relevant information and financial assistance. Three participants would like to know more about solar compatible equipment that could facilitate economic activity like solar freezers, television sets and fans. The suggestion was that if there was access to

information and financial support from the municipality, some people may try indulging in some entrepreneurial activities within the village.

> ….the villagers are not active because they lack information and knowledge. I have completed eight thousand installations across many villages. If I got more tenders, I could make more money (Participant V, September 2019).

> I never had any thoughts of nor noticed any economic activity in the village (Participant C, September 2019).

> If it was possible to have solar fridges, I could sell cold drinks and meat because I would be able to preserve them for longer and do other business (Participant I, September 2019).

Some participants however, did not show interest in entrepreneurial opportunity even if information and financial support was possible and provided.

> Possible but I am not interested. I am too old for that now (Participant G).

The educational facilities are substandard, and the habitat is typically rural in nature with no modern facilities, infrastructure nor access to basic services. The social network is mainly family based and distributed. For example, my host has a large plot of land in the village. He has divided and allocated them separately to his adult children as they started their own families within the village. Safety and security concerns are real but low criminal activity was reported by the participants.

> If at all, criminal activity will be primarily animal theft here. (Participant T, September 2019)

There is no police station located within the village so it was impossible to confirm the veracity of the claims nor source valid data officially. Communication is possible using cell phones but you need to ensure they remain fully charged for easy use. There is a road under construction through the village but no drainage and sewerage services are available. Bathing is possible by using water that is boiled, mixed with some cold water in a small basin with a face cloth and soap. This is because ablution and sanitary facilities are not modern but the people who can afford it, use gas for cooking while the majority use wood. Service delivery is of low quality in the village.

4.7 Social, environmental and gender equity

There is a levelled basis for every household to be non-functional in this village within the framework of the sustainable livelihood theory. The village lacks all development criteria like basic educational standards, technical personnel, roads, electricity and development infrastructure. Cellular communication is the only functional item but without electricity and ability to pay the fee required, how do you keep the phones on always? Poverty is the common theme visible in this village as the young people and children roam around with no aspiration. Marriage is the likely route out of poverty for the young females.

> We can see each other and interact better at night, while the children are able to do more schoolwork before they sleep. We discuss some current affairs news we hear on the radio with our children (Participant G, September 2019).

With most of the systems offline due to the dead batteries, negative feedback was in the majority;

> Family dynamics is not positive anymore in comparison to when the system worked. Things have changed in my household. The grandchildren living with me used to benefit a lot. The ability to access the internet and social media is a major confirmation of equity. Jobseekers are able to view and apply for jobs online from the village "without incurring major costs" (Participant U, September 2019).

CHAPTER 5: DATA ANALYSIS AND FINDINGS

5.0 Introduction

This chapter discusses and explores the data and themes mentioned in chapter four in the context of the literature and what it means in line with the sustainable livelihoods theory. The findings, personal commentary and conclusions were made thereafter based on the results generated from chapter 4.

The sample population excluded residents who were not living in Mpame village before 2014 and those who had lived in Mpame village for less than two years after the installation. They were automatically excluded from the sample because they did not meet the set criteria of having lived in the village at least two years prior and two years after the solar PV installation. To understand and interpret the data, it needs to explain and answer the research question(s). Firstly, descriptive statistics was undertaken to interpret and understand the data. The demographic analysis considered participants' age, household role (head or representative), and if the person had lived at least two years prior and post the 2014 installations. The interview questions linked into the themes of the sustainable livelihoods theory from the interview transcripts.

5.0.1 Mpame village conditions and trends described by participants

Participants expressed the challenges of living in darkness consistently for decades if they did not have money for matches and paraffin for their lanterns and candles. The data shows that life was challenging and harsher without solar electricity as regards darkness due to lack of electricity. There are security and safety challenges at night especially for the more vulnerable groups like the aged, women and children. The findings established that economic and social interactions was limited to daylight hours. During winter, economic and social activities would be even less as there is shorter daylight suggesting weather has a short-lived effect on economic and social activity indicating at Mpame village. The analysis was that solar electricity was welcome, accepted and appreciated as a positive impact by all the participants.

5.0.2 Livelihood resources and strategies (Analysis of livelihood strategy and pathways)

There are no production and income generation activities in the village. The only mode of transport in and out of the village is one taxi that leaves at 5am and returns at 7pm from Dutywa during the

week only. In the event of an emergency or an urgent need to leave the village, or a mechanical breakdown, one would be stranded. Processing exchange and marketing activities is impossible and non-existent but for the two private tourist lodges close to the sea shore. The scenery is calm, cool and quiet with undulating, green and rolling hills in the background but the locals do not benefit from these sceneries for recreation and leisure. In the experience of this research borne out by the Bangladesh experience, access to the levels of power provided by solar does not result in increased economic activity like job creation (Baurzhan and Jenkins, 2016; Rahman and Ahmad, 2013).

Communication or social engagement within and between the households, with neighbours and family outside the village, is a major benefit especially during emergencies. With the ability to charge their cell phones at night, villagers interact better by calling each other or use WhatsApp service for communication purposes. The few who still have their systems active because they could afford to replace the batteries, maintain a positive outlook. They are still able to charge their cell phones and also have electricity inside and outside their homes.

> Communication with friends and family members outside this village and security at home was much better when the systems were functional. If government could replace the batteries for everybody, we would be happy and feel safer (Participant H, September 2019).

Service delivery perceptions remain positive for many of the participants regardless of the current circumstances because it turns out that Mpame villagers were promised national grid electricity after five years when the 2014 project was completed. There remains a strong belief that this promise will eventually come true though some participants showed doubt, disappointment and scepticism.

> I believe that the government will deliver on its promises eventually. I am happy with government service delivery efforts because electricity made a big difference but presently disappointed as the batteries have packed up (Participant P, September 2019).

> I am appreciative of government's effort at bringing electricity to this village. The government tried but now that the batteries are not working, we are gradually going back to the life of darkness (Participant R, September 2019).

There seemed to be a strong conviction amongst some of the participants that the provision of grid electricity or battery replacements for the solar systems will become reality one day. This is probably due to their loyalty to the governing party within the province. Even when they were probed to explain

their perception of the delay experienced so far, there was reluctance to give up hope. This is probably because of their levels of poverty and vulnerability making them believe in the promise and hold on to it since they had no alternative option to consider. One of the participants succinctly expressed this conviction thus;

> If the government was able to bring solar electricity to this village in 2014, I believe it will eventually bring grid electricity one day. After all, the clinic and some households here are connected to grid electricity (Participant V, September 2019).

The few participants who indicated negative response to the project′s sustainability and scepticism about governments′ ability and willingness to replace the batteries, did not seem strong enough to verbalize their scepticism emphatically. They instead nodded in the negative silently and possibly borne out of prior failed promises and failure to implement infrastructural policy mandates.

5.0.3 Economic, social, environmental and gender equity

The introduction of solar electricity indicated a positive impact on households as it improved living standards. Solar electricity reduced household expenditure as well as improved health due to a reduction or complete elimination of biofuel smoke emissions, when the systems were functional. Gustavsson, 2004, showed in a Zambian case study, that the integration of a solar power home system had a positive impact on a user's livelihood. Komatsu, Kaneko, Ghosh and Morinaga, (2013), undertook a study on the determinants of user satisfaction with solar home systems (SHS) in rural Bangladesh. They found that users who received the benefits of solar electricity, resulted in an increase in children's study time and showed a higher level of satisfaction with the system.

Grimm, Munyehirwe, Peters and Sievert (2016), in their study on low cost solar kits and household's welfare in rural Rwanda, showed a significant positive effect on household energy expenditures, health, domestic productivity and the environment. These studies are evidence of an indication that apart from safety being improved, livelihoods were better. The negative attitudes are due to failed promises and allocation of adequate budgets. To mitigate the tensions expressed by participants, Lemaire (2011), suggests a clarity of the role of each stakeholder in the institutional framework where government,

small electricity companies and community are all involved in the planning and implementation of electrification projects.

5.0.4 Variation in use and Applicability

Most of the experiences were positive when the solar system worked but negative it is not functional Financially, Komatsu, Kaneko and Ghosh (2011), argue that most households are free from having to buy kerosene, candles, lanterns and rechargeable batteries that account for 20–30% of monthly expenses. Other benefits (micro-benefits) include but not limited to electric lighting, watching television, and the ease of mobile phone recharging at home. For example, electric lamps provide better lighting quality, improve the indoor air quality and also creates a better environment for studying and working at home. Television provides entertainment programs and updated news. One participant indicated he had never owned a cell phone or TV in his lifetime.

Communication in human interactions, social dynamics and general livelihoods is essential. The modern cell phones enable online access to services from their fingertips. For example, some participants charge and use their phones to access the internet for general information, job vacancies, read current affairs online and interact on social media platforms like Facebook and Whatsapp. Cell phones in some rural African communities have been used for economic purposes by farmers that use cell phones to negotiate with potential customers thus, can indirectly contribute to facilitating economic processes and activities. Collings (2011), found some use the phone to keep track of family members, to move money, and to exchange information.

Some participants are optimistic of the potential of economic activities in Mpame village but indicate some barriers such as lack of access to information. In the research literature, evidence suggests a link between solar electricity, lighting and economic activity. Obeng and Evers (2010) in their Ghanaian studies, established a significant association between solar PV lighting and increased income for rural grocery enterprises (merchandise stores). There is guarded optimism from Mpame villagers about the possibility of economic activity if issues like a source to change their batteries, supply solar-compatible products and access information on solar installation, maintenance and repairs was sorted. The analysis for now however, is that there was no possibility of economic activity even if they wanted.

> If it was possible to get fridges to work with solar electricity, I could do something. I am unaware of solar products (Participant Q, September 2019).
>
> Yes. there is a lot of opportunity. Firstly, the local solar PV suppliers 'SSS', can sub-contract installation jobs to 'co-ops' formed by the municipality to share technical expertise, experience and after-sales maintenance. There are sales opportunities for solar products like fridges (Participant V, September 2019).

5.0.5 Safety & Security

This was a priority for participants regardless of gender. Night darkness around the surroundings is a concern as it influences the feelings of wellbeing. This is because safety and security is linked directly to solar electrification as a benefit in a study on identifying the needs of communities in rural Uganda (Hirmer and Guthrie, 2016).

> Feelings of personal safety improved when the systems were fully functional as there was lighting inside and outside their homesteads. Lighting enabled children to undertake personal and increased educational chores due to the extended time electricity provided. There was an increased, positive feeling and perception of development even with their low economic status (Participant R, September 2019).
>
> Electricity access has been proven possible and improves my feeling of progress, wellbeing and development (Participant U, September 2019).

Buragohain (2012), found that crime rates declined due to availability of solar street light in the villages sampled in her Indian studies. Though not an economic activity, it is noteworthy to mention that there is a significant association between lighting and a reduction in crime, personal wellbeing and improved perception of development was generated.

5.0.6 Forest stocks

The size of the solar installations was never such that they could use it for cooking hence, this is not an issue in this research. On a larger scale however, there will be a gradual decrease in the use of wood for cooking purposes. The impact on biomass was not negatively affected with the introduction of

solar electricity at this level of implementation but the continued dependence on biomass and wood for cooking purposes and the construction of an access road through the forest on a larger scale and in the long term, will create a direct and negative impact on forest stocks as it will dwindle. The cost of using gas for cooking would be unsustainable as an energy source for the majority of the respondents in this study in the long term.

> The challenge with solar electricity is that it does not allow for cooking so, we still buy gas or use firewood to cook and boil water for ablution purposes (Participant A, September 2019).

With the batteries not functional anymore for most of the participants, they have resorted to using wood again which over time could contribute to the depletion of the forest stocks in the area.

5.0.7 Personal commentary, points of interest and observation

Neo-liberalism policies from 1994 under the guise of "market friendly policies", have worsened the levels of socio-economic inequality created under the apartheid system and has failed to stimulate significant growth and development. The prospects for long-term economic, social, gender equity and human development to resolve the development debacle in South Africa, is directly linked to its energy mix strategy policies. The non-inclusion of an energy mix strategy may result in South Africa reflecting one of the great failures of mainstream economics and neo-liberal policy recommendations in World history. Breaking the poverty cycle and uneven development requires fundamental changes in institutions, policies, democracy practices, ownership structures, and the very nature of the economic system and the methods of implementation (Schneider, 2018).

Corruption or low service delivery levels could be compromising the implementation and/or installation of grid infrastructure in Mpame village. The local clinic and a few households are linked to the grid but if they pay (and how) is the question? There were no visible signs of pre or post-paid electricity metering infrastructure noticed during the study. The current status for most of the villagers of the inability to access electricity therefore raises questions as to how the few households have access to electricity but majority do not?

5.0.8 Conclusion

This chapter discussed the effect of the study data presented on livelihood and resource strategies and outcomes, the economic, social, environmental and gender equity aspects, the variation in use and applicability, communication, safety, security, forest stocks, a personal commentary, points of interest and observation. Chapter 5 espouses the lived experiences of Mpame housholds and attempts to answer the study's research questions such as; the changes in lived experiences of Mpame households with solar electricity, and, the extent to which solar electricity helped to sustain forests, gender and social equity.

For example, Mpame households lived experience included but not limited to a positive peception towards solar electricity as they welcomed, accepted and appreciated this as a positive impact to their village. Conversely, participants indicated negatively towards the project's sustainability and scepticism about governments' ability and willingness to replace the batteries. Also, households perceived solar electricity to have contributed to reduced household expenditure as well as improved health due to a reduction of biofuel smoke emissions, when the systems were functional. Regarding the variability in use and applicability, most households interviewed were positive about the solar system when it worked but negative when it did not work

Continuing, darkness around the surroundings was a concern as it influenced the feelings of wellbeing among households when safety and security is concerned. With regards forests stocks, this study noted that the impact on biomass was not negatively affected with the introduction of solar electricity because the solar PV was not designed to contain enough energy for cooking. However, the continued dependence on biomass and wood for cooking purposes will continue that will create a direct and negative impact on forest stocks due to dependency for heat and cooking.

Lastly, the study researcher observed that there were no visible signs of pre or post-paid electricity metering infrastructure at Mpame village. This study notes that the non-inclusion of an energy mix strategy may contribute to SA many failures but with the new administration, that energy mix is slowly becoming a reality both in strategy and implementation and a future benefit for households in villages like Mpame.

The next chapter discusses the recommendations, areas for further study and conclusions made by the researcher based on the data and observations during the study.

CHAPTER 6: CONCLUSION

6.0 Introduction

This study in attempting to provide answers to the primary and secondary research question(s) raised in chapter 1, suggests that there were positive lived experiences of Mpame village households with the introduction of solar PV electricity. Notwithstanding the current technical status of the systems, the respondents welcome the introduction of that strategy to enable them access electricity as a human right as stipulated in the South African constitution. The introduction of solar PV electricity facilitated the sustainable livelihoods model even if it was in a limited capacity considering the outcomes. The four criteria of the theory were actualized but the issue of its sustainability raises concerns about its effectiveness and the items in the list of its outcomes. As to what extent solar PV electricity has helped to sustain forests, gender and social equity, the results are not clear-cut due to the extent of its implementation. The solar PV systems are designed for basic lighting and security but do not cater for cooking and economic activities.

The introduction of an upgraded solar system that can cater for cooking, refrigeration or more solar-powered electronic equipment would address the need to explore the knowledge gap further. Areas for further studies have been suggested in the recommendations made in the following section.

6.1 Recommendations

The access to electricity as a constitutional right for development and sustainable livelihoods in South Africa is possible through solar PV electricity. The respondents are happy, appreciative and remain hopeful of more infrastructure to better their lives and livelihoods at household level. The primary recommendation is that the residents need to hold the government (Mbhaise municipality, Eastern Cape province and the national government) directly responsible and accountable for the battery replacements required, and the sustainability of this strategy through their collective voting power in the next round of municipal and provincial elections due in 2020.

Further recommendation includes the need for the local municipal government to consider the residents' socio-economic circumstances in the strategy implementation to make it sustainable and meaningful. A person who has experienced the difference between total darkness and limited electricity access but has to relive darkness again, will find it challenging to adapt than one who never

had the experience of electricity access because, the difference is very clear. Secondly, policy implementation, budget allocation and communication with the community is essential to show political will and expediency to sustain service delivery and implement policy mandates. There are visible efforts to get grid electricity into or through Mpame village from observation because of the infrastructure (poles, cabling, trucks and municipal workers) sighted during the study. The perception is that the 2014 project was timeous as it was an election year. Thirdly, grid electricity may not be the permanent solution for Mpame village as respondents will have to pay for the service. Considering that the residents may not be able to afford it in the long term due to their financial circumstances, the people who can afford and pay for it, can have it but those in majority who cannot, can remain on solar system with the understanding that government will replace the batteries periodically and/or at end-of-life stages.

Lastly, the decision can be made to connect the village in totality to the grid and be provided free electricity as promised. Their needs and consumption requirements are minimal and basic so they can be subsidized with higher rates by residents in the more affluent and nearby suburbs and towns. In that way, there will be no ambiguity nor unwarranted expectations and/or perceptions of political machinations regardless of who governs the municipality in future.

6.2 Areas for Further Study

This study is suggesting some areas warranting further studies. One, the impact of corruption on implementing solar PV electricity. Second, the socio-economic and psychological effects of leaving Mpame residents in darkness perpetually, and the effect of the type of political culture (parochialism, subject and participant) on development strategies.

6.3 Summary

This research set out to explore the lived experiences of Mpame village residents of South Africa's Eastern Cape province, with regards to the sustainable livelihoods theory criteria as an outcome of solar (PV) electricity at household level.

The answers to the research questions were that the lived experiences of Mpame village was positive and expectant of access to other basic services like water and sewerage services from the government. The sustainability of this strategy remains the question as the batteries are now dead and there is no forthcoming communication from the government to remedy the situation and stop the return to the life of darkness and under-development. Having undertaken this study along the analytical framework of the sustainable livelihoods theory, the outcomes generated are that productivity, educational standards, safety, wellbeing, forest stocks, gender and social equity questions have not been addressed due to the question of sustainability. There is discomfort due to no lighting within the village. The children are unable to do homework at night, young people remain jobless, unemployable, unskilled and unable to access the internet via their cell phones for information and job opportunities as they are unable to charge their cell phones easily. They find it challenging to start paying for this service or walking all the way to coffee bay again.

There are no prospects of economic activity nor signs of government availing itself in assisting with battery replacements. If this strategy cannot be sustained in the long term, as it seems at the moment, life will revert to the old 'normal' where social, economic and gender equity disparity reigned. The forest stocks may not be depleted at this point considering the scale of the installations but a sustainable livelihood for the residents will not be possible, practicable and realistic either without considering their daily socio-economic realities and conditions in the long term.

The need to break the poverty trap and sustained poverty cycle for generations has to be a priority for the government by implementing and executing pragmatic policies backed up by sufficient budget, personnel and infrastructure allocations. This study is arguing that solar electricity is the most pragmatic, alternative and affordable means of enabling electricity access as determined by the constitution as a basic human right for all citizens.

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APPENDIX 1:

Interview questions, scope and area of interest

The change in lived experiences of Mpame village households using solar photovoltaic (PV) electricity.

No	Questions	Probes	Aspects / Themes
Section A: Contextual analysis, conditions and trends (Lived experiences)			
1	How long have you lived here?	Prior + Post rollout?	Residency and Relevance to research study
2	How was life without (or before) solar PV electricity?	Please elaborate with examples	Impact
3	How has life changed since you had solar PV electricity?	Please elaborate (Probing Qs)	Benefits, Change and Inclusive Development?
4	Has your attitude towards govt service delivery changed since the PV electricity? How?	Please elaborate with examples	Socio-economic adaptation
Section B:	Resources, Strategies, Institutions & Organizations	(Sustainability)	
1	Family dynamics, schoolwork?	Please elaborate with examples. How and why?	Educational improvement, Feelings of wellbeing
2	How do you use solar PV power?	Please elaborate with examples	Adaptation
3	Has economic activity increased?	Please elaborate with examples	Diversification
4	What is your experience accessing other services (Dutywa)	Please elaborate with examples	Health, water, sewerage, communication services
5	What is your perception of security, safety and wellbeing?	Please elaborate with examples	Livelihood strategies
Section C:	Demography and Bio – Data	(Demographics)	
1	Age		
2	Gender		
3	Position in family		Household Head?
4	No of children in household?		Household composition
5	No of people in your household		Household composition