LAUREA
AMMATTIKORKEAKOULU
Uuden edellä

Renewable energy Solution to poor households/Companies

Case study Muhanya Solar Limited

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2014 Leppavaara Unit

Laurea University of Applied Sciences
Unit

Green Energy Solution to poor households/companies
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Degree Programme in Business Management
Bachelor's Thesis
Novermber, 2014

Laurea University of Applied Sciences **Abstract**
Laurea Leppavaara Unit
Bachelors Degree Programme in Business Management

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Green Energy solution to poorhouseholds/ companies.

Year 2014 Pages 41

This study has been conducted for Muhanya Solar Limited a Zambian company that has a core business of selling of green energy products to both local and international markets in order to reduce rural poverty levels and helping small scale entrepreneurship.This process involved accessing the existing renewable energy business and markets specifically in Zambia. The main objective of this research is to highlight Muhanyas business operation in the eradication of poverty at household levels in rural areas and how its business can benefit other businesses in Zambia.

The purpose for this study is to access the opportunities for Muhanya business expansion, the demand for renewable energy and how this would translate in the reduction of rural poverty levels.The energy problem is increasing extensively in Zambia due to high demand of electricity energy by highly mechanized mines and there is a great interest that alternative energy resources be used especially at household level and small scale business.Although the country has much water and coal resources to be used for energy production, the investment in this type of energy production requires an enormous amount of financial investment.

The method used in this study thesis is qualitative research, which includes personal interviews through email and questionnaire with two organisations namely Muhanya Solar Ltd company who are the case study company and the Ministry of Energy in the Rural Electrification programme departmemt,content or documentary analysis and archived research.Common questions relating to the availability of natural resources to support green energy, economic and environmental competitiveness,social acceptance of renewable energy,how renewable can uplifts the living starndands of the poor people especially in the rural areas. These open-ended questions were sent to the organization involved. Other literature such as books, reports and online resources were used to conduct this study and come up with both knowledge base and empirical studies.

For millions of Zambia's rural residents, a lack of access to electricity creates a numerous daily challenges. From children who can't do schoolwork in the evenings, to family providers that direct a large portion of their meagre earnings toward kerosene, candles and other alternative forms of lighting, access to electricity has a profound impact on daily life for human being.

Keywords Energy,Renewable energy.

Abbreviations

CEC	Copperbelt Energy Corporation
EIA	Energy Information Agency
EPA	Environmental Protection Agency
ERB	Energy Regulation Board
ERC	Energy Research Corporation
GDP	Gross Domestic Product
HDI	Human Development Index
IREN	International Renewable Energy Agency
LDC	Least Developed Country
LHPC	Lusemfwa Hydro Power Company
Mw	Mega watts
NDP	National Development Plan
NEP	National Energy Policy
NWEC	North Western Energy Company
REA	Rural Electrification Authority
RET	Renewable Energy Technology
REP	Rural Electricfication Programme
SMEs	Small and Medium Enterprises
SNDP	Sixth National Development Plan
UNIS	United National Information System
WHO	World Health Organisation
ZDA	Zambia Development Agency
ZESCO	Zambia Electricity Supply Corporation
ZPL	Zengamina Power Limited

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1 Introduction

Energy is one of the basic needs a human need to survive and without it, challenges are faced by lack of it. These challenges are even more pronounced when the energy required to heat, cook and light. However, depending on ones means of income and situation (poor) the energy would not be easily accessed or afforded.The people who are not able to pay for heating, cooking and lighting energy are poor people living especially in rural areas.

There is currently a shortage of electric energy in Zambia and its pricing has been rising as demand is ever increasing. People with less income are at a disadvantage to have access to electric energy. The easiest solution is the promotion use of renewable energy because of its minimal costs associated in setting up an household electric energy source. The government of Zambia is encouraging and giving incentives to the private sector to participate in solving the energy crissis, especially to business that are aimed at easing the living condition of its citizen.

Muhanya Solar Limited has been one of the pioneers in renewable energy business in Zambia. Its many clients are people who are in rural areas where the poverty levels are high. With the government policies on energy and economic developmental projects, the company would tailor its business strategy in a way that will make it corroborate with government and other associated organisations that are interested in alleviating peoples living standards and improve SMEs.

1.1 The purpose of the thesis and research limitation

This study has been done for Muhanya Solar Limited and the main purpose of this project is to note how renewable energy can be used in rural areas in Zambia to reduce poverty levels and enhance peoples lives.Trade in renewable energy especially in developing countries such as Zambia and how it can impact on both government country's developmental programme and on peoples lives is the main objective of this thesis.The study looks at the availability and the market for renewable energy, the challenges that people without readily available energy face and what the government strides has been to mitigate the energy problem.Although Zambia has abundant sources of water to produce hydropower, the potential has not been harnessed due to number of reasons such as the lack of technical expertise,lack of reinvestment and maintenance, political will and and capital for new investments. For these reasons the country has been facing energy shortages and resorted to energy rationing commonly known as load shedding throughout the country.To overcome this energy problem, the government of the Republic of Zambia has called on the private sector and foreign businesses to invest in simple and cheaper ways of making electricity energy available to the population.

However, there were many limitations regarding this thesis but, the following are a few significant ones:
Firstly, the renewable energy topic is wide and the incomprehensiveness of the sources which would be more than mentioned in this thesis may be appreciated.

Secondly the brief explanations of some concepts would be brief due to limited information and the limitation on coming up with a concise thesis structure.

The explanations and definitions of some concepts may differ slightly from other academic literatures and therefore all the mistakes related to this thesis in the explanation of some concepts are entirely mine. The thesis is an overview of the parameters that are for the stated topic.

1.2 The research approach and knowledge base

This thesis has been written in inductively in order to effectively look into the research problem and offer simplified outcomes with no strong personal opinion. The case study was used for this in order to have a clear and practical views on the research matter. The authors interest in the topic coupled with knowledge gained through studies made the research to progress accordingly. Interviews were conducted with the employee of the case company through electronic mail and a questionnaire was sent to the relevant government ministry in order to obtain further information on the subject matter.

Other literature such as books, reports and online resources were used to conduct this study and come up with both theoretical and empirical studies.

1.3 Research questions of the thesis

By the end of this research, the following questions will be addressed.The questions being, what kind of challenges do the energy sector is experiencing? How can RE help in improving livehoods at household level and at small scale enterpreneurship? What government policies are in place for businesses that are investing in Res, such as taxes and subsidies? How can MSL suit its business strategy according to the government plans to expand its business profile? How much is the demand of energy and renewable energy in the country? Who are the many buyers and competitors?

1.4 Research process

In order to have a balanced data on how the use of renewable energy and how it is able to improve poverty levels among households, a questionnaire containing open-ended questions was sent to the Rural Electrification programme department under the Ministry of Energy. The questions were sent to this department because it is the section that has a direct contact to the rural area as well as the reliable data on the energy distribution, the information on how many people are affected by the lack of energy and the impact of not having it. The means of communication used were through a connection working in the department. The aim of this questionnaire was to have governments view through its past studies and on how renewable energy is able to improve the living standards of people as well as enhance the growth of small scale entrepreneurship.

1.5 Key definitions in the thesis

The phrase Renewable energy refers to energy whose sources will never be finished, and which can be regenerated naturally from the sun, the wind, and water. When compared to non-renewable energy, renewable energy does not harm the environment. This type of energy is also known to be environmentally friendly.The energy generated from non-renewable energy like fossil fuels produce the harmful gases which have caused a number of environmental problems, such as the ozone depletion and global warming, that have to be faced these days.while as Biomass energy is considered a major indoor polluter (Edu Green 2014).With the high demand for energy in Zambia and the world at large, RE technologies are the fastest growing technologies in the world.

The word solicitation is used in the thesis as defined as an act of persuasion, entreaty, or formal application.
The poverty level, or poverty line, is the minimum level of income deemed adequate in a particur country.
Energy is defined as the capacity or effort to create heat, light, or motion.

1.3 The structure of the thesis

The thesis consists of eight chapters. In the first chapter, the background information is given and the purpose of the thesis and the research problem.

The second and third chapter are concentrated on the theoretical knowledge background.The second chapter deals with the renewable energy concept, what are the forms on renewable

energy and what importantly outlines the benefits of using this type of energy in the improving of human living standards. The third chapter concentrates on the different research approaches and methodology type that has been chosen in for this thesis.The later part of chapter three explains the reliability and validity of the study that has been conducted.

The fourth and fifth chapter focuses on the empirical study. Chapter four concentrates on the case company. The details on the company are covered and gives more insight on its operations, the marketing strategy, the company swot analysis, action plans and the current situation of the company in the promotional use of renewable energy in improving peoples lives. Whilst the fifth chapter looks at the questionnaire that was sent to the ministry of energy in the rural electrification programme department.

The six chapter explains the theoretical and empirical study linkage of all the data gathered from the questionnaire as well as the information used.The seventh chapter is the summary of the thesis with its limitations explained.

2 Knowledge base

2.1 The energy situation in Zambia

The accessibility of energy is at the core of social, economic and environmental concerns facing all nations, (United Nation Information System, (UNIS) Energy Exploration Resource 2012). It is particularly critical in developing countries as the implications to reduce poverty are significant. Numerous studies on the relationship of access to reliable energy and The Human Development Index (HDI) as shown that access to reliable energy has a positive effect on human development (UNIS).

Zambia has abundant renewable and nonrenewable energy resources, and they include water reserves for hydropower generation, industrial minerals such as coal, arable land that would support the farming of bio fuels plants, wind for wind energy and importantly the country has long intense hours of annual sunlight to support solar energy generation.

However, demand for energy has been rising due to economic activities in the country particularly in the manufacturing, agriculture and mining sectors. According to the Ministry of Finance, Zambia's economy has been growing at an average of 5 % per annum over the past decade. (Ministry of Finance, Sixth National Development Plan (SNDP) Annual Progress Report, 2012). The mining sector and domestic consumers account for a combined total of 82 % of the total electricity consumption in the country. This leaves other sectors such

as manufacturing, transport, agriculture and service sectors to compete for the 18 % (ERB, 2012).

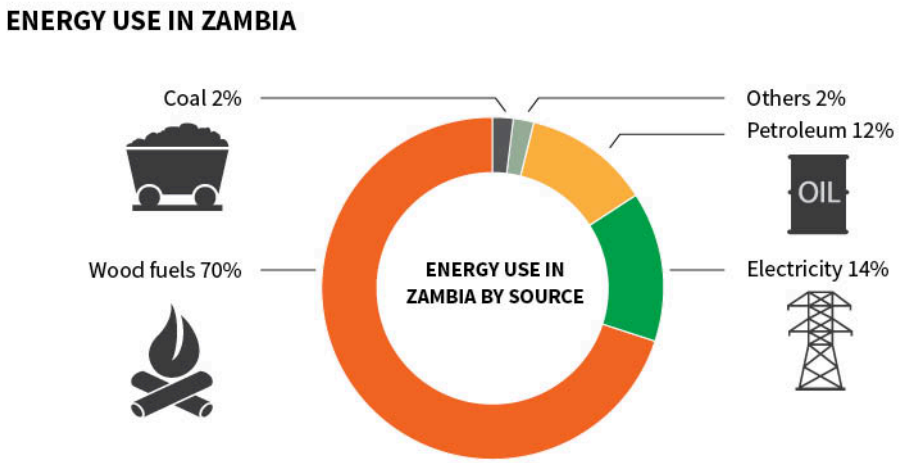

Illustration 1: Energy use in Zambia

However, these sectors are important in the functioning of the economy of the country and can not survive without the energy that they need to operate on effectively. In order to maintain the balance of supply and demand among the different sectors load-management has been practiced so that every sector can have a share according to the economic role it plays. Zambia's power demand forecast by ERB shows a severe and immediate shortfall in supply,and if this situation is not addressed by all stakeholders the country's economic growth would be hindered and delay the pace of further development. This would in turn result in many people facing poverty mainly in rural areas to have no access to efficient and reliable energy (ERB, 2012).

The current companies, that are providing hydroelectricity to the Zambian market are Zambia Electricity Supply Corporation (ZESCO), Copperbelt Energy Corporation (CEC), Lusemfwa Hydro Power Company (LHPC), North Western Energy Company (NWEC) and Zengamina Power Limited (ZPL).The total energy produced by these companies is not sufficient enough to cover for the current domestic peak demand for electricity, which is at 1780 Mw, against the total combined energy production of 1515 Mw leaving a shortfall of 165 Mw (Energy Regulation Board, 2010). The shortage makes the distribution of energy to the masses difficult by the energy distribution companies and results in load shedding or power cuts. This makes it diffi-

cult for even other household to be connected to the energy national power line grid, for there is not enough energy to distribute for expansion (Energy Regulation Board, 2010).

2.2 Supply and demand of electric energy in Zambia

According to the report by the Zambian Development Agency (ZDA) of June 2013, the installed capacity of electricity was estimated at 2 000 Mw. The level of available generation is however slightly lower. Out of the total installed capacity, 1 895 Mw comes from hydro which is 90 %. Out of the total interconnected installed capacity of 93 % and most of the off-grid (including SHP) installed capacity are still owned by ZESCO supplying electric power to 55 699 customers. The energy grid network in Zambia is owned by ZESCO and CEC and consists of 66 kV, 132 kV, 220 kV and 330 kV covering the distance of 3 200 km (ERB, "Energy Sector Report", 2010). Zambia has developed several inter-connections with its neighbouring countries and is a net exporter to its Southern and Eastern neighbouring countries such as Zimbabwe, Namibia, Angola and Democratic Republic of Congo. However, only LHCP and CEC are the biggest private operators in the country owning a capacity of 52,5 Mw and 80 Mw respectively (ZDA Zambia Energy Sector Profile, June 2013).

As in many other developing countries, wood fuel, which is mainly used as thermal source for cooking, remains Zambia's main energy demand source of up to 79 %. Hydropower is the second most used source, contributing to 10 %. Whilst petroleum products cover only 9 % of the national energy requirements with an annual standing at 40 %. In the mining sector which generates the countrys cash crop, copper is the highest energy consumption representing more than half of Zambia's total electricity demand. The industry apart from mining and commerce's electricity demand is estimated at 4 % and that of households demand is at 19 % (International Renewable Energy Agency IRENA - Zambia Renewables Readiness Assessment, 2013).

Access to electricity by the both business and household in Zambia is at 22 %, and particularly in rural areas which is at 3,5 % are the lowest. The annual growth of total electricity access rates is estimated to be at 0,5 % of the population and only covers 12,5 % of the annual population growth. However, during peak time demand is estimated to be at 2 000 Mw, whilst growth in power demand is estimated at approximately 6 % per year (150 - 200 Mw) and is expected to remain below 3 000 Mw by 2020 according to the ZDA Zambia energy sector profile report, 2013. The rate of power outages represents 49,8 days/year. The private sector's reliance on self-generation of energy through renewable energy means and use of power generators is estimated at 19,5 % of it demand

(ZDA Zambia Energy Sector Profile, June 2013).

2.3 Government policies on energy

The government has formulated policies that aim to promote and guide the energy supply and demand.The policies help in the government energy planning of certification of private players and monitors the impact the energy demand has on the environment.

I The National Energy Policy (NEP) 2008

The government has formulated policies on energy and in 2008 it came up with the National Energy Policy which guides development of the country's energy sector. The aim of the policy is to promote optimum supply and utilisation of energy. Furthermore, the policy is to facilitate the socio-economic development of the country and maintenance of a safe and healthy environment (NEP, 2008). The policy recognises the potential role that renewable energy technologies such as solar energy can play in meeting the country's energy demand and providing for the following:

Promotion of renewable energy technology.

Appreciating of wider application of Renewable Energy Technologies (RETs).

Promotion of information dissemination on the use of RETs.

Promotion of education, research and training in RETs at various levels.

The 2008 Energy Policy further seeks to create conditions that ensure the availability of adequate supply of energy from various sources, which are dependable and efficient, at the lowest economic, financial, social and environmental cost, and consistent with national development plans. The Energy Policy contains objectives and policy measures and strategies that cater for all the various energy sub-sectors in Zambia.

II. The Electricity Act

The Electricity amended Act No. 21 of 2003 is an Act to regulate the generation, transmission, distribution and supply of electricity.

III. The Energy Regulation Act

This Act (Chapter 436 Of The Laws Of Zambia) establishes The Energy Regulation Board (ERB) and defines its functions and powers. The aim is to provide for the licensing of undertakings for the production of energy or the production or handling of certain fuels. It further repeals The National Energy Council Act and The Zambia Electricity Supply Act.

IV. The Petroleum Act

This Act (Chapter 435 Of The Laws Of Zambia) makes provisions for regulating the importation, conveyance and storage of petroleum and other inflammable oils and liquids.

V. The Rural Electrification Act

The Rural Electrification Act provides for the establishment of The Rural Electrification Authority (REA) and defines its functions and procedures. The REA is a non-profit making organization mandated by an Act of Parliament to provide electricity infrastructure in rural areas of Zambia. In addition, the Act provides for the establishment of The Rural Electrification Fund (REF), which consists of money appropriated by Parliament on an annual basis through the electricity levy and grants, loans and donations.

The above policy statements have a role in the development of the renewable energy sector. However, in order to accelerate development in the sector, there should be other incentives in order to harmonise the results of the Renewable Energy Strategic plan that would streamline all the objectives into an achievable implementation plan and this is a sure way of achieving stated targets (ERB Report,2012).

VI ZDA Investors Act

The act gives an investment threshold and non fiscal incentives for investors who invest not less than US$ 500 000 in the Multi Facility Economical Zone, an Industrial Park, a Priority sector and an investment in a Rural Enterprise.The following incentives are applicable:

(i) Zero percent tax on individuals for 5 years from the first declaration of dividends.

(ii) Zero percent tax on profits for 5 years from the first year of operation.

(iii) Zero percent import duty rate on capital goods, machinery including specialized motor vehicles for five years.

In additional to the fiscal incentives given above, an investor is entitled to the following non fiscal incentives:

(i) Investment guarantees and protection against state nationalization.
(ii) Free facilitation for application of immigration permits, secondary licenses, land acquisition and utilities.

While investors who invest an amount no less than US$ 250 000 in any sector or product not provided for as a priority sector or product under the Act, the incentives given are:

(i) Investment guarantees and protection against state nationalization.
(ii) Free facilitation for application of immigration permits, secondary licences, land acquisition and utilities (ZDA 2013).

2.4 Types of renewable energy in Zambia and market Investment

This renewable energy sources available in Zambia highlighting current initiatives that are being undertaken by both the public and the private sector in mitigating the energy shortages and improving the countrys economy. It specifically analyses biofuel, solar, wind and geo-thermal options.

RENEWABLE ENERGY	OPPORTUNITIES/USE	RESOURCE AVAILABILITY	POTENTIAL ENERGY OUTPUT
Sunlight	Thermal (water heating), Electricity (water pumping, lighting, refrigeration)	6-8 sunshine hours	5.5 kWh/m2 /day (modest potential especially for limited irrigation)
Wind	Electricity Mechanical (water pumping)	Average 3m/s	Good potential, especially for irrigation
Biomass (Combustion and Gasification)	Electricity generation	Agro wastes, Forest waste, Sawmill waste	Requires elaboration and quantification

Biomass (biomethanation)	Electricity generation Heating and cooking	Animal waste, Agro and industrial waste, waste water	Potential requires elaboration
Biomass (extraction, processing and transport)	Ethanol for bleeding with gasoline to replace lead as octane enhancer biodiesel for stationary engines	Sugarcane, Sweet sorghum, Jatropha	15,000 ha to meet current demand
Biomass (for household energy)	Improved charcoal production, improved biomass stove	Sawmill waste and indigenous trees from sustainable forest management	Reasonably extensive

Illustration 1: Types of renewable energy sources

Source: National Energy Policy (NEP), 2008

2.4.1 Solar energy source

According to The Energy Information Agency (EIA), solar is the radiant energy produced by the sun and exists in both light and heat. Solar is a competitive choice in remote areas, especially for electrifying village communities, water pumping and refrigeration in health clinics. Solar is cost effective for street lighting and powering toll gates, but the main problem of its development in the country has been the high initial investment cost. Investment opportunities in this area include local production of solar system components, setting up isolated grids, and sale of solar panels and related accessories. In 2007, the government came up with a plan to use both solar energy and hydropower to electrify the rural areas with a programme called Rural Electrification Programme (REP) under the ministry of energy. This programme has thus far undertaken installation of solar home systems in over 230 chiefs palaces, 60 basic schools, 60 teachers houses and in 23 rural health centers across the country (Rural Electrification Authority (REA), 2013).

2.4.2 Biofuels energy source

Biofuels are clean burning alternative fuels made using natural vegetable oils and fats. They include sources and fuels such as ethanol, jatropha which is a plant, methanol, palm oil and moringa. Another example of biofuel includes alcohol from fermented sugar compounds. Statutory instruments legalizing biofuels, standards and a regulatory framework on biofuel and pricing methodologies were developed by the government as a policy to help support

small and medium scale business ventures. Furthermore, Biofuels Association of Zambia, The Civil Society Biofuels Association, and District and Provincial biofuels farmer associations have all been formed to coordinate the marketing and accessing information on biofuels (Zambia - Renewables Readiness Assessment 2013 – IRENA).

However, the local market for biofuels is yet to be solid, and entering international markets has been difficult. The Government is further looking to develop a pricing mechanism that would support large-scale biofuel production and a notable step has been the signing of an MOU with Zambia Sugar PLC, to build a fuel ethanol plant to serve the domestic market. Zambia Sugar is still analyzing production costs and the plant may be completed by 2017 (Zambia - Renewables Readiness Assessment 2013 – IRENA).

2.4.3 Wind energy source

The Renewable Energy Association (REA) defines wind energy as electrical energy obtained from harnessing the wind with windmills or wind turbines. According to the ZDA - Energy Sector Profile (2013), reports that wind energy generation is relatively low in Zambia. The recorded wind speeds are not suitable for sufficient generation of electricity, but are suited for water pumping for household use and irrigation purposes. The report further says that the minimum wind speed, that can make electricity generation economically feasible, is 5 m/s. Investment opportunities for private businesses, therefore, lie in the supply of equipment for wind measurement; production of wind mills for water pumping and more advanced technology that can facilitate the production of electricity from the wind. Wind source remains a viable alternative especially in Agriculture as it can power mechanical equipment for irrigation as well as electricity for use.

2.4.4 Geothermal energy source

Geothermal energy is defined as energy derived from the heat contained in the earth. It is environmentally clean, sustainable and is the ready energy source available on the planet. It can be used directly as a heat source with a range of industrial applications, or indirectly to produce electricity (Meiswinkle Rudiger, Meyer, Julian, Schnell, Jurgen, 2013). Geographically, Zambia is suitable for geothermal energy because of the African rift valley system fault structures that pass through the north and southern part of the country. Geothermal power in Zambia has the potential to develop and would be an alternative way of managing the current power deficit facing the nation. Geothermal exploration has been ongoing, with 80 potential sites known to exist and 16 sites short listed for further investigations. However, this type of energy source remains highly unexploited due to lack of specialized expertise and financial

investment that are associated with exploration and development (Renewable Energy Association (REA) – Geothermal Energy, 2012).

2.5 Renewable energy as a way to reducing poverty levels

The energy sector is the critical driver of sustained economical growth, industrial efficiency and job creation all of which have positive implications on income generation and poverty reduction in both rural and urban area. In recognition, this and the power shortage in the country the government in 2008 issued a Statutory Instrument (SI) # 42 that declared biofuels and other renewable energy as energy sources under the Energy Regulation Act. (Ministry of Mines, Energy and Water development,2012). This is the act that has brought other private players to offer business solution to the energy shortage.

With the country adopting an economical liberalized (Definition: Economical liberalization encompasses the process including government policies, that promote free trade, deregulation, the downsizing or privatization of public services (Woodward, 1992). Thus, government policies were redirected to follow a non-interventionist approach to economic activity, relying on market forces for the allocation of resources. With the aim that market-oriented policy reforms would spur growth and accelerate poverty reduction in the country. Among the benefits that Zambia would gain in the policies on renewable energy that it has made in the past are:

2.5.1 Poverty alleviation

Renewable energy projects in Zambia which is a Least Developed country (LDC) can directly contribute to poverty reduction by providing the required energy for establishing both small and medium business and in turn create employment to the people around that business. Other benefits, that renewable energy techonologies provide, are better space heating, efficient and improved energy for cooking and lighting (United Nations Department of the Public Information, African Renewal Journal August 2013).

2.5.2 Education

Renewable energy can contribute to improved education by providing electricity to schools especially in rural areas and the energy for heating and cooking reduces the time that the children spend out of classes collecting firewood. This gained time by school children would be spent on learning, doing homework even after dark (United Nations Department of the Public Information, Africa Renewal Journal August 2013). Furthermore, the reduced pollution

levels that come with RE, reduces the health problems that are associated with the traditional fuel sources with high levels of pollution. According to the Geographical information systems of Zambia, lack of access to the energy grid translates into higher illiteracy rates in rural area and erodes their opportunities to find decent rewarding jobs, pushing them further in poverty.

2.5.3 Health

The World Health Organisation (WHO) estimates that 2,4 billion people in the world use only traditional biomass, such as residues, dung and wood for heating and cooking. The use of this energy sources exposes people indoor harmful particles and carbon monoxide concentrations many times higher than the WHO standards. It results in acute respiratory illness which affects 6 % of the world population. However, renewable energy can contribute to improving the situation by avoiding exposure to indoor pollutants. Another health benefit of renewable energy is that it can be used to refrigerate medicine and sterilize medical equipments in rural areas, where access to electricity, fresh clean water supply is difficult, and sewerage services is needed to reduce the spread of infectious diseases such as diarrhea and chorela (WHO, 2005)

2.5.4 Industrialisation

The industrialization of the country can not be achieved without a reliable energy sector. The four factors of productions (land, labour, enterpreneure and capital) can only be efficiently used when a viable energy sector is in place to grow the country's economy. This would also in turn attract huge investments in the manufacturing, construction and production sectors. With the more use of renewable energy to lessen the energy shortage the country would be industrialized, bringing its citizens out of poverty through employments. (Ministry of Finance, Sixth National Development Plan (SNDP) Annual Progress Report, 2012)

2.5.5 Economical Growth

The energy sector contributes to the country's Gross Domestic Product (GDP) in most nations, except for those in which oil and gas income emerge largely. But mostly importantly, energy is an input to a relative number of goods and services in the economy. Its for this reason that reasonable and stable energy prices are beneficial to sustaining and expanding economical growth. Stable prices and reasonably priced energy can only be achieved through innovative ways of providing renewable energy to sectors that would drive the country's economy (Ministry of Finance, Sixth National Development Plan (SNDP) Annual Progress Report, 2012).

2.5.6 Employment

Energy is an important sector of the economy that creates employment and value by extracting, transforming and distributing energy goods and services throughout the economy in a country. The energy industry extends its reach into economies as an investor, employer and purchaser of goods and services. However, the energy sector directly employs fewer people than might be expected given its share of GDP, especially when compared to other industries. In the United States it shows that the energy industry supports many more jobs than it generates directly, this is due to its long supply chains and spending by employees and suppliers (Energy Research Report, 2010).

2.5.7 Agriculture

Energy has an important role in economic and social development, but there is a lack of rural energy development policies that focus on agriculture in Zambia. Agriculture has a dual role as an energy user and as an energy supplier in the form of bio-energy. This energy function of agriculture offers important rural development opportunities as well as one means of climate change mitigation by substituting bio-energy for fossil fuels (Energy Research Corporation (ERC), National Energy Balance Report, Sao Paolo, 2009).

2.5.8 Mining

Mining is one of the country's major industry involving a diverse range of energy intensive processes such as excavation, mine operation, material transfer, smelting, concentration and separation. The rising demand for mineral resources, driven by emerging markets, highlights the fact that maintaining the levels of needed supply will be a significant challenge in the future and energy will become increasingly more important for the bottom line, shareholder value and license to operate.

Many of the key industry players in the mining sector have developed energy saving strategies and are investing directly into renewable energy infrastructure. This is primarily derived by the industry wide realization that emerging technologies and strategies exist to better manage energy consumption, costs, supply, and risks from international and national regulations. The high-energy consumption of the mining industry signifies that the potential for generating electricity as a by-product of the process of mining is an attractive venture with benefits going to reduced production operations (Ministry of Mines, Energy and Water development Report, 2012)

2.5.9 A Vast and Inexhaustible Energy Supply

Through out Zambia, strong winds, sunny skies, plant residues, heat from the earth, and fast-moving water can each provide immense and constantly replenished energy resource supply. These sources of renewable energy have the technical potential to provide all the electric energy the country needs.

The estimated technical potential of each renewable energy source is based on its overall availability with given technological and environmental constraints. For example, in 2012, National Renewable Energy Laboratory in America found that, renewable energy sources have the technical potential to supply 482,247 billion kilowatt-hours of electricity annually (NREL.July 2012). This amount is 118 times the amount of electricity America currently consumes. In the same vain, Zambia with similar energy source would benefit and solve the energy shortage by use of renewable energy technologies and spurs the countrys economy.

2.5.10 Stable Energy Prices

The costs of renewable energy technologies have been declining steadily, and as technology advances it is expected to drop even more. For instance, the average price of a solar panel has dropped almost 60 percent since 2011. The cost of generating electricity from the wind source has dropped more than 20 percent between 2010 and 2012 and more than 80 percent since 1980. The cost of renewable energy will decline even further as markets mature and companies increasingly take advantage of economies of scale (Zachary Shahan.Sept 2013).

Although renewable facilities require huge investments to setup, once in operational the cost declines and, for most technologies, the fuel is free. As a result, renewable energy prices are relatively stable over time. This would make other forms of energy prices to become cheaper and affordable to everyone.In contrast, fossil fuel prices can vary dramatically and are prone to substantial price fluctuations. More RE use can lower the prices of and demand for natural gas and other conventional energy by increasing competition and diversifying our energy supplies. An increased reliance on renewable energy can help protect consumers when fossil fuel prices rise (Energy Information Administration. 2013).

Furthermore, utility energy companies spend millions of dollars on financial instruments to protect themselves from fossil fuel price uncertainties. With RE use, it can help companies to save money they would otherwise spend to protect their customers from the volatility of fossil fuel prices (Energy Information Administration. 2013).

2.5.11 Summary of the Knowledge base discussion

Renewable energy technologies have an important role to play in Zambia's energy sector and can help in reducing poverty levels among the citizens. With the right approach, the renewable energy industry in Zambia can become a major player in the energy sector, thereby meeting the energy needs of a significant proportion of the population and reduce the burden on the current supply of electricity.

Although bio-fuels are stimulants to development, developing countries, like Zambia, should make a careful analysis of the consequences involved in bio-fuels production. This is because bio-fuels have their fair share of challenges with the most prominent being competition with food crops for land, labour, capital and water use.
In an effort of the country formulating policies aimed at reducing poverty levels through the promotion use of renewable energy. It would be important to note that stimulating of industrial development and sustaining of mining activities at production level, the nation should avoid investing the limited resources it has into one solution only.This is because it is not only energy that is responsible for the country to have lower standards of living among its people. The standards of living obtaining would be as a result of other sectors other than energy as indicated by the Ministry of Energy from the questionnaire results analysed.

Other accessible, clean energy sources such as wind, solar, hydropower and biogas from waste should be considered extensively and encouraged too. The current support, that the government is pressing on the promotion of green energy, can be increased in terms of enactment of legislation that caterers and harmonise all stakeholders in the energy industry.This would in turn provide affordable energy and hopefully increase access to energy in the rural areas. Overall, other countries that have invested in efficient sources of energy, show how tackling the barriers to energy efficiency investment can bring about clean energy potential and realize huge gains for the environment, energy security and economic growth and thereby improving the livelihood of its citizens.

3 Research approach

Research is defined as a process that is undertaken by the collection of data and interpreting it in a clear and purposeful manner to find out things. The two types of research, that are commonly used, are qualitative and quantitative research (Saunders, Lewis & Thornhill 2009, 5).

The qualitative research is one that is used in all non numeric data or data that cant not be quantified. This method is often accompanied with interviews, survey design in order to eveluate findings over a broader scale, while quantitative research is a method that is based on

collecting numerical data which can be turned into statistics, graphs and charts. Most common tools, that are used in quantitative research, are questionnaires whose results can be mathematically or statistically analysed (Saunders, Lewis & Thornhill, 2009, 414, 480 - 481). However, some researchers gather data by means of interviews and observations, techniques normally associated with qualitative methods. They code the data in a manner that allows them to be statistically analyzed, hence in effect, quantifying qualitative data (Lapan, Riemer & Quataroil 2012, 7).

The following part will go further in the research method chosen for this thesis, and how data was gathered and reliability and validity of the research that has been done.

3.1 Choosen method

The qualitative research method was used in this thesis because this is mostly used by scientists and researchers studying human behaviour and habits. Many qualitative research that are conducted places less importance on examining cause and effect and often find it necessary or even possible in most cases to draw conclusions that can be generalized beyond the research setting (Lapan, Riemer & Quataroil 2012, 8).

In the qualitative research method the interest is to uncovering the meaning of the phenomenon for those involved, by understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences. Therefore, it is a type of research that is concerned with meaningful text than numbers. Hence, the method unravels the phenomenon with depth understanding of the current situation using its own hypotheses (Lapan, Riemer & Quataroil 2012, 8).

The use of the qualitative research approach in this thesis includes a case study. A case study is a study type of observational data collection technique in which a particular situation or phenomenon is studied in-depth to identify behavioral, emotional, and qualities that are universally true, on average, of others and often include an interview. Multiple or a combination of techniques would be employed for one study. To provide the opportunity to observe and analyze a phenomenon or situation a single case study is usually selected (Saunders, Lewis & Thornhill 2009, 146).

According to Lapan, Riemer & Quataroil (2012, 246 - 247) case study explore instances or cases to build new theories or compare findings to current ones to either corroborate them or question their validity. To achieve that a case study aim to create a diversity and complexity in order to avoid the study being simple when designing it.The first step is to understand the

study in concept, which includes clarifying the purpose, defining and limiting the case, identifying the questions, and considering potential audience for the outcome.

There are two types of case studies, intrinsic and instrumental. Intrinsic case study aims to focus on the case being studied, answering questions about that entity only to communicate the important operations to participants and other stakeholders. While instrumental use case results to support a theory or construct a new way of explaining some phenomenon (Lapan, Riemer & Quataroil 2012, 246).

3.2 Methodology

The data was gathered through the existing literature, emails, case study, reports and through questions sent to the company respresentative. The theory part was collected through the available hard copy and online literature resources. In order to get information of the company, company website, questions sent and answers received through email were used. The interview through email was addressed to the Operation Manager who is in charge of the operational system, processes and ensure that the policy and mission of the company is upheld. The questions sent in the email related to how the business operations of Muhanya Solar Ltd is helping in the improving of peoples livelihood and what is its planned business strategy.

The questions that were sent ranged from knowing what kind of products and services the company offers that are related to renewable energy generation, who are its many customers, how its operations and services can be evaluated as improving the living standards of its customer. The questions further inquired on the company's planned business marketing strategy and who are its competitors and how they plan to market their products in order that the customers who need renewable energy can afford it. The setup of the questions was done in order to get the correct and required information for the thesis. Enough time was allocated for feedback so that the respondent would give as much information as possible.

3.3 Validity and Reliability

The word validity is referred to the extent of how well the data collection methods measure what they were supposed to measure, and reliability is defined as the extent to which the data collection technique will yield consistent results, similar observations would be made (Lewis and Thornhill 2009, 600 - 603).

The reliability and validity of the information contained in this thesis were generated from authentic materials listed under references.The theoretical information part is reliable for it was gathered from different book sources and reports, both hard copies and online sources that cover the subject of renewable energy.The company information is based on the information provided, through a company report, emails and answers received from the questions sent to the Operation Manager. The information therefore, came from credible sources and would be said to be reliable and valid.

It is important to note that the information in this thesis research should not be generalized to other similar company dealing in RE other than Muhanya Solar Ltd.

4 Empirical study

This chapter introduces the case company in more detail and explains what kinds of services and products it offers. An insight of the comapny's marketing strategy as well as its business model is explained. Further in the chapter the SWOT analysis is given and sales and concluded with the action plans of the company on its products and services impacts on its clients.

4.1 Muhanya Solar Limited

The company started its operations in 2005, as Muhanya Solar Limited and it is a fully registered Zambian company. The company works to provide sustainable energy solutions to the public through the use of renewable energy technologies.

The company has a team of professionally trained staff members, with a wide range of relevant experience in specific fields such as, financing, marketing and sales, technical operations, and business development.

The company offers various products, consultancy, design, installation and maintenance services. Listed below is the products that it offers:

- Hybrid power systems
- Solar Photovoltaic (PV) systems
- Solar geysers
- Solar water pumping systems
- Standby power systems
- Wind turbines

In order for the company to offer standard after services to its clients it stocks the following RE equipment:

- Charge controllers
- Energy saving bulbs
- Inverters/inverter chargers
- PV modules
- Solar batteries
- Solar fridges and vaccine refrigerators
- Solar thermal systems/solar geysers
- Solar water pumps
- Wind turbines

Due to the preveiling stable and positive economic conditions in the nation, coupled by shortage of conventional electric energy. The company is currently experiencing sound business growth in terms increased sales and installations of renewable energy equipment throughout the country. It has supplied and installed systems of various sizes and applications to both public and private institutions as well as to retail customers (households). Currently, the company's turnover has been increasing annually.

4.1 Business model

The company offers its products and services to the public by giving them a product or service that would have the client appreciate the value for the money spent. It does this through understanding the customer need, as to why the client want to have a certain type of product from Muhanya ?, and what purpose do they intend to use that product for?. Knowing this, the technical operations assist the customer as to what kind of product is suitable for them and give recommendations. The company prides itself in the after sales services and makes sure that the client is educated on how to use the product especially the products that are installed and needs monitoring with technical knowledge.

4.2 Muhanyas Solar Marketing Strategy

The company has adopted a marketing strategy that is focused on customer satisfaction and value for money by providing quality products and services. It has a policy of stocking of its products that are of quality standard in order to be different from its competitors who use cheap products. This ensures that their part of reference work would help in advertising the company to other would be clients. In addition the company engages itself in corporate social responsibility to help build its visibility to the market by installing solar panels in selected

health posts and schools in rural areas. The use of other marketing tools that the company uses include radio, newspaper, its own website, search engine marketing and through social media such as twitter and facebook (Operations Manage, 2014. Email communication).

However, the company uses soliciting marketing as well by identifying potential clients needs, and make appointments and sale their products and services to them. In additional, it competes and bid for any business offers that are in both public and private markets. The company marketing department usually attends to business forums where they help in selling their company's portfolio. This helps in networking and builds and opens up further business opportunities. The company has partnered with other non governmental organisations who deal with alleviating the poverty levels among the people in Zambia. This is in order for Muhanya to provide a base future business and collaboration of its work with these organisations and helps in the marketing and sales (Operations Manager, 2014. Email communication).

4.3 S.W.O.T Analysis

Strenghts • Zambian company • Knowledge of market • Qualified work force • Compentitive pricing	**Weakness** • Low knowledge of renewable energy by the population • Lack of policy for RE
Opportunities • Wide market • Developing country economy	**Threats** • Competitors • Importation Tariffs

Figure 1: S.W.O.T analysis matrix table

Muhanyas Solar Ltd business strengths are based on the company being a local company. Therefore, it has a good understanding of how business is conducted in the country. This is attested by the fact that it has been growing since its establishment. The knowledge of the clients, especially the rural customers, who have low literacy levels help the company to offer continuous after sale services. This helps in customer retention and build up a recommendation record. The company offers competitive pricing methods and payment system for clients to choose from.

The weaknesses that the company has to contain with rage from limited knowledge of renewable energy among the population of the country. This makes the company's budget on marketing to be significant and deprive it to expand. According to Policy Monitoring and Research Centre PMRC report, 2014, there has been no concrete policy from the government on the maximization of Zambia's potential on renewable energy. This makes the players in the RE sector to lack needed incentives and framework to operate in.

The company has the opportunity to expand its operations and reach many people who are in need of energy and improve their lives. According to the report published by the Ministry of Energy, (2012), 21 % of Zambians have access to electricity. Overall, access to electricity increased only by 2 % points from 2005 to 2009 against an annual population growth of 2,7 % and urbanisation rate of 4 %. While access to electricity in rural areas is only 3,5 % compared to 48 % in urban areas and the implementation of the rural electrification programme by the government remain slow due to inadequate financial resources. Therefore, the company see the market that is not covered to be wide and can establish themselves. Furthermore, there is an opportunity for the company to grow for the country's economical growth has been positive for the past years, creating an enabling environment for all sectors of the economy to grow (Ministry of Finance and National planning, 2012 Report on Energy)

The main business threats of Muhanya Solar Ltd are competitors with similar products and services that are offered at cheaper prices. The country being free market, it brings competition to any sector were there is potential of profits. Among its competitors are Suntech Appropriate Technology Ltd, Solaris Africa Ltd, Songhor Agriculture Ltd, and Greenfields Energy Corporation Ltd. The high importation tariffs imposed on the products that the company sells makes the cost of operations be substantial and affects its expansion programme.

4.3 Action Plan on increased Sales

The company formulated an action plan on sales for its marketing strategy, by coming up with a roadmap on marketing its products and services. Management planned to partner with non governmental organisation that operate on the basis of poverty alleviation. This has been successful, for the company has engaged itself in a number of projects and recorded increased sales revenues. Furthermore, the government policy on construction of health posts and schools in remote areas has increased the company solicitation of its business portfolio to government projects by installing solar equipments to those infrastructures (Operations Manager, 2014. Email communication).

Although the undertaken actions have covered a significant percentage on its operational budget, the actions made have brought in growth and the company's projected outcome in

this action plans looks to be positive. The operation of marketing plan is as well based on the technology available and the required expertise of the company's employees. The employees have required qualifications in the field of renewable energy with strong academic and work experience in engineering (Operations Manager, 2014. Email communication).

4.4 Muhanya Solar Ltd currently improving poverty levels through its business

In order to reduce poverty levels, which stands at 60 % according to the world bank report (2014 report. Zambia Overview). Combined effort is needed from both the public and private sector to invest in the energy industry for it is among the important sector that can help in improving the country's economy.

In October 2013, Muhanya Solar Ltd launched a campaign “Light up Zambia” to help address lighting challenges in rural areas using renewable energy. In this campaign the company donated solar lamps to various households in rural areas and according to the Company managing director the campaign was aimed to help save lives by avoiding homes being burnt down by candles and help many children who have no access to electricity for lighting to do their school work in the night. This was done in order for the would be future clients to be aware that there are cleaner sources of energy as opposed to the traditional sources that destroy the environment and also for the renewable energy to be appreciated. (Zambia Daily Mail, 10, 2013)

The products and services that the company offers are well appreciated by the customers as evidenced in one of European-times report, 2012. Where a farmer living on less than 1,5 euros per day, used to spend almost two euros a week on candles to light his home. But after purchasing the solar panel from Muhanya Solar Ltd, he is now able to purchase meat for his family to improve their diet, and notes the impact solar has had on study habits (European-times report, 2012).

The company currently has outlets in three provinces and has ambitions of expanding its presence in all nine provinces in the country.

Illustration 3: Muhanya Solar installs solar panel on a water bowhole

5 Content of the Questionnaire

The content and extent of the questions sent has been attached to the appendix in the appendices section of this thesis.

5.1 Analysis of the questionnaire

The analysis part is divided into two, namely analysis of questionnaire answers and analysis of the information/responses on the impact of green energy towards poverty alleviation.

The question No	Justification
3	This is to find out the figures that would prepare Muhanya solar ltd to understand the market they intend to explore in its roll out plan.
4	To have an assessment if the government have any direction on the promotion of renewable energy and this would be an opportunity for the company to aligin itself with government furure polices.
6	To find out what the benefits company such as Muhanya can capitalise on it imported products.
7	This is to know what really the government has noted as benefits trickle down effect to its promotion of renewable energy
8	For Muhanya to look out for any possible corroboration in any government led project in the implementation of its rural electrification programme.

Figure 2: Table Analysis of content of questionnaire

5.3 Analysis of the questionnaire results

From the data that was gathered in this project, solar energy as a renewable energy source is more appealing and with ferwer difficulties in implementation. The Environmental Protection Agency (EPA) and International Renewable Energy Agency (IRENA) have highlighted on how clean energy initiatives can generate significant economic, public health and bring numerous environmental benefits. The government through relevant ministries and authorities appreciate that renewable energy technologies should be promoted. Where formulating a reliable and sustainable form of energy services can support income generation activities and stimulate local economic growth.

The energy for development concept note report of 2010 by the ministry of energy and water development indicate that the government will in the next five years put up expansion program on the energy sector through five elements: Transmission, Generation, Grid electrification, Off-grid and of more importance create stand-alone renewable energy systems. It is the creation of these stand alone renewable energy centres that would make access to energy by rural households and small scale businesses to have low-cost lighting products that can provide electricity services to meet their basic needs and accelerate development.

From this it would be easy to achieve an economy of scale, if it is also recommended that the institutions such as schools, clinics, small businesses operating in one area and household market should be aggregated in a contiguous manner to reduce transaction costs of service being provided by the created stand alone RE systems. The ministries findings point out that the clients of these scheme should sign a long-term contract with the service providers to cover supply, installation, maintenance, and training. This will in effect make the high cost be distributed among the users. However, the household market are encouraged to also target at a fordable, standardized, and good quality small size solar home systems that they would install at their homes.

With such planning and facilitation by the government it gives potential business opportunities to MSL to expand its business operations by engaging in relevant authorities and be either one of the service provider of the stand-alone RE systems or provide quality and affordable solar home systems to these households.

Furthermore, in the answers that were received from the ministry through the questionnaire indicates that, government is working and willing to partner with the private sector in order to achieve its goals on the rural electrification programme. The Act No 20 of 2003 of the government of Zambia for the rural electrification program, has been formulated in order to guide the ministry on the implemetation of the program and demonstrate that the government through its ministries is able and moving forward in the helping of small scale business as well as poor rural households to have affordable energy for development.

Enhanced use of renewable energy technologies helps in the creation of local jobs through human resource needed to manage the energy system. Both small and large-scale renewable energy projects can adequately contribute to increased energy access and security through increased energy supply, and reduce pollution.

There are also other challenges that the rural customers of solar energy in the rural areas face as noted by a few experiences thus far. The technical part of maintaining the solar panel needs to be prioritised by companies that are doing the selling and the installations. This is because many customers in these areas can hardly pay for the continuous maintenance of the panels because of the product technicalities. In such instances were the customers can not find or afford to pay for maintenance it becomes a wasted high hopes and expectations such purchases bring about in poor families and this could result in negative feedback and making would be customers to dismiss the idea of set up solar panels too.

6 Theoretical knowledge

The used theory focused on the concept of using renewable energy as a way of improving living standards of the people and how current players such as Muhanya Solar Ltd have modelled their business to meet the demand for energy.

The theory helped the author in appreciating the impact of renewable energy and how the government and the private sector can collaborate in uplifting the living conditions of its people. The questionnaire sent to the ministry department linked well with the vision plan of case study company.

7 Summary

Energy is an important input into all sectors of the economy and thus a reliable and efficient energy sector is key to achieving sustainable economic development in the country. The demand of energy at household level should be met through public and private sector participation supported by cost reflective tariffs, sustainable subsidies and isolated grids in addition to the national grid. Economically viable and self-financing ventures such as Muhanya Solar Ltd should be given incentives for not only are they employing, but also as improving peoples living standards.The policy of greater utilisation of renewable energy sources by private and public sectors can be achieved by setting targets and highlighting government policy, legal and institutional framework.The country has abundant renewable energy resources, including hydro, biomass, solar, wind and geothermal energy that may be utilised for both on-grid and off-grid systems.

There has been more emphasis on grid-connected hydropower rather than other renewable energy technologies by the government policy makers, although National Development Plans (NDP) and National Energy Policy point to the importance of maximizing the available renewable energy resources to meet the country's growing energy needs. The government should further provide an enabling environment with incentives that promote the renewable energy technologies sector as well as invest in research and development to ensure that Zambians are able to manage this technology.
Muhanya Solar having the necessary expertise in the field of renewable energy should work closely with the government ministries and non governmental organisations that appreciate the use of renewable energy as a cost effective energy and a mean to improve human living conditions. The company should expand and have a presence in other provinces and target more rural farmers that are in remote areas away from the national electricity grid.

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Illustrations

Figures

Tables

Appendixes

QUESTIONNAIRE formulated for the project
Introduction to the benefits of renewable energy

The main object of this questionnaire is to solicit for information from credible sources, such as government ministry department that deals in energy, specifically the rural electrification programme department. Find out how the use of renewable energy helps in improving the living standards for the people and what are the government policy on renewable energy to ecounrage local companies participation.

Questionnaire

1. Name of Ministry and department
   Answer:

2. Position of respondent
   Answer :

3. Whats the demand and supply of renewable energy to the public?
   Answer :

4. What government implimentations has been put in place for the support of Renewable energy?
   Answer :

5. What type of renewable energy is the government, through your ministry Supporting, if any ?
   Answer :

6. What tax incentives are in place for the local and foreign business venturing In renewable energy ?
   Answer :

7. What are the tangible benefits that the government/ministry have dir rived from the implementation of rural electrification especially concerning

renewable energy ?

Answer :

8 . Is there any corroboration between the government and the private Sector dealing in renewable energy ?

Answer :

Appendix 1