INTRODUCTION

From time immemorial, the majority of Zambian households have used woodfuel in form of firewood and charcoal as their main energy source for cooking and heating. Though the coming of modernisation and resultant industrialisation saw the development of hydro power generation systems in the 1970s, the growth in demand from the growing economy and population has led to the outstripping of this resource leading to the continued dependence of the greater part of the country's population on woodfuel.

This growth in population has also led to an increase in consumption of the woodfuel, resulting in the depletion of Zambia's woodlands. The resulting effect has been rapid deforestation and land degradation in a country whose economy largely depends on agriculture after mining. In theory, woodfuel could be considered a renewable energy source and use of biomass in itself, not a cause for concern. However, when resources are harvested unsustainably and energy conversion technologies are inefficient, there are serious adverse consequences for health, the environment and economic development. This has led to increased efforts from the government and cooperating partners in identifying and promoting initiatives and policies aimed at improving access to cleaner, more sustainable energy services in the country.

However, despite these efforts and the abundant natural energy sources in Zambia, which include hydro-power (electricity), petroleum, coal, biomass and renewable energy such as solar, wind and geothermal(NEP, 2008, p.2), the majority of Zambians especially in the rural and peri-urban (urban poor) communities, continue to use firewood and charcoal in ways that are both inefficient and unsustainable. This has resulted in the consumption rates of trees exceeding the yielding rates, meaning that unless the consumption of woodfuel can be controlled or reduced to manageable levels it can no longer be considered as a renewable resource (NEP, 2008, p.2). Apart from petroleum which is wholly imported, the country has substantial unexploited reserves of these other forms of energy (NEP, 2008, p.2).

Though efforts continue to be made in the hydropower and solar energy sectors, their potential coupled with the limited fossil fuels continue to fall short of the population's requirements as is evidenced in the continued load shedding, power outages and limited fuel supply in the country. This has in turn perpetuated people's misguided perception that woodfuel is not only the cheapest but also most readily available as there are always forests from which this energy source can be obtained.

The aim of this study was to assess the awareness levels of the Zambian people of the alternative energy sources available for household use, in light of government's policies and dissemination strategies and to establish the reason(s) behind the apparent slow adoption of these alternatives. The study was conducted in Fisenge, a peri-urban area of Luanshya town. Luanshya is one of the metropolitan centers situated in the Copperbelt Province in Zambia. While primarily a mining town, Luanshya is home to a reasonable number of livestock farmers and is in close proximity to some of the country's largest forest reserves. As a consequence, Luanshya has an abundant source of biomass in the form of agro-waste, waste generated by activities in the timber and other industries in the area. Like most per-urban areas, the majority of the households in Fisenge are not electrified and even those that are electrified still depend heavily on charcoal for cooking and heating. The study area has the added advantage of having been identified in a baseline study conducted by the Netherlands Developmental Organisation(SNV), an NGO working in collaboration with the Department of Energy (DoE) and other stakeholders, as having the potential to successfully use bio-digesters running on animal (or human) waste for their cooking requirements. To demonstrate how the technology works, SNV is setting up commercial digesters at some resource centers (like the Milk Collection Centre) in the community.

This report is divided into six (6) chapters. Chapter one gives a background to the growing global energy problem that saw the need to consider alternative more

sustainable energy sources. It introduces the focus of the study, the rationale behind the study and the context in which the study findings are later interpreted. Chapter two reviews the literature on efforts that have been made by other countries to tackle this energy problem in an environmentally friendly and sustainable manner. It looks at the lessons learnt from countries in similar situations as Zambia (developing countries) as well as developed countries. Chapter three delves on the research methodology used. Chapter four outlines the main theories guiding the study and defines the main concepts according to the way in which they are used during the course of the study. Chapter five is a presentation of the research findings, their interpretation and their significance to the study's purpose and objectives. The final chapter lists the conclusion drawn from the research findings and offers recommendations for immediate action and future research.

CHAPTER ONE

1. BACKGROUND INFORMATION

1.1. Introduction

Global concerns over environmental decline resulting from continued industrialization and economic growth have sparked a lot of debate and study into better practices which can either combat or at the very least slow down resultant effects such as climate change. Sharon Beder's Sustainability Principle is one such study which notes that continuous industrialization and economic growth cannot be sustained forever on a planet (Earth) that has limited natural resources and a limited ability to deal with pollution (Beder, 2006, p.13). Rees defines human carrying capacity as 'the maximum rates of resource harvesting and waste generation (the maximum load) that can be sustained indefinitely without progressively impairing the productivity or functional integrity of relevant ecosystems (Rees, 1996, p.197). Beder further brought out another measure of human impact on the environment referred to as the Ecological Footprint. The Ecological Footprint is a tool for measuring and analyzing human natural resource consumption and waste output within the context of nature's renewable and regenerative capacity (or biocapacity) (Venetoulis et al., 2004, p.7). The concept implies, among other things, that individuals are responsible for, and can contribute to the reduction of their own footprints. To be sustainable this ecological footprint must remain within the Earth's limits otherwise resources will be used faster than they can be renewed, leading to environmental degradation and the inability of the Earth to sustain human life together with its industrial metabolism, which also requires natural resources as inputs and produces outputs in form of pollutants. Ecological footprint analysis enables the resource use of different populations to be compared and for those that are clearly unsustainable to be identified (Beder, 2006, p.28). In a nutshell, it is becoming increasingly clear that the environment is deteriorating, both by the depletion of resources, as well as the pollution and environmental degradation resulting from ever increasing production and consumption which is the real threat to the planet's future (Beder, 2006, p.12). The

aforementioned coupled with the energy crisis of the 1970's resulting from the Arab Oil Embargo led to the rise in global interests in alternative energy sources.

1.1.1. Technological background

In the period immediately following World War II, development was largely considered synonymous with industrialization (Rapley, 2007, p.1). Powered by different forms of energy, fuel sources have evolved from the traditional wood fuel to the more 'efficient' coal, fossil fuels and hydro-power electricity according to demand. The realization though, that unless these energy needs can be met in sustainable ways, catastrophic climate change will result, has led to increased attention across the globe on eco-friendly, renewable and sustainable energy sources. However, even as interest has turned towards renewable energy, the historic pattern of focusing on industrial hydro-power and solar energy systems has continued, with biomass being overlooked despite the fact that it has been, and still is, the most widely used source of energy. Biomass comprises any organic matter of either plant or animal origin. Biomass energy is the stored solar energy, carbon and hydrogen – captured initially through photosynthesis into chemical bonds – that is now available on demand within that organic matter. It comes in a variety of forms although woody biomass accounts for most of this total annual biomass use globally (87 per cent) (Macqueen & Korhaliller, 2011, p.1). It is the oldest form of energy used by humanity in the form of wood fuel or charcoal, but is often tarred as 'inefficient', 'non-commercial', 'trapping people in poverty' (for example through the drudgery of wood collection eating into other more productive uses of time and smoke inhalation from cooking on inefficient stoves) (Macqueen & Korhaliller, 2011, p.5).

To overcome some of these accusations against biomass energy, which may be true when it is inappropriately managed and used, technological advancements have been made which have proved effective in developed countries and are now taking root in some developing countries. Energy efficient stoves have been designed to reduce on both the amount of charcoal being used and the emissions causing respiratory problems. Simple cost effective technology has been developed to produce biogas from animal and human

waste. Currently briquettes from agricultural and industrial waste are being promoted to provide an alternative to charcoal and reduce on deforestation. At the household level, alternatives to the wood fuel such as biofuels from energy crops like Jatropha are also being promoted in pilot projects in Zambia's Northern, North-Western and Central provinces. There is unfortunately an immediate and rather striking correlation between domestic biomass dependence and poverty, which has more often than not, been interpreted to mean that biomass energy is symptomatic of poverty. According to the Global Network on Energy for Sustainable Development (GNESD) 'firewood (if extracted in a sustainable manner) and waste biomass, are the renewable biomass resources with the highest potential to meet the energy needs of the poor' (GNESD, 2006, p.37).

Primary conversion inefficiencies, however, indicate that biomass energy production is likely to be relatively land intensive. In an increasingly land-scarce world this will favour biomass options that are either (i) residues or by-products of other forest or agricultural land uses, provided these are not too dispersed or low density or (ii) fast growing perennial crops, which do not require annual energetic land preparation (around 10 per cent of a typical crops' annual gross energy content); adapted to marginal rather than prime agricultural land and requiring minimal energy-intensive fertilisers or (iii) clever cropping arrangements in existing agricultural or livestock management that enhance the productivity of the system (such as agroforestry) (Macqueen & Korhaliller, 2011, p.5). The main focus of this paper is the residue or by-products of other forest or agricultural land uses otherwise known as waste biomass. Waste biomass is the use of trees and crop residues, animal and human waste (although not strictly a solid biomass source, it is often included in this category), household or industrial residues to provide energy for heating, cooking and other energy requirements.

1.1.2. Policy background

Though not widely enforced, let alone acknowledged, efforts have been made on the global and international levels to provide a basis on which individual countries can

formulate policies which can encourage citizens to contribute meaningfully to sustainable development. Examples of these laws and principles as enshrined in the International Environmental Laws include:- the *Draft International Covenant on Environment and Development, IUCN, 1995* which states that "All persons have a duty to protect and preserve the environment" (Article 12.2) and "All persons, without being required to prove an interest, have the right to seek, receive and disseminate information on activities or measures adversely affecting or likely to effect the environment and the right to participate in relevant decision-making processes."

The *Hague Recommendation on International Environmental Law, 1991 (SL)* which states that "Environmentally sound waste management must go beyond the mere safe disposal or recovery of wastes that are generated and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption."

Steven Rockerfeller for the *Earth Charter Project* also listed as Principle VIII that "Environmental education programs should be established in school systems as an integral part of general education at all levels, and environmental information and opportunities for environmental training be availed to the public, ensuring that all people have the knowledge, skills and values to cooperate in protecting the environment and achieving sustainable development."

The 2007 Kyoto Protocol recommendations may also be integrated in policy formulation to provide more opportunities for the local communities. An example of such recommendations is the Clean Development Mechanism (CDM) where Industrialized (AnnexI) countries are allowed to buy Carbon Emission Reduction (CER) units from CDM emission reduction projects in developing countries. The CDM is based on the idea of emission reduction "production" (Toth *et al*., 2001, p. 660). With the aim of achieving compliance with their quantified emission limitation and reduction commitments,

countries are bound by the principle of "common but differentiated responsibilities" which puts most of the burden for combating climate change on rich nations with larger historical rates of emissions (Cazorla & Toman, 2000, pp1-3). The CDM allows industrialized countries to buy CER units and to invest in emission reductions where it is cheapest globally.

Table 1: Selected International Environmental Agreements to which Zambia is a party

Agreement	Objectives
1989 - Montreal Protocol on Substances That Deplete the Ozone Layer	To protect the ozone layer by controlling emissions of substances that deplete it
1993 - Convention on Biological Diversity	To develop national strategies for the conservation and sustainable use of biological diversity
1994 - United Nations Framework Convention on Climate Change	To achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system
1996 - United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa	To combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements

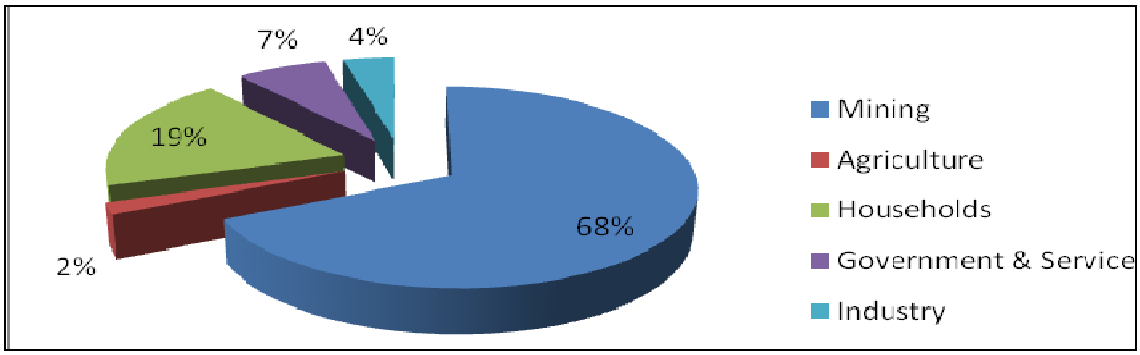
1.1.3. Zambia's energy background

Zambia is endowed with a wide range of energy resources including woodlands and forests, hydropower, coal, renewable sources such as solar (thermal and photovoltaic); biomass (agricultural waste, forestry waste, industrial/municipal organic wastes, energy crops and animal waste); geothermal, and wind (NEP, 2008, p.2), and the imported petroleum. However having had supposedly 'abundant' hydro-electric energy potential, little progress has been made in the exploitation of other alternative energy sources.

Hydropower (electricity) is one of the most important energy sources in the country, second only to wood fuel and contributing about 10% to the national energy mix.

Developed in the 1970's to provide cleaner more modern energy, demand for electricity has risen significantly with the increase in population and economic activity, causing a strain on the efficiency of the country's electricity supply systems. This deficit is especially felt in the household sector which only receives 19% of the total electricity generated in the country as illustrated in ***figure 1*** (NEP,2008, p.3).

Figure 1 – Electricity Consumption by Sector



Source: National Energy Policy, 2008

Currently the Zambian energy sector is guided by the National Energy Policy which was drawn up in 1994 and later revised in 2008. The policy seeks, among other things, to ensure environmentally sustainable exploitation of the woodfuel resource. The National Energy Policy is supported by other Acts of Parliament such as the Electricity Act (1995) amended in 2003 which permits private investment in the power sector, the Petroleum Act (1995), the Energy Regulation Act (1995) under which the Energy Regulation Board (ERB) has been established, the Rural Electrification Act (2003) which established the autonomous Rural Electrification Authority (REA) and the Zambia Development Agency (ZDA) Act of 2006 (World Bank GEF/REA Project, 2006). Those related to the biomass subsector include the Forest Act (1998), Environmental protection and Pollution Control Act - now Zambia Environmental Management Authority (ZEMA) Act (1990) and Energy regulation Act (1995) (NEP, 2008). Vision 2030 and the Sixth National Development Plan (SNDP) for the period 2011 to 2015 also stress Government's continued encouragement of energy substitution and conservation practices at household,

institutional and industrial levels. To support the policy reforms undertaken, the SNDP states that the energy sector will put in place legislative reforms and appropriate measures to promote the role of these energy sources in the national energy mix.

Working from the perspective of the country's opportunities, government has taken advantage of Zambia's large potential in hydro-power and solar energy, and embarked on rural electrification programs through REA. However, constraints such as the high cost of extending power grids to rural remote areas where the load demand is too low to justify the cost, has made the success of electrifying large parts of the population through conventional grid-based services unattainable, while the high installation costs of solar systems in homes have also proved to be cost prohibitive. Even with government imposed electricity tariffs, prices are still considered too high. As a result many people in the cities use charcoal, partly because it is perceived to be cheaper than electricity, and partly because in some parts of the cities there is still no access to electricity. Although evidence suggests that this energy path has so far failed to meet the energy needs of the poor, it is nevertheless still being pursued by many governments including Zambia (Macqueen & Korhaliller, 2011, p.25).

Current policy measures and strategies include providing incentives to encourage energy conservation and substitution; encourage efficient end-use technologies and household energy practices; provide innovative financing schemes designed to reduce the initial cost problem for low income households; formulating and facilitating the implementation of pilot projects and demonstration projects for promotion of efficient use of energy; setting up small-scale enterprises to develop briquetting technology and encourage the use of briquetting products through practical demonstrations and pilot schemes; raising public awareness on the benefits and opportunities of other modern biomass energy sources and develop capacity for their implementation; improve the technology of charcoal production and utilization; promote alternatives to woodfuel and reduce its

consumption and encourage agro, forest and sawmill residues for combustion and gasification.

1.1.4. Historical background of Luanshya

Luanshya belongs to a family of copper mining towns in the Copperbelt Province of Zambia. The town whose population is in the range of 117,579 (CSO, 2008) primarily owes its existence to Copper. With the demise of some mines which became costly to operate, a lot of people were laid off. Many of the retired and retrenched miners have since ventured into subsistence farming in the growing peri-urban areas. Fisenge is one such area which, though connected to the national grid through growth centres such as the Health Centre, has little to offer in terms of energy service delivery to the rest of the community.

1.2. STATEMENT OF THE PROBLEM

Widespread deforestation is one of the major problems currently being faced in the country today. In Southern Africa, the rate of deforestation is highest in Zambia (2.4%) and Malawi. Between 200,000 and 300,000ha of forested land is lost per annum respectively (Mfune & Boon, 2008, p.180). Regional studies conducted in the recent past have attributed this mainly to the excessive woodfuel harvesting which is a consequence of increased energy demand from the rising population. As the majority of population growth over the next few decades is predicted to occur in urbanised areas, energy poverty will increasingly become an urban issue for which innovative solutions are needed to match urban demand with sustainable rural supplies (TERI, 2008, p.58).

Around 1.6 billion people worldwide lack access to electricity in their homes. Some 2.4 million people use inefficient forms of biomass as primary cooking and heating fuels (Flavin & Aeck, 2004, p.7). In Zambia, over 70% of the national energy mix is sourced

from woodfuel and eighty-eight percent (88%) of this wood- fuel resource is consumed in form of charcoal and firewood in the household sector (NEP, 2008, p.2).

This extensive dependency on wood-fuel is linked to a number of underlying issues among them, **low income levels of energy consumers with access to supposedly abundant woodfuel resources** (over 64% live below the poverty datum line) and **inadequate electricity supply** (NEP, 2008, p.2)**.** Zambia´s hydropower potential is assessed to be 6,000 MW of which, only 1670MW is installed. Only 22% of the 13 million strong population has access to electricity, implying that 78% of the population has no access (ZESCO strategic plan 2013-2018, p13). With this population growing at a steady rate of 3-4% per annum, demand for electricity has also been growing at an average rate of 4 % per annum since 2005 and is projected to outstrip the country's generation capacity by 2015 (ZESCO strategic plan 2013-2018).

Despite this outlook, no additional generation development has taken place since the 1970s when the construction of the existing power plants was completed. In 2004 power rehabilitation projects (PRPs) were executed with aid from the World Bank, but these were just to extend facility life at the existing stations and assure supply over the short term to meet the growing demand (PSDMP, 2010, p.3). Although the Electricity Supply Industry was liberalized in 1995 to attract private sector participation in the Generation, Transmission, and Distribution of Electricity, there has not been any major investment in the industry due to the high barriers to entry, such as the large initial investments required and the unattractive tariff regime (ZESCO, 2013-2018 strategic plan, p.18). Moreover, as the country's electricity is predominantly consumed by the mines, the majority of Zambians are left to depend on wood fuel for their household energy needs.

There is, on the other hand, significant potential in Zambia to expand biomass use by tapping into the large volumes of unused residues and wastes from agro and timber processing industries which not only represent a loss of resources both in the form of materials and energy, but also poses an added problem of pollution and environmental degradation.

Table 2: Renewable Energy Resources and Technologies

Renewable Energy Source/Technology	**Opportunities/Use**	**Resource Availability**	**Potential Energy Output**
Solar	Thermal, Electricity (Water pumping, Lighting, and refrigeration)	6 – 8 sunshine hours	5.5 kWh/m 2 /day modest Potential 1 especially for limited irrigation)
Wind	Electricity, Mechanical (Water pumping)	Average 3 m/s	Good potential, Especially for irrigation)
Grid Extension	Electricity	Existing infrastructure	Excess power (approximately 200 MW)
Micro – hydro.		Reasonably extensive	Requires elaboration and Quantification
Biomass (Combustion and Gasification).	**Electricity generation**	**Agro wastes Forest wastes Sawmill wastes**	**Reasonably extensive**
Biomass (Biomethanation).	**Electricity generation Heating (cooking)**	**Animal wastes Municipal and Industrial waste Wastewater**	**Potential requires elaboration**
Biomass (Extraction, processing for transport)	Ethanol for blending with gasoline to replace lead as octane enhancer Biodiesel for stationary engines	Sugarcane Sweat sorghum Jatropha	15,000 Ha to meet current demand 40,000 – 50,000Ha
Biomass (for household energy).	**Improved charcoal Production Improved biomass stove**	**Sawmill wastes and indigenous trees from sustainable forest management**	**Reasonably extensive**

Source: CSO, *Energy Statistics*, 2007

These biomass resources if efficiently converted, are estimated to be sufficient to support electricity generation of approximately 500 MW, the majority of which would be fuelled by agricultural, forest and municipal waste.

However, the 2006 World Bank GEF/REA Project Report on *Promotion of Renewable Energy to increase access to electricity* reports that development of these rich renewable energy resources has been and is still being deterred by factors like **low national uniform power tariffs,** which is a major hindrance to both ZESCO grid extension and to those interested in venturing in mini hydro power stations. **Weak capacity of local stakeholders**: most private entrepreneurs lack expertise to develop, operate, and maintain the equipment, which often results in poor installations and maintenance especially in the case of solar PV systems. The report cites the need for more business support to provide pre-investment resources, advisory services to develop business plans, training, and information on Renewable Energy (RE) technologies and project development. **Limited information and awareness on RE**: utility, financial institutions, and the public, including end users, are not fully aware of the availability, usage, and benefits of Renewable Energy.

This is echoed in another research on Promoting Renewable Energy Technologies for Rural Development in Africa, which apart from recommending the promotion of decentralized Renewable Energy Technologies, not just limited to home solar systems and wind machines for pumping water, but including geothermal and biomass technologies (Mfune & Boon, 2008, p.188), also pointed out the following challenges being faced in the dissemination of alternative energy sources.

- The range of adopted RETs remains narrow with solar home systems leading in households. Wind energy is predominantly used for water pumping in rural institutions. Geothermal, micro-hydro, solar thermal and modern biomass technologies remain unexploited despite the enormous existing potential.
- Unlike other sectors of the Zambian economy, few initiatives exist for awareness raising and information dissemination of RETs. This situation can partly be explained by the incapacity of the department of energy itself which is more or less a Cinderella department. It has no presence at the provincial and district levels. Consequently, there is a general lack of awareness of RETs in the district.

- The prices of RETs are a major inhibiting factor in the dissemination of these technologies. While the price of most RETS on the world market and in Zambia has experienced a general fall, the reduction is largely insufficient to induce the rural population to actively engage in the renewable energy market.
- Dissemination of RETs is also hindered by inadequate policy, poor integration of renewable energy in development plans and inadequate commitment to effective policy implementation.
- For RETs such as solar thermal technologies and solar home systems, there are no active manufacturers in Zambia. All components of solar energy technologies are imported from countries such as Japan, France and South Africa. In addition, companies that deal in renewable energy technologies are located in the main cities on the Copperbelt and Lusaka Provinces and lack distribution networks in the countryside. Most retailers do not perceive RETs as viable business opportunities.
- The government needs to create incentives for the private sector's participation in RETs in rural areas. Further efforts should be targeted towards the involvement of credit or financial institutions in financing renewable energy projects (Mfune and Boon, 2008, pp.187-188).

The Zambia Energy and Gender Mainstreaming Strategy for the period 2011-2013 also gives a gender perspective to the problem. The strategy notes to begin with, that though household energy utilization in Zambia is largely dependent on woodfuel, most of the energy projects have been centered on electrification which accounts for only 10% of the national energy supply and whose benefits do not trickle down to the majority of Zambians as most of them live in poverty and cannot afford electricity for their domestic needs. It then focuses on a research conducted by the Program for Biomass Energy Conservation (ProBEC) in Chikankata area in Southern Province, which highlights the dangers faced by women in the inefficient use of traditional biomass. Already walking more than 5km every other day in search of firewood which will last them a day or two, women now have to walk longer distances due to increasing deforestation. This cultural

and traditional stereotype view of women perpetuates women's role in energy utilization with health implications. For example, firewood can be heavy sometimes a load weighs up to 20kg which is a danger to the spine. And in settings where cooking is traditionally done indoors, women are more exposed to pollution and smoke, which can lead to or worsen lung cancer and tuberculosis (TB) and other respiratory infections.

Zambia's concern for the environment was first articulated in the national conservation strategy (NCS) of 1985. The objectives of the NCS were to ensure the sustainable use of Zambia's renewable natural resources, maintain Zambia's biological diversity and maintain essential ecological processes and life-support systems. This culminated into the Environmental Protection and Pollution Control Act (EPPCA) in 1990, and the establishment of ECZ in 1991 which later became ZEMA. The energy sector policy however, did not come until much later in 1994 when the National Energy Policy (NEP) was formulated. Revised in 2008 to include cross-cutting issues like gender, the NEP outlined policy objectives aimed at promoting efficient use of energy resources; reducing dependence on wood fuel; ensuring sustainable provision of affordable, reliable modern energy services to rural and urban households as a means of reducing poverty and raising standards of living; ensuring that all energy sources are produced, transported, stored and utilized in an environmentally friendly manner and to ensuring environmentally sustainable exploitation of the biomass resource.

Therefore, in view of the already stated problems concerning the inefficient production and utilization of woodfuel and the slow adoption of alternative energy sources leading to consequences such as deforestation and climate change, this study aims at assessing the awareness levels of the Zambian people of the alternative 'more sustainable' energy sources available for use at household level, in the light of government's policies and dissemination strategies. As can be seen, most of the concerns and challenges raised so far, hinge either directly or indirectly on information dissemination and public awareness.

1.3. RATIONALE

Energy poverty is defined by the United Nations Development Programme (UNDP) as the absence of sufficient choice in accessing adequate, affordable, reliable, quality, safe and environmentally benign energy services to support economic and human development (UNDP, 2000, p.508). According to the UNDP, key barriers to accessing energy are physical access, affordability as well as the lack of opportunities involved in energy supply. This extends to lack of entrepreneurial and technical skills, constraints to market development and most importantly – the lack of awareness of the various alternatives available in the energy supply. The United Nations 'Sustainable Energy for All (SE4ALL)' initiative aims at increasing access to affordable and reliable energy services, increasing the share of renewable energies in the country's energy mix and increasing energy efficiency levels by the year 2030.

It is, therefore, necessary to undertake this research because it will provide the following benefits:

- For the government, it will establish the gap between existing knowledge, attitudes and practices with regards to energy sources and what is desirable for sustainability.
- The research will establish the necessity of communication strategies for DoE to market alternative sustainable energy for domestic usage.
- Although this exercise is in the first place an academic requirement in partial fulfillment of the award of a master's degree, it is hoped that copies will be taken to the Ministry in charge of Energy for possible implementation to contribute to the wellbeing of the communities in which findings and/or recommendations will be addressed and implemented.
- It will provide fresh researched evidence of the perceptions people have with regard to alternative energy sources and contribute to the knowledge of the subject and to research.
- It will show the different communication strategies that can be used to promote and sustain the use of alternative energy sources in communities. The Media guru

Marshall McLuhan says “the media is the message”. DoE does not have a communications department because it seems to have nothing to do with the media. This research will show that DoE needs such a department in order to be in touch with the public. The type of media used will either cause the public to believe the message or reject it.

- It will also show the effectiveness of government’s policies and dissemination strategies with regards to RETs.

1.4. OBJECTIVES

1.4.1. General objective

The general objective of this study is to assess the efficacy of government’s dissemination strategies regarding alternative energy usage at household level.

1.4.2. Specific objective

- Assess the appropriateness and effectiveness of government’s policies regarding the use of alternative energy sources in the prevailing situation in the country.
- Determine and assess the communication strategies (quality of message, language, content, and frequency, as well as the channels) being used by the government to sensitize the people in peri-urban areas of the available alternative solutions to their energy poverty.
- Establish the target audiences current sources of energy (available and those in use) and assess how knowledgeable they are of the impact these have on the environment?
- Assess the target audience’s perceptions, knowledge and attitudes towards the use of alternative energy sources in light of government’s current communications and policies.

1.5. RESEARCH QUESTIONS

1.5.1. General questions

- How effective are government's dissemination strategies regarding alternative energy usage at household level?

1.5.2. Specific questions

- How appropriate and effective are the policies and strategies by government in promoting and supporting the use of alternative energy sources, given the prevailing situation in the country?
- What communication strategies (messages, language, channels and frequency) are currently being employed by the government to sensitise the people in peri-urban areas (urban poor) of the available alternative solutions to their energy poverty?
- What are the current sources of energy (available and those in use) for the target population and how knowledgeable are they of the impact these have on the environment?
- How knowledgeable is the public and what perceptions and attitudes does the public have regarding the alternative sources of energy available for use at household level and the existing policies and strategies promoting and supporting them?

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Introduction

Renewable energy is a fairly new concept whose study has been almost synonymous with current environmental threats such as climate change, greenhouse emissions and their resultant effects of global warming, pollution and acid rain to name a few.

One of the earliest considerations of sustainable energy was made in1966 by Kenneth E Boulding, a professor in economics who wrote of the need to recognize that the planet earth has limited supplies and a limited capacity to extract wastes, hence the need for people to find their place 'in a cyclical ecological system which is capable of continuous reproduction of material form' (Boulding, 1966, p.5). He called for an economy whose aim would be to:- limit extraction and pollution

- decrease consumption
- continuously reproduce the material form
- increase stock maintenance, goods would be built to last as long as possible (Beder, 2007, pp.12-13).

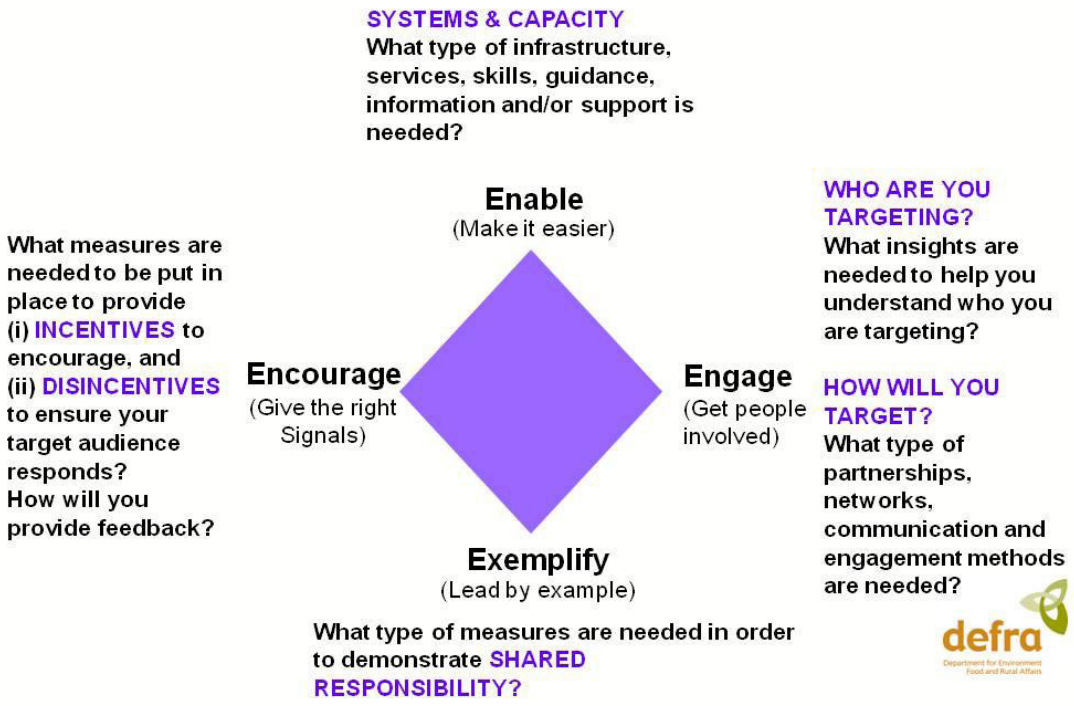
The study was, however, optimistic in its assertion that "it is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future" (Beder, 2007, p13).. This was supported by Simon, 1981 in his book *The Ultimate Resource*, in which he argued that human resourcefulness would ensure that resources would never run out because, if a particular resource became scarce, either new sources would be discovered, people would learn to do more with less, or substitutes would be found (Simon,1981, pp.73-77,578-589). It was on this basis that the notion of 'sustainable development' was developed, which argued that ways could be found to sustain economic growth through the discovery of new resources, recycling and pollution controls (Ekins, 1992, p.272). It was acknowledged though, that complete recycling, is in fact, not possible, since some materials are always lost through wear and tear.

2.2. LESSONS LEARNED FROM OTHER COUNTRIES

2.2.1. The United Kingdom: Policy development model

In 2005 the Secretary of State for Environment, Food and Rural Affairs, presented to the United Kingdom (UK) Parliament, The UK Government Sustainable Development Strategy. In it, is a model that has shown promise in understanding aspects of policy development that seek behavioural change by taking an analytical, holistic and systematic approach to influence different individuals, households and businesses. The Department of Environment, Food and Rural Affairs (DEFRA) model, developed for use within a policy context, proposed that for successful (and sustainable) government intervention, there needs to be a balanced approach addressing both internal and external barriers to change through the "4Es namely **encouraging** (giving the right signals - incentives and disincentives), **enabling** (making it easier), **engaging** (getting people involved), **exemplifying** (leading by example) (Defra, 2005, p.26).

Figure 2: DEFRA model for policy formulation



Source : DEFRA 2005

To motivate people to adopt environmentally friendly behaviors, an environmental segmentation model was developed to segment the public into groups, sharing a distinct set of attitudes and beliefs towards the environment. Each profile included information about motivations and barriers, knowledge and engagement with the environment, current environmental behaviours in the home and media usage and lifestyle information. This meant that the government was better able to target communications and policy to address the needs and motivations of different population groups. The segmentation model has been used in communication to inform, campaign, develop messages as well as improve the targeting and reach of projects. It is designed to support policy development and implementation in Government Departments and externally.

2.2.2. Finland: Climate-oriented development policy

In 2007 the Finnish Government announced that "Finland will place greater emphasis on climate and environmental issues" in development policy (Prime Minister's Office 2007, p.9). This statement of political intent was followed up by an influential Development Policy Programme, aimed at legitimising the integration of climate objectives to the development agenda. In this approach the main environmental sectors are interpreted through their relevance to climate change. For example, it is stated that mitigation is dealt with in the energy and forestry sectors (carbon sinks), and adaptation in the water sector and rural development. Environmental guidelines highlight the importance of creating opportunities for the private sector, while the public sector and development institutions are given a supporting and facilitating role through focusing on administrative capacity building, promotion of technology cooperation by supporting the creation of a favourable investment climate and by boosting private investment. The Finnish development policy was referred to in the EU as an inspiring pioneering model or "beacon" (Remes 2011).

The policy program prioritises a sustainable energy economy through private sector cooperation and trade citing Clean Development Mechanism (CDM) as an important dimension of energy cooperation with developing countries (MFA 2009a; 10). Energy policies have materialised in different projects and funding decisions, the flagship program being the Energy and Environment Partnership (EEP) which supports different

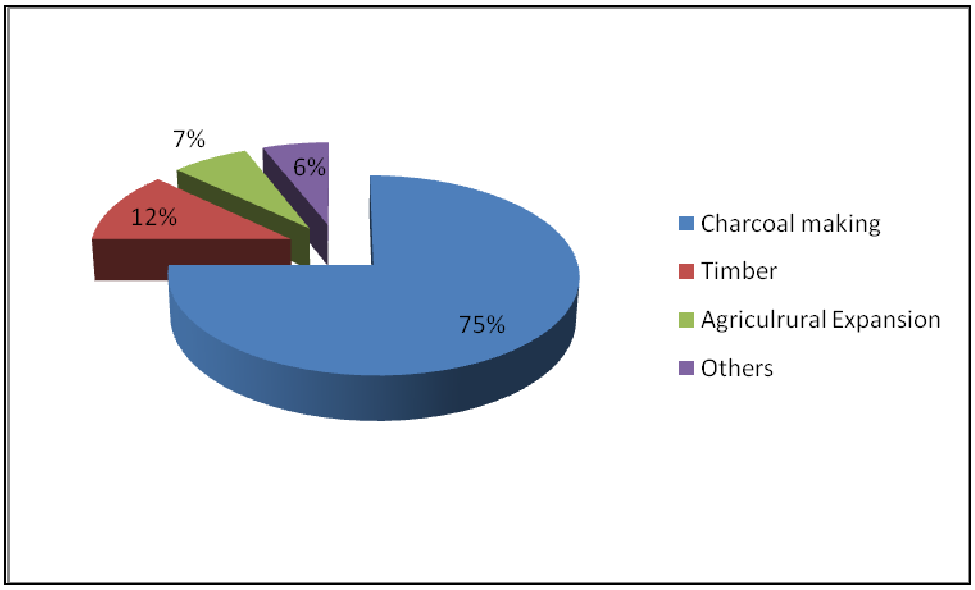
renewable energy projects. EEP and CDM are presented as win-win mechanisms in terms of greenhouse gas emission reductions and sustainable development.

The reduction of deforestation and forest degradation in developing countries has also been argued to be the cheapest way to quickly reduce global emissions, as the sector currently accounts for approximately 10% of global emissions. The Finnish policy documents see mitigating climate change through halting deforestation as a key opportunity, where Finland drives an "inclusion of forest carbon sinks within the emission trading in the future" (MFA 2009a; 12). The 2007 Development Policy Programme argues for active management of forests because "[s]ustainably managed forests grow faster and capture more carbon than forests in a natural state" (MFA 2007; 19). Though the program does pay attention to the multiple values that forests protect or harbour, policy documents for the forest sector seem to argue that multiple benefits can best be reached in mitigation projects.

2.2.3. Tanzania: Forest resource management

The Charcoal Potential in Southern Africa (CHAPOSA) project which commenced in November, 1999 aimed at increasing the understanding of the effects of the utilization of charcoal in three countries: Zambia, Mozambique and Tanzania in Southern Africa. In Dar es salaam and its catchment area, for example, it was established that apart from the conversion of woodland to agricultural use (using the popular chitemene system), the leading cause of deforestation in many parts of Eastern and Southern Africa was charcoal production. In a bid to curb the damage caused by unplanned charcoal production, most countries in the region have imposed restrictions on production and transportation of charcoal. These restrictions however, are quite difficult to administer due to insufficient manpower and the fact that charcoal trade in urban areas is legal. Therefore, unless modern techniques are used, charcoal is a wasteful use of natural resources that will lead to massive land degradation and deforestation (Malimbwi et al., 2004, p.230).

Figure 3: Observed activities contributing to woodland degradation in Tanzania



Source: Malimbwi et al, Field survey data, 1999.

In Tanzania, charcoal production has far reaching socioeconomic dimensions. In areas with reasonable accessibility, charcoal is the main cash crop of the rural households. For example in eastern Tanzanian communities, 75% of farmers in charcoal producing areas had charcoal as an important source of income. The income from the sale of charcoal was also found to be above the minimum wage paid to most of the governments' employees. This has a consequence of attracting more people to engage in charcoal making. Additionally, the activity requires neither formal education nor large capital investment although it is time consuming and labour intensive which is usually drawn from household members or other producers collaborating for specific tasks in the production process. While men carry out most of the production activities such as tree felling, cross-cutting and kiln building, women participate in breaking the kiln after carbonization and in recovering and bagging the charcoal (CHAPOSA, 2002; Brigham *et al*., 1996 cited in Malimbwi 2004, p.238). Given the low education level required, the income is attractive to other people to join the business, and thus more deforestation to the woodlands.

Existing biomass harvesting practices in developing countries like Zambia are often informal, or even illegal but where the economic and social benefits are clearly

identified, there are incentives for communities to protect the forests and secure a continuous supply of fuelwood. One of the key ingredients to fostering community involvement in biomass energy programs, is securing the land tenure and resource rights for the areas from which biomass is sourced. As one global review states:

> "Forest tenure security is important because it is often the foundation for the social identity, personal security, and cultural survival of indigenous peoples and ethnic minorities. Forest tenure is also important for economic reasons. It has a strong role in determining who benefits or loses in the competition for economic goods and environmental services provided by forest ecosystems. Security of tenure is often a prerequisite for capital investment by government or businesses, while conversely conflicts over forest lands discourage investment and undermine sound management" (RRI, 2009 cited in Macqueen & Korhaliller, 2011, p.51).

Such statements are as true for biomass energy development as they are for any other form of agricultural or forest land use. Without confidence that they will benefit commercially from the sale of their biomass, few rural communities will invest in replanting or managing natural resources towards that end (Macqueen & Korhaliller, 2011, p.74). When woodfuel and charcoal production is criminalised because the land tenure, biomass resource and use rights are either undefined or defined in such a way as to outlaw widespread practice, harvesting and processing operations are driven underground. Beyond the immediate incentive for corruption that this presents, this is problematic on two counts. Firstly, without secure land tenure and biomass resource and use rights, there is little incentive for sustainable forest management where the harvesting activities are deemed illegal. Secondly, the conversion efficiency of wood to charcoal in mobile ditch pits or earth mound kilns (8-15 per cent) is notably less efficient than conversion in brick kilns (up to 30 per cent) or steel kilns (27-35 per cent) (Seidal, 2008 cited in Macqueen & Korhaliller, 2011, p.71). Yet no-one will invest in brick kilns if this exposes them to official sanction.

It is in view of the foregoing that the Tanzanian government has introduced Forest Certification, a process designed to provide assurance that people who live in or close to the forest benefit from its management and use. The first Tanzanian Energy Policy published in 1992 and revised in 2003 included the following salient features: that ″Wood fuel for the foreseeable future will remain the main energy source″. To ensure sustainable supply of biomass fuels, the policy emphasizes that ″Biomass, particularly

woodfuel should be conserved through efficient conversion and end-use technologies which could be complemented by tree growing at household level and beyond" (Malimbwi 2004, p.244). It can be observed that the policy gives high emphasis on the need to sustain rural energy and in particular woodfuel. It also promotes efficient woodfuel conservation and end-use technologies in order to save resources, reduce rate of deforestation and land degradation, and minimizing threats on climate change. A Renewable Energy Fund has also been provided for in the Energy policy.

Examples of woodfuel projects established in Tanzania based on these provisions include:- The **Ruvu Fuelwood Pilot Project** whose goal to promote sustainable forest resources management, through increasing forest regeneration and forest products to meet rural and urban primary energy requirements (MNRT, 2004 cited in Malimbwi et al 2004, p.244). Three (3)ha plots have been allocated to 670 households each to be planted with agroforestry tree species such as eucalyptus, with potential to be used as woodfuel. The project, which is essentially participatory, has trained farmers on growing woodfuel trees, how to make charcoal kilns and firewood stoves (Malimbwi 2004, p.245). The **Maseyu Eco-Charcoal project** is mainly aimed at improving the livelihood of the producers of charcoal while promoting the sustainable use of wood as an important natural resource. This is done through t**ree nursing and woodland management -** to continuously replace the wood used for charcoal; e**fficient production** - using improved brick kilns and coordinated **marketing** – to an assured commercial market such as hotels and supermarkets. Like the Ruvu project, the Maseyu project is highly participatory involving a Community Based Organisation (CBO) of 24 villages and other stakeholders like Energy for Sustainable Development Africa (ESDA) to provide the technical backstopping (Malimbwi 2004, p245).

2.2.4. Sudan: Why the charcoal industry works (the importance of woodfuel and institutional arrangements)

Sudan derives 71% of its energy from woodfuel. The remaining 29% is from petroleum

and electricity. Out of all the wood harvested, 88% is used for woodfuel and the remaining 12% for poles, posts and timber. The government has recognized charcoal as an important source of energy and vested the power to regulate it in the Forest National Corporation. The agency is responsible for planning and organizing production from natural and planted forests. Natural forest in Sudan represents 68% of the total forested area, while plantations account for the remaining 32%.

The government has also recognized charcoal producers to whom it sells the trees by tender at officially set prices. While most of the charcoal is produced by large-scale contractors with Sudan Charcoal Producers Association, individuals also produce limited amounts. The charcoal is sold to merchants who transport it to wholesalers in urban centres for distribution to retailers and users. Overall, production costs are about 41% of the retail price. Transportation accounts for 37% and service fees (royalties, taxes, duty) 22%.

Additionally, the Sudan Charcoal Producers Association was started to negotiate with the government on behalf of traders. Grouping producers, transporters and traders, the association has set up its own rules in addition to those laid down by the government. For example, the association expels members who fail to pay taxes or engage in corruption. The expulsion means one cannot trade in charcoal. The organization has paid off, with some members producing between 2,000-5,000 bags of charcoal and earning up to USD50,000 a season. The association is not problem-free, however. Members complain of high taxes, unclear boundaries and conflicts due to animal routes through contracted land.

Charcoal export is restricted to specific places and the Forest National Corporation sets the minimum price. Export of high quality charcoal, mainly acacia, is limited to 5,000 tonnes a year. However, exports could rise as the government is promoting private investment in charcoal production for foreign markets. Private forest owners are also allowed to export their charcoal and many companies are coming in to exploit the

opportunity. Under this arrangement, investors meet the cost of establishing and maintaining the forests. The government is also encouraging farmers' to plant trees under the agroforestry land management system.

Considering what is happening in the countries of the region and the way the charcoal industry is run in Sudan, the following lessons can be drawn. In Sudan:

- Charcoal is recognized as a key source of energy.
- There is a specific institution, a government parastatal, to implement wood energy
  policies.
- Production of charcoal from plantations and natural woodlands is well planned.
- Resources are allocated yearly for establishment of plantations.
- There is strong public and private sector participation.
- Charcoal is a formal and lucrative industry. Being a formal, legalized business, charcoal in Sudan is produced in permanent earth kilns of up to 120 cubic metres. Studies have shown that alternative charcoal-making technologies are neither more productive nor more economically attractive to the producer than the pit-kiln (Paddon, 1988, p.8).

- There are clear marketing arrangements and rules.
- Traders are organized into a formal association recognized by the government.
- The government is paid royalties and taxes, which are reinvested in establishing plantations.

2.2.5. Kenya: Waste recycling

Developing countries have also started showing interest in the considerable biomass materials that could be used for energy but are wasted. In Kenya, research by the Chardust Briquetting Company has identified bagass, coffee husks, sawdust, coconut husks and shells, and lump wood charcoal waste as materials that can be made into good quality charcoal. It is estimated that the country can produce 150,000 tonnes of charcoal

briquettes valued between USD 0.1billion and USD 0.2billion a year and save USD1.75 million that would otherwise be used for proper disposal of the biomass waste while reducing the demand for lump charcoal(Mugo and Ong, 2006, p,12).

Chardust Limited is a private Kenyan company which operates from a 1 hectare plot on the southern side of Nairobi. Their objective is to replace lumpwood charcoal with charcoal briquettes in the Kenyan marketplace. Taking a participatory approach, the company started with manufacturing charcoal briquettes using salvaged waste from charcoal traders in the city of Nairobi, Kenya.

Charcoal demand in Kenya exceeds 1.6 million tonnes per year, but fifteen percent of the charcoal supply is discarded at urban trading sites as dust. This discarded dust creates more than 70 tons of waste, clogging waterways and exacerbating air pollution. Chardust, a company that compresses charcoal dust into fuel briquettes, teamed up with a CBO in the Kibera slum of Nairobi that has an existing garbage collection program to encourage Kibera slum dwellers to act as "carbon collectors", salvaging charcoal dust to sell to Chardust for processing into briquettes. Over 30% of its raw material is sourced through this CBO, which has mobilised its members to gather dust in small volumes and centralise it for bulk collection at six self-contained sites across Kibera. Chardust saves money on transport costs (as Kibera is relatively close to their plant). Until recently collection in Nairobi has been limited to a few large charcoal wholesalers, with most of the city's charcoal dust being discarded in numerous, inaccessible, small-scale charcoal shops. Chardust has already developed a strong market for these briquettes, selling more than 2,500 tonnes a year with customer demand growing at over 25 percent. Chardust sells 7-8 tonnes of briquettes per day through a variety of channels, including retail kiosks in the city of Nairobi. The operators can break up a 50 kg sack of briquettes into 1.5 kg tubs and realise a 30% profit margin. The strong market also ensures a steady stream of income for the carbon collectors.

Standard briquettes are some 40% cheaper by weight than regular charcoal, enabling users to save significantly on their energy bills for heating and cooking. Emissions are lower than charcoal because the raw material is fully carbonized and, therefore, contains almost no volatiles. The product has significant environmental benefits because it directly displaces unsustainably produced lumpwood charcoal at the point of consumption by using waste material from the supply chain that is normally thrown away. Since its establishment in 2000, Chardust has already two permanent dust collection centres, designed the necessary collection equipment, trained approximately 50 collectors, and begun converting the charcoal waste into two different grades of briquette. As a result, up to 300 low-income slum dwellers earn USD900 per month (equivalent to over a year's income) as charcoal dust suppliers, and at least 1,000 charcoal-using households benefit from lower fuel costs.

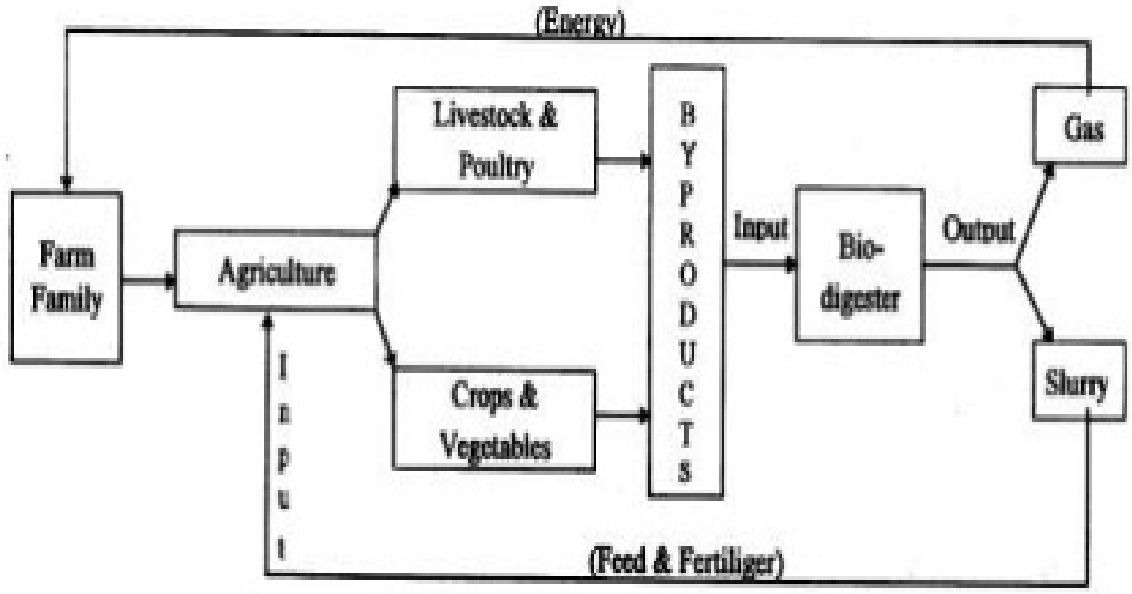
The company has also launched a joint venture with the Chemelil Sugar Company in Nyanza Province to produce charcoal briquettes from bagasse-fibrous sugar cane processing waste. This 'CaneCoal' plant will convert waste crushed cane, known as bagasse, into affordable charcoal fuel briquettes. Chardust aims to get its CaneCoal product onto the market at a price 30% lower than regular lump charcoal. As with any new staple commodity, it's expected that there will be some resistance to change. It is hoped that a regionally focused marketing campaign designed to introduce CaneCoal to the local consumer can be developed that not only rides on cost-competitiveness but also a 'Green' theme which will involve some type of educational component.

2.2.6. Cambodia: The successful implementation of waste-to-energy technology

Water and sanitation are some of the most pressing issues for the many rural Cambodians who work in agriculture – many of whom have no access to electricity and use collected woodfuel for cooking. Recognizing the power of RET's in the form of biodigester to address these issues, the Cambodian Ministry of Agriculture, Forestry, & Fishery (MAFF) joined with the Netherlands, through the Dutch Ministry of Foreign Affairs'

Asia Biogas Program and their development agency, SNV, and Germany, through their development agency, GIZ, to create a National Biodigester Program (NBP) for Cambodia, so as to disseminate biodigester technology – using marketing techniques and grant/loan assistance – to farmers in the neediest of the Cambodian provinces. The technology basically works as follows:

Figure 4: Biodigester product cycle



The program had the purpose of establishing a permanent domestic biodigester sector on a commercial, market-oriented basis for the dissemination of biodigesters as an indigenous, sustainable energy source in selected provinces in Cambodia. By 2012, the program's specific objectives were: 1) to increase the number of family-sized, quality biodigesters to 22,000 units in the selected provinces; 2) to ensure the continued operation of all biodigesters installed under the biodigester program; 3) to maximize the benefits of the operated biodigesters, in particular, the optimum use of digester effluent; 4) to develop technical and promotional capacity of the stakeholders within the program for further wide-scale deployment of biodigester technology in Cambodia; and 5) to strengthen and facilitate the establishment of institutions for the continued and sustained development of the biodigester sector. On the national front the Humanist Institute for

Development Cooperation (HiVOS) was co-opted as the cooperating agency to purchase the carbon offsets generated by the project.

This project began in May 2005 and is still ongoing with activities generally falling into one of the following six components: 1) trainings and workshops, for capacity building of stakeholders, including government staff, masons, and farmers through technical / user / managerial trainings, through 'training of trainers' and subsequent training activities; 2) promotion and marketing, to create awareness and raise interest in farmers to purchase a biodigester through the production and use of various IEC (information, education, communication) materials; 3) quality management, to ensure long-term program success by implementing and following quality control processes for supervisors of construction and offering regular technical assistance to farmers should problems arise with an installation; 4) bio-slurry management and promotion, to promote the use of biodigester effluent as a fertilizer among purchasing farmers, by establishing demonstration farms using the product and showcasing them via exchange visits, and instructing on the proper storage, treatment, and application of the bio-slurry; 5) research and development, to continually adapt or improve the biodigester technology being promulgated by the program and improving standardizations, performance, and construction techniques; and 6) institutional support, to create market supply for biodigesters by developing private sectors partners responsible for marketing, constructing, and servicing biodigesters, through selection of potential entrepreneurs who agree to sign on to the sales conditions of the program, and subsequent trainings and coaching. The majority of the 'on-the-ground' work is being done by the local government or NGO groups, which include the promotion and marketing activities, investigation for potential users, registration and assistance to purchasers, quality control, local trainings, and database management and reporting. The Provincial Biodigester Program Office (PBPO) and NBP Steering Committee are responsible for more of the general IEC activities and marketing, the research and development, the financing activities, and overall reporting on and management of the program. The private sector businesses hold main responsibility for

the actual construction of the biodigesters, and hold supporting responsibility for sales and technical support.

The costing structure for the different sizes of biodigester, as well as the USD150 subsidy provided by the program to each individual farmer upon completion of construction and the subsequent costs to the farmer, are as displayed in Table 2.

Table 3: Cost of biodigester provided by the NBP program

Biodigester size (m3)	Total cost (US$)	subsidy from NBP (US$)	Farmer cost (US$)
4	400	150	250
6	500	150	350
8	550	150	400
10	650	150	500
15	900	150	750

While these costs sound high for poor rural Cambodian farmers, the economics of using free biogas instead of fuelwood/charcoal/LPG/kerosene help to provide a fast payback period, as shown in Table 3 for a 4m^3 unit, which, therefore, provides a strong incentive to buy, even without considering the loans that are also available through the microfinance institutions.

Table 4: Payback period of the 4m3 Biodigester costing USD400

Type of Fuel Sources	Quantity saved	Cost per unit	Total cost saved per day	Total cost saved per year	Payback period without subsidy	Payback period with subsidy (US$ 150)
Firewood	6 kgs	US$ 0.07	US$ 0.42	US$ 153	2.6 years	1.6 years
Charcoal	2 kgs	US$ 0.2	US$ 0.42	US$ 153	2.6 years	1.6 years
Kerosene	0.7 litre	US$ 0.65	US$ 0.46	US$ 166	2.4 years	1.5 years
LPG	0.5 kg	US$ 1.00	US$ 0.50	US$ 183	2.2 years	1.3 years

Though this program is still underway, its results to date have nevertheless been substantial. As mentioned, 12,014 biodigester units (with the most commonly sold size being the 6m^3 version) have already been sold, benefitting over 60,000 Cambodians.

Sales are continually growing as more new businesses are trained, with 21 companies already established and more being trained, which should allow monthly sales volumes to continue growing. Having sold 12,000+ biogas digesters and established a comprehensive management framework for their sales and maintenance, including businesses, banks, microfinance loan institutions, marketing and promotions campaigns, business trainers, technical designers, researchers, and the various levels of managing administration is an impressive feat that ensures the long-term sustainability of the demand for and supply of biogas digesters in Cambodia, as well as their long-term operation and proper maintenance. Indeed, an important result to date is that, from local monitoring, 95% of all biogas digesters sold are still operational, which shows both the effectiveness of the quality control measures implemented for construction and also on the availability of the local PBPOs and businesses to address any maintenance issues that may arise. As well, to date, 75% of the units sold are making use of the bio-slurry produced by the digester for fertilizing the owner's agriculture, which is improving the lives of these farmers by reducing their need for costly synthetic fertilizers and eliminating the health, groundwater, termite, and weed risks to the farmer that were previously brought about by using raw manure as a direct fertilizer.

2.3. Lessons learned from World Bank funded projects in South America and Sub-Saharan Africa

Reviewing the experience of household energy projects and their success and failure, factors revealed a few lessons. According to Koffi Ekouevi and Voravate Tuntivate (Ekouevi, K. and Voravate Tuntivate, V., 2011, pp.26-27), the following are the important lessons:

- **A holistic approach to household energy issues is necessary:** Successful programs are designed with a holistic approach on how household energy access can contribute to a global agenda of social transformation and poverty reduction. With this perspective, the programs are designed to cover: (a) supply-side interventions ensuring that the fuelwood supply is sustainable; (b) demand-side

and interfuel substitution with the introduction and dissemination of improved stoves and alternative household fuels, such as kerosene and liquefied petroleum gas (LPG); and (c) the capacity to develop and strengthen institutions to create the regulatory incentives for the sustainable production of fuelwood and for the facilitation of fuel switching (Ekouevi, K. and Voravate Tuntivate, V., 2011, pp. 26-27).

- **Public awareness campaigns are prerequisites for successful interventions:** Successful programs have paid particular attention to public awareness, education, and information campaigns. Households need to be sensitized to the risks they incur by cooking with inefficient stoves. Programs that have assumed that households would adopt spontaneously improved stoves or participate in forest management initiatives have failed. Households need to perceive and to be convinced about the direct and indirect benefits associated with these interventions (Ekouevi, K. and Voravate Tuntivate, V., 2011, pp.26-27).

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- **Local participation is fundamental:** Experience indicates that the active participation of communities, governments, NGOs, and the private sector is fundamental for household energy access projects to be successful and sustainable. For example, local communities need to be involved at an early stage to ensure that they own supply-side forest management initiatives. They should understand why they should be the ones protecting the forests in their communities. A clear rule of engagement should be discussed for communities to know their rights and responsibilities, the prerogatives of the national forest service, the role of NGOs and local associations (Ekouevi, K. and Voravate Tuntivate, V., 2011, pp.26-27).

- **Consumer fuel subsidies are not a good way of helping the poor:** Experience has shown that across the board consumer fuel subsidies are not a good way of helping the poor. Affluent households tend to benefit the most from prevailing

fuel subsidies, given that in most cases, energy consumption increases in parallel with income. For governments, these subsidies result in heavy fiscal deficits diverting direct public expenditures away from productive and social sectors. Alternative options are usually designed in the form of social protection programs. The challenge remains in successfully implementing these options to effectively reach the poor (Ekouevi, K. and Voravate Tuntivate, V., 2011, pp.26-27).

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Introduction

This chapter explains in detail how the research was carried out. The research, which was a form of case study, was a type of correlation research whose purpose was to establish a relationship between variables (covariance), which may suggest a possible base for causality.

3.2. Research design

This research applied the cross sectional design. This is because this research is looking at several programs/projects in which DoE has made attempts at promoting and disseminating alternative sources of energy. Though data was collected at one fixed time, the cases being looked at were isolated and conducted in different setups. This is justified by Bryman (2012, p.58) who says that "a cross-sectional design entails the collection of data on more than one case and at a single point in time [...] and detect patterns of association".

It further employed a non-intervention exploratory study in form of a questionnaire and focus group discussions to assess the efficacy of government's policies and public awareness strategies regarding alternative energy usage at household level. This also added a qualitative dimension to cross-sectional study and possibly explained the reasons behind the findings from the cross-sectional study.

3.3. Research Methods

This study used triangulation methods in gathering the data, applying both qualitative and quantitative methods. The quantitative methods helped to quantify the

occurrence/patterns of results and answer ‘what’ numbers or percentages of the population were affected while the qualitative helped to find reasons or ‘why’ this is the case. Thus the application of both methods complemented each other thereby sealing the loopholes that might be created if just one method was used. In this way, the research was more comprehensive and hence able to realise the objectives of the study.

3.4. Data Collection Methods

Both primary data collection and secondary data collection methods were used in this research.

3.4.1. Primary Data Collection

In the primary data collection, the researcher used qualitative methods in form of Focus Group Discussions and in-depth interviews, while in the quantitative methods the researcher used self-administered questionnaires.

- **Qualitative Methods**

Qualitative research is defined as an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyses words, report detailed views of informants, and conducts the study in a natural setting (Creswell, 1998, p. 132). Neuman (2006 p.141) refers to qualitative approaches as “data enhancers; they show the key aspects of cases more clearly”. Therefore, in this study qualitative techniques were used in order to gather an in-depth understanding of how RET’s are developed and disseminated by the government through the Department of Energy and other

implementing partners. Qualitative methods also contextualised responses that the researcher got from the quantitative questionnaire survey.

(i) In-depth Interviews

The researcher used an in-depth interview method because it accorded her a chance to ask some staff members in DoE in a more detailed way, what activities they carried out in order to fulfil their mandate as outlined in the NEP. Since they were part of the government system, if these staff members were asked in the presence of their colleagues, they could be shy or afraid to speak out their deep personal opinions and feelings either because they could be considered as traitors or they could be fired from their jobs in case they spoke negatively. So this accorded respondents privacy, confidence and hopefully they spoke out the truth for the betterment of this research.

The in-depth interviews allowed the researcher to gain a broader perspective with regard to how the alternative sources of energy were actually developed and communicated/disseminated compared to the strategies stipulated in the NEP and other guiding principles and regulations. Direct observation was also used to confirm the assertions during the period that the researcher would be attached to the department.

(ii) Focus Group Discussions

Focus group discussions (FGD) were used to explore the meanings of survey findings which could not be explained statistically, the range of opinions/views on a topic of interest and to collect a wide variety of local terms. FGDs can be useful in providing an insight into different opinions among different parties involved in the change process, thus enabling the process to be managed more smoothly. It is also a good method to

employ prior to designing questionnaires (http://www.odi.org.uk/publications/5695-focus-group-discussion, viewed on 24/01/2014).

The researcher also used FGD in an attempt to gain an understanding of the knowledge/perceptions, attitudes and behaviour of the different sections of society towards alternative energy sources and governments efforts regarding their dissemination. The FDG provided an arena to discuss complex issues and gain insight into the participants' understanding of key concepts such as sustainable energy sources and environmental degradation. This is vital as respondents in the questionnaire may not fully understand complex issues and as such, the researcher might fail to extract the necessary information for the survey. The focus group discussions were done with community leaders (councillors and other group leaders from the dairy co-operative for example) and other relevant groupings such as women groupings and charcoal producers.

- **Quantitative Method**

(i) Self-Administered Questionnaire

Since it was not possible to capture everybody in the Focus Group Discussions, the researcher administered self-administered questionnaires for the end users or recipients of the various energy services in the country. The questionnaire enabled the researcher to explore what the general attitudes, opinions and perceptions of the people in the community were regarding the communications and ideas or practices being promoted. The questionnaire focused on issues such as message assessment, communication channels and effectiveness. It also included issues on energy service delivery, alternative energy sources and environmental protection. Due to the difference in socio-economic status which in turn affects people's exposure to different kinds of information as well as their disposition towards issues such as alternative sources of energy, the questionnaire

was best suited to collect details from a reasonably large number of respondents giving a representative picture of the total population.

3.4.2. Secondary Data Collection

The researcher also used some books, magazines, newspapers, reports and the internet to beef up on the primary data that she will collect. This has been reflected in the chapter dealing with literature review. Document data collection is crucial as a starting point and for the purpose of reinforcing the primary data as well as the entire research so that there is more substance and evidence. This also prevented repetitions and ultimately added up to the credibility of the research findings.

3.5. Study Site

The study site is the Department of Energy at the Ministry of Mines, Energy and Water Development. The researcher chose this study site because this is the department whose mandate it is to develop and promote the dissemination of the various forms of energy sources in the country. All energy related activities are channeled through this department including those championed by implementing partners like the Rural Electrification Authority and other stakeholders. Policy formulation and implementation is also done by DoE to create an enabling environment for the sustainable development and dissemination of all forms of energy in the country.

Additionally, the researcher administered the questionnaires in Luanshya's Fisenge Compound on the Copperbelt Province. Luanshya is one of the metropolitan centres situated in the Copperbelt Province in Zambia. While primarily a mining town, Luanshya is home to a reasonable number of livestock farmers and is in close proximity to some of the country's largest forest reserves. As a consequence, Luanshya has an abundant source of biomass in the form of agro-waste, waste generated by activities in the timber and

other industries in the area. Like most per-urban areas, the majority of the households in Fisenge are not electrified and even those that are electrified still depend heavily on charcoal for cooking and heating. The study area has the added advantage of having been identified in a baseline study conducted by SNV in collaboration with the Department of Energy and other stakeholders, as having the potential to successfully use bio-digesters running on animal (or human) waste for their cooking requirements. To demonstrate how the technology works, SNV is setting up commercial digesters at some resource centers (like the Milk Collection Centre) in the community.

3.6. Study Population

Employees of the Department of Energy at the Ministry of Mines, Energy and Water Development and residents of Fisenge Compound in Luanshya.

3.7. Sample Size

A sample size representing 50% of the total number of projects undertaken by DoE in the last three (3) years was picked, to examine the dissemination strategies used by the government and other stakeholders and to quantify the outcomes, limitations and possible reasons for the outcomes of the efforts in the dissemination of alternative energy sources.

Additionally, questionnaires were administered to 150 households coupled with two (2) focus group discussions with area leaders (civic, religious and traditional leaders), relevant groupings such as the Fisenge Dairy Cooperative and the local women as the primary end-users who, therefore, have a major influence on the choice of energy source at household level.

3.8. Sampling Technique

This research applied the purposeful/ judgemental sampling for the FGD and the in-depth interview. This is because the researcher knew the target group which could provide the required information.

Simple random sampling was also used for the questionnaire as the subject matter affects members of the public in more or less the same way, thereby making the sample population homogenous.

Census data from Luanshya City Council was used to establish the target population and sample frame for both the questionnaire and the focus group discussions.

3.9. Data Analysis

The analysis of the data is crucial and extremely important because it is this analysis that gives value and meaning to the data that is collected. Since not all the information collected during the research may be useful for the study, data analysis helps to isolate useful data from irrelevant material.

For the quantitative data, the researcher used Microsoft Excel for analysing the data as that's the software which the researcher is familiar with among the recommended software packages.

For qualitative data, stakeholder analysis was used. Stakeholder analysis is a process of systematically gathering and analyzing qualitative information to determine whose interests should be taken into account when developing and/or implementing a policy or program (Schmeer, 1999, p.3). Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal

representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interests, the academic community, or other businesses (Sequeira & Warner,2007, p.10).

The development in the 1990s of stakeholder analysis in natural resource management has largely stemmed from concern that many projects have not met their stated objectives because of non-co-operation or even opposition from key stakeholders, who believed they would be adversely affected by change. Moreover many interventions that have been perceived to be successful by their designers, have in fact achieved their success only at the expense of certain stakeholders — often local resource poor people. Stakeholder analysis recognizes the different interest groups involved in the utilization and conservation of natural resources and provides tools that help to identify and resolve tradeoffs and conflicts of interest (Grimble, 1998, p.1).

The stake may originate from institutional mandate, geographical proximity, historical association, dependence for livelihood, economic interest and a variety of other capacities and concerns (Borrini-Feyerabend, 1996, p. 6).

3.10. Ethical Considerations

According to Karashani and Rioba (2002, p.12), ethics can be defined as "rules of conduct or principles of morality that point us towards the right or best way to act in a situation". With this in mind, the researcher adhered to and followed the ethical standard practice in a scientific research. So the following ethics were applied:

- **Informed consent:** the researcher got permission and gave adequate information to the potential participants on the topic so that they understand properly what was involved in the study and consequently made an informed, voluntary decision out of their own personal volition to participate in the study. No manipulation or coercion was used.

- **Confidentiality:** the researcher took care to safeguard the privacy and identity of all the respondents. Though interview questions were for specific officers the researcher ensured that there was maximum privacy, anonymity and confidentiality by identifying all the interviewees or questionnaire respondents by code numbers.
- **Objectivity:** the research team ensured that they remained focused without any biases or prejudices during data collection. Though similar research has been conducted in the recent past, the researcher recorded and presented the findings of this particular research independent of previous findings, without any manipulation.

3.11. Limitations of the study

- **Authentication of data**: The Department of Energy like any other government wing can sometimes be bureaucratic and hence the workers may be timid to answer questions causing delays in the research. Sometimes information is given but cannot be authenticated by the Energy Officers due to fear of reproach.

- **Outdated database**: Most of the data on energy development in the country is outdated, in some cases dating back 20 years like the Energy Sector Management Advisory Programme (ESMAP). That which can be considered more recent is scattered among unofficial sources as there is no proper information management system in the Ministry. A number of implementation documents such as the Renewable Energy Strategy are still in draft form while the Ministry's website is dormant.

- **Lack of access to information**: Information sharing in the sector is also not very evident as most stakeholders are looking at renewable energy as a possible business opportunity. This in a way explains the concerns by DoE over the lack of concerted efforts among stakeholders in the sector. In some cases, as was experienced by the researcher, unless directives came from the government through the DoE, stakeholders such as NGO's and development institutions were

unwilling to share information even when they were informed that it would only be used for academic purposes.

- **Sampling limitations**: While it is good to have a big sample size, it was not easy to capture all the respondents within a short period of time (especially during the farming season when most people were out in the fields), hence delaying the research. The sample population was also quite widely dispersed as it is mostly a farming community on small holdings.

CHAPTER FOUR

4. CONCEPTUAL AND THEORETICAL FRAMEWORK

4.1. Introduction

As a platform for this study, two main theories have been used to contextualise the research. These are defined in this chapter, together with major concepts, in the way in which they relate to the apparent delayed adoption of alternative energy sources in the country.

4.2. Conceptual definitions

Renewable energy sources: this is any naturally occurring, theoretically inexhaustible source of energy, as biomass, solar, wind, tidal, wave, geothermal, and that is not derived from fossil or nuclear fuel. It is energy which can be replenished or 'renewed' for fresh use if not overused (NEP, 2008, p.6).

For the purpose of this research, renewable energy sources will be considered as theoretically inexhaustible sources of energy for example waste biomass which is constantly being produced from the day-to-day social and economic activities. They will be considered synonymous to sustainable energy sources which do not deplete with the frequency of use. They can continue to be readily available far into the future despite being used and their use does not present any negative impact on their environment if properly managed.

Biomass: comprises any organic matter of either plant or animal origin. Biomass energy is the stored solar energy, carbon and hydrogen – captured initially through photosynthesis into chemical bonds – that is now available on demand within that organic matter. It comes in a variety of forms although woody biomass accounts for most of this total annual biomass use globally (Macqueen & Korhaliller, 2011, p.1)**.** Biomass resources include primary, secondary, and tertiary sources of biomass. Primary biomass resources are produced directly by photosynthesis and are taken directly from the land.

They include perennial short-rotation woody crops and herbaceous crops, the seeds of oil crops, and residues resulting from the harvesting of agricultural crops and forest trees (for example, wheat straw, corn stover, and the tops, limbs, and bark from trees). Secondary biomass resources result from the processing of primary biomass resources either physically (for instance, the production of sawdust in mills), chemically (for example, black liquor from pulping processes), or biologically (for instance, manure production by animals). Tertiary biomass resources are post-consumer residue streams including animal fats and greases, used vegetable oils and paper packaging wastes. Often the solid biomass will undergo physical processing such as cutting, chipping, briquetting, to mention but a few but retains its solid form. Biomass is a fully indigenous energy which contributes to the reduction of carbon dioxide while growing as a plant. Therefore, although it produces carbon dioxide when used as an energy source, resultant carbon dioxide emissions are neutral to global warming (Filho, 2010, p.7).

For the purpose of this research, biomass will be considered in all three forms (primary, secondary and tertiary) as all the three forms can be used for the generation of energy.

Waste Biomass: this is residual of day-to-day activities which as earlier alluded to, are organic in nature. They are found everywhere such as bagasse (fibre) from sugarcane, straw from rice and wheat, hulls and nutshells, as well as manure lagoons from cattle, poultry and hog farms in the agricultural industry. Similarly, the timber industry has a lot of wood wastes like sawdust, timber slash and mill scrap. In cities, paper and yard wastes are usable. Waste biomass need only undergo a simple process of densification which is the process of squeezing the air out of biomass materials leaving just the energy producing component so as to enhance energy production. The resulting pellets can be in different forms including wood pellets from the timber industry, straw pellets from agricultural waste such as barley straw and corn cobs and grass pellets which can be directly used as a source of biomass power. Densification also eases handling, transportation and storage.

For the purpose of this assignment, waste biomass shall be considered as all bio-degradable material which is a by-product of any process and is of no further use.

4.3. Theoretical framework

Two main theories have been selected that cover the essential elements of the targeted behavioral change. These are:-

- Agenda Setting
- Diffusion of Innovations

Agenda setting theory refers to the idea that there is a strong correlation between the emphasis that communications through various media place on certain issues (for example based on relative placement or amount of coverage) and the importance attributed to these issues by mass audiences (McCombs & Shaw, 1972, p.177). Dating as far back as 1922, when the Newspaper columnist Walter Lipmann showed concern that the media had the power to present images to the public, the idea was further studied and linked to memory-based models of information processing which assume that people form attitudes based on the considerations that are most salient (that is to say most accessible) when they make decisions. In other words, judgments and attitude formation are directly correlated with ‘‘the ease in which instances or associations could be brought to mind’’ (Tversky & Kahneman, 1973, p.208).

It is based on the assumptions that media concentration on a few issues and subjects (which may not necessarily reflect reality) leads the public to perceive those issues as more important than other issues. Different media have different agenda-setting potential.

Agenda setting occurs through the cognitive process of "accessibility" which implies that the more frequently and prominently the news media cover an issue, the more instances of that issue becoming accessible in audience's memories. The agenda-setting effect is not the result of receiving one or a few messages but is due to the aggregate impact of a

very large number of messages, each of which have different content but all of which deal with the same general issue. Therefore, by making some issues more salient in peoples mind (agenda setting), government communications can also shape the considerations that people take into account when making decisions regarding certain issues.

Diffusion of innovations theory, according to Everett Rogers in his 1995 book *Diffusion of Innovations*, seeks to explain how innovations are taken up in a population. An innovation is an idea, behaviour, or object that is perceived as new by its audience. Instead of focusing on persuading individuals to change, the theory considers change as being primarily about the evolution of products and behaviours so that they become better fits for the needs of individuals and groups. Five qualities determine the success of an innovation (Rogers, 1995, p.206). **Relative advantage:** the degree to which an innovation is perceived as better than the idea it supersedes by a particular group of users, measured in terms that matter to those users, like economic advantage, convenience, or satisfaction. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption is likely to be. There are no absolute rules for what constitutes "relative advantage". It depends on the particular perceptions and needs of the user group. **Compatibility with existing values and practices:** the degree to which an innovation is perceived as being consistent with the values, past experiences, and needs of potential adopters. **Simplicity and ease of use:** new ideas that are simpler to understand are adopted more rapidly than innovations that require the adopter to develop new skills and understandings. **Trialability:** the degree to which an innovation can be experimented with, on a limited basis. **Observable results:** the easier it is for individuals to see the results of an innovation, the more likely they are to adopt it. Experimentation and visible results lower uncertainty and also stimulate peer discussion of a new idea, as friends and neighbours of an adopter often request for information about it. It is believed that these five qualities determine between 49 and 87 percent of the variation in the adoption of new products (Rogers, 1995, p.206).

Since the adoption of new products or behaviours involves the management of risk and uncertainty, it's usually people who are personally known and trusted – and who are known to have successfully adopted the innovation themselves – who can give credible reassurances that the attempts to change won't result in embarrassment, humiliation, financial loss or wasted time. Peer-to-peer conversations, peer networks and opinion leaders, therefore, also play a significant role in innovation adoption.

However, considering the bottlenecks faced by most third world countries, of economically and socially challenged societies, it is imperative that innovation promotions focus more on the potential adopter's ability to gain access to its benefits as the adoption of an innovation relies heavily on the socio-economic status and structures of the social system in which the diffusion is taking place (Agarwal,1983, p.359). Major bottlenecks in applying Renewable Energy Technologies (RETs) in rural settings relate to communities' level of income, policy and planning implications, the nature of the supply networks, information on the RETs and knowledge about this technology. Lack of information on these and other factors weakens the drive towards application of RETS (Mfuna & Boon, 2008, p.178).

The energy solutions in this case, therefore, need to match the energy needs of the target population and should pose less stress. This can be done after energy needs assessments have been conducted. As proposed in this theory, prospective energy solutions should have **technical merit** (accessibility of technology and existence of local champions), **financial and economic merit** (cost effectiveness, cost-benefit ratios and coherence with local and national development priorities – for inclusive development and sustainability small-scale initiatives/schemes should be community/cooperative owned and linked to income generating activities), **ecological soundness** (climate proofing) and should fit in with ongoing programs and institutional capacities - solutions should be affordable, accessible and acceptable to local circumstances and people by adopting a participatory approach (FAO/UNEP, 2010, p.45).

Taking the economic and technological absorption capacity of the segment of the population currently depending on charcoal for household energy, small-scale community initiatives for local use are likely to have a higher chance of succeeding than the more advanced technology which (though more efficient) tend to have higher capital costs and demand more skilled human capacity.

CHAPTER FIVE

5. PRESENTATION AND DISCUSSION OF FINDINGS

5.1. Introduction

The main objective of this study was to assess the efficacy of government's dissemination strategies regarding alternative energy usage at household level. More specifically, it was to determine and assess the communication strategies (quality of message such as language, content, and frequency, as well as the channels) being used by the government to sensitize the people in peri-urban areas of the available alternative solutions to their energy poverty, and assess the people's perceptions, knowledge and attitudes towards the use of alternative energy sources in light of government's current communications and policies. This chapter presents both the qualitative and the quantitative findings as they relate to these objectives.

5.2. Assessment of government's efforts in disseminating alternative energy sources at household level over the last five years

A total of ten (10) projects were availed to this researcher as having been undertaken by the Renewable Energy sector of DoE over the last five years. An analysis of five (5) projects in form of mini case studies has been made, representing approximately 50% of the total number of projects undertaken. This is to establish possible trends and barriers to the dissemination of the various RETs that have been undertaken by the Ministry and other stakeholders in the energy sector.

- **Promotion of efficient woodfuel utilisation – The improved cookstoves project**

According to the documentation and literature reviewed by the researcher at the DoE, improved cookstoves were first introduced as part of a general programme to reduce

charcoal consumption in Zambia by the Department of Energy in 1987. Three (3) low cost technologies were identified as possible solutions to the increasing threat of deforestation at the time. These included more efficient kilns and retorts for charcoal production; more efficient charcoal stoves for households and 'cooking without boiling' using hay baskets. A working group was formulated to propose a general strategy and programme for production and dissemination of the improved charcoal stoves and suggest solutions to all involved issues such as supply of materials, procurement of templates, training of tinsmiths, information campaign and education of housewives to name a few. UNZA School of Engineering was contracted to develop a model for the improved stoves. Eight (8) models were developed out of which one (1) was accepted and modified for greater acceptance. This culminated in 'The Charcoal Stove' project, whose objective was to introduce improved charcoal stoves to Zambian households in all urban and peri-urban areas where charcoal is the dominant source of energy, and was officially launched in February 1989. It ran for two (2) years during which 934 tinsmiths and 2641 consumers were trained mainly in Lusaka, Central, Eastern, Copperbelt and Southern Provinces. The publicity activities carried out during the project was through Posters, T-shirts, Leaflets, a few radio and television programs, demonstrations, news items in the newspapers, Trade Fairs and Agricultural Shows. The main challenge faced at the time was lack of material (heavy drum metal) which is either expensive scarce or just difficult to obtain.

To continue with the activities under the program organisations such as Zambia Environment and Energy Organisation (ZENGO), Centre for Energy Environment and Engineering Zambia (CEEEZ) and ZAMBIA ALLIANCE OF WOMEN (ZAW) were appointed to continue with the dissemination of the improved stoves. This culminated in various projects such as the Lusaka Sustainable Energy Project, Save 80 and additional interventions like that from the Program for Biomass Energy Conservation (ProBEC) – a SADC initiative introduced in Zambia in 2005 by the German Agency for Technical Cooperation (GTZ) to focus on improving access to sustainable & affordable energy among low-income groups. The Centre for Energy Engineering & Environment of

Zambia (an NGO research organisation that works primarily in issues pertaining with energy, engineering and environment) tried commercialisation of charcoal stove through African Rural Energy Enterprise Development (AREED) program which failed & stove production ceased (MEWD 2010).

The challenges faced over the years, to reach the critical mass for the penetration of improved cookstoves as highlighted in a Woodfuel Utilisation Workshop aimed at establishing the status of woodfuel activities in the country in December 2010 included **affordability** of the cookstoves on the part of the consumer; non-availability of **raw materials**; technology transfer and **capacity building**; **cultural barriers**; low **awareness levels; resource availability**; low **cost of conventional braiziers** and unconcerted efforts among stakeholders. These sentiments were echoed by other stakeholders running similar projects such as the Climate Management Project (2008). The project promoters lamented that the delay in local producers to pick up the technology due to tech transfer problems, has delayed the uptake of the stoves. Insufficient info dissemination, cultural barriers, stove design (produced too much smoke), suited for urban and not rural areas were some of the challenges highlighted in their submission (MEWD 2010).

In 2013, the project was once again resuscitated with the erection of billboards in Lusaka's high and medium density areas. Being the most affected by the load shedding, it was assumed that a major part of the charcoal consumed in the city was by households in these areas. Random interviews were conducted by officers from DoE and this researcher among consumers and tinsmiths in the same areas to assess their levels of knowledge of the improved cookstoves being advertised. Indications however still showed that there is need for more information dissemination on where the stoves can be found, how they should be used and the benefits one gets from the proper use of these stoves. Tinsmiths also showed interest in producing the improved cookstoves once trained. Complaints however surfaced from consumers who had sampled the stoves

regarding the poor quality of the stoves which subsequently affected their performance in terms of efficiency. This has prompted or reinforced the need to develop standards (through ZABS and ECZ) by which the improved cookstoves should be manufactured, if they are to be appreciated and adopted by society.

Hoskins, from a study carried out in Ghana, identified three general insights into the sort of technical factors that prevented the successful diffusion of improved cookstoves:-

- Failure to identify the key figures in the stove diffusion process, that is, the women who cook on the stoves, the local artisans who can help in designing the stoves and taking care of repairs and alterations.
- Imposition of laboratory-tried models incorporating 'western' standards of improvement and ill-adapted to the local setting and cultural norms.
- Failure to relate the physical elements of stove design to social realities.

The economic aspects of the improved cookstoves involve a private financial cost of investment, which is difficult to justify when the benefits are often in form of intangibles, mostly non-financial (such as the absence of smoke) and do not necessarily accrue to all the stove adopters. For example, men usually make the adoption decision by virtue of them controlling the household income yet most of the benefits accrue to the women that actually use the stoves. All these aspects introduce complexities in improved stove diffusion such that they cannot be merely placed on the market and be promoted through advertisements.

- **Dissemination of solar home systems as an alternative source of energy for lighting and entertainment – The ESCO's Project**

In the year 2004, the Swedish Government provided a grant of 400 solar photo voltaic home systems to the Zambian government through the then Ministry of Energy as a way of helping the Zambian government attain its goal of increasing access to cleaner energy

services in rural areas. Following the failure of several projects in the sector which, under the mistaken perception that solar was a maintenance free technology, did not take into consideration the maintenance of the solar systems, the Zambia PV Energy Service Companies (ESCO) project was conceived with the aim of finding a sustainable method of disseminating Solar PV in Zambia,

Borrowing from a project implemented in the Pacific Island of Kibarati, where it was noticed that people are not interested in the hardware per se, but the service provided. The ministry through the Department of Energy used this opportunity to embark on a similar programme of providing an energy service to the people without their involvement in procurement, ownership and maintenance of the hardware. Working from the premise that rural communities do not have required funds to invest in hardware but can easily raise small amounts to pay for the service, energy service companies (ESCOs) were introduced to provide the service to the community on a **fee per service basis,** where clients do not contribute to the cost of the equipment but merely pay for the service at an agreed tariff and time (usually monthly, quarterly or yearly). In executing the project, the Ministry was assisted by a Swedish Consultant – Stockholm Environment Institute (SEI) whose contract for services ended in Sept 2005 (MEWD 2013).

As is the case for rural electrification projects where most governments subsidise the capital cost for rural electrification, ESCOs in Nyimba, Chipata and Lundazi (all in Eastern Province) were given the Solar PV Home Systems on a loan basis and were expected to pay back on a discounted rate after which, they were to assume ownership of the systems. The systems were then distributed to end users who were selected on the basis of their capacity to pay as well as their location/distance from the electricity grid. Clients paid ESCOs an agreed tariff under agreed terms and conditions. It was envisaged that the proceeds would be used by government as a revolving fund to procure more solar PV systems which could then be distributed to other districts as a way of project expansion and increase in rural electrification rate (MEWD, 2013).

However after the official withdrawal of support from the Swedish International Development Agency (SIDA) in November 2011, an evaluation of the project by DoE officers revealed that more than 50% of the systems supplied were no longer operational and the ESCOs were almost non-existent on the ground. The only systems that were operational were the ones where the final user was innovative enough to replace the battery that came with the Solar Home System while maintaining paying a small fee to the ESCO. Despite the ESCOs receiving training in solar home system installation, trouble shooting and maintenance, the number of technicians trained were too few compared to the number of solar systems that they were to work on. This resulted in a major weakness of the ESCOs failure to have a working monitoring system, giving chance to customers to vandalize the systems and even overload them resulting in systems malfunctioning (MEWD 2013).

The major hindrances to the success of this project as assessed by DoE officers included among other things **lack of ownership** of the systems by the end users; lack of **technical support**; low **awareness levels** on how the system works and best practices to lengthen the systems lifespan; **technology transfer and capacity building** to ensure proper monitoring and management, for example the ESCOs should have been empowered to an extent that they are be able to supply problematic parts to their clients (MEWD 2013).

- **Promotion of biofuels as a substitute for lighting and cooking – The Jatropha oil project**

The draft Biofuels Industry Development strategy paper identifies six major sources of feedstock for biofuels production. For ethanol, molasses coming from Sugar factories, cassava and sweet sorghum are the feedstock preferences in Zambia. Maize although produced in surplus is not considered as it is the staple food of the country and diversion of maize to biofuels can cause an imbalance in terms of food security and trade (MEWD,

2011). As for biodiesel, palm oil, soya beans and Jatropha have been identified as the potential crops to provide the feedstock. Sunflower, being a food crop, is also approached with caution to avoid competition with animal feed production and vegetable oil for human consumption (MEWD, 2011).

Jatropha curcas is a bush or plant of about 5metres in height and belongs to the euphobia family. As Jatropha is not browsed by animals, it has historically been planted as a living hedge or fence by farmers all over the world around homesteads, gardens and fields. The tree has a straight trunk and grey or reddish bark, masked by large white patches. It has green, alternately arranged leaves. Jatropha curcas originates from Central America (Brazil through to the tropical islands of Fiji), but is today cultivated in almost all tropical and subtropical countries. Pollinated by insects, the plant produces a trilocular ellipsoidal fruit out of which black seeds averaging 18mm long and 10mm wide. On average the seeds weigh approximately 1kg for every 1375 seeds. The life of the Jatropha curcas plant is more than 50 years (MEWD/BAZ, 2007).

Bio-ex was a project set up in North Western province to demonstrate how development of a biofuels industry can bring benefits to small farmers or poor resource farmers in Zambia. Sixty-five (65) farmers were contracted in Kisalala area under an out-grower scheme, to grow Jatropha which would later be bought by North West Bio Power (NWBP) for processing into biodiesel. Jatropha is not a new tree in Zambia. For generations, farmers have protected their gardens with hedges of Jatropha curcas, which is not eaten by animals and thus protects the food crops as a living fence. However the Jatropha industry in Zambia is still in its infancy. Jatropha cultivation and biofuels production in Zambia have been predicted good opportunities, as a lot of officially unused land and degraded bush land seems available. The cultivation of Jatropha in Zambia is mostly done through smallholder farmers. Projects mainly rely on out-grower schemes, mostly profit-oriented and to a less extent, development oriented (cfr Ladefoged T., Hansen R.B., Worsoe T.A. and Fredslund W., 2009).

The Bio-ex project was well received with over 8000 out-growers being recruited. While a number of achievements were visible from the project which included the creation of awareness and expectations on Jatropha in the province; practical experience for the farmers and field officers involved, about Jatropha and its production complexities as well as the provision of a platform to engage key stakeholders needed to develop a sustainable biofuels industry, the project also faced a number of challenges to remain sustainable. Among the challenges highlighted was the perceived **low price** of Jatropha (compared to other crops) which was not attractive enough to encourage farmers to grow more of the Jatropha as shown in the table.

Table 5: Price of different crops in Zambia

CROP	**PRICE IN USD/kg**
Beans	1.25
Cassava	0.42
Goundnuts	1.04
Jatropha	0.14
Maize	0.23
Millet	0.42
Sorghum	0.42
Sweet Potatoes	0.35

Source: MEWD 2011

The **labour demand** of Jatropha was also considered to be too high posing a potential labour competition with other crops. Farmers also expressed disappointment that despite the promise that **training** would be given, only seeds and/or seedlings were distributed and not the promised training and field extension services. It was noted though that during meetings, tips on how to look after the plants like pruning and weeding were given, but basic knowledge (**awareness**) about use of agricultural waste coming from

Jatropha and other crops as composite fertilizer was conspicuously absent. These and other challenges such as the long gestation period required before one can start harvesting (**stranded investment**) as well as the environmental and health impacts - apart from being toxic if ingested, Jatropha attracts a lot of pests affecting other plants with which it is intercropped thereby inhibiting growth & yield of crops like maize & cassava. Though there have been claims by the Biofuels Association of Zambia that the Jatropha plant is not an invasive, there have been reports from farmers working without protective clothing that the liquid released at the end of the stem at the time of harvesting itches when it drops on one's skin or damages clothes. These sentiments have been echoed in similar ventures like the Oval Biofuels Out-grower Scheme in Eastern Province and Marli Investments in Central province. The foregoing has led to some ventures where Jatropha was successfully introduced and grown, either using the seed for soap production which is perceived to be more profitable, or abandoning the crop altogether. (MEWD 2012)

- **Promotion of energy efficiency through the use of by-products/waste as substitutes for cooking – The liquefied petroleum gas (LPG) stove project**

Liquified Petroleum Gas (LPG) according to Speight is predominantly a mixture of hydrocarbon gases mainly propane (C3H8) and butane (C4H10) which is liquified under pressure. It can be derived from either natural gas processing or crude oil refining (Speight 2007, p827). Up until recently the LPG produced at Zambia's Indeni Refinery in Ndola was considered as simply a by-product of no economic value (waste). Consequently the product was burnt as a way of disposal. LPG however is known to be widely used in countries like India, Brazil, Sudan, South Africa, Kenya, Zimbabwe and Tanzania, some of which have now started importing LPG from Zambia. Though not a renewable fuel like biomass energy, LGP is clean burning and provides much greater efficiency than most improved biomass stoves.

In 2009 Project Support-Zambia was engaged as a consultant in the implementation of the LPG Stove Pilot Project in Lusaka's Mtendere township. The aim of the project was to lessen the total dependency and pressure of households on charcoal, firewood and electricity. The obvious effective benefits would be the promotion of environmental conservation and counteracting global warming as well as making the lives of the vulnerable households a little easier and more comfortable. According to the final project report presented to the Department of Energy, a baseline survey was conducted to establish the rightful beneficiaries of LPG stoves and ascertain the capacity of the rightful beneficiaries to purchase and rightly use the LPG stoves after which approximately 400 LPG stoves were distributed in Mtendere. Among the challenges recorded during these phases of the project were the general **lack of knowledge** of the LPG stove among the people; high poverty levels leading to inability to meet the **cost of the stoves** and the **prevailing attitudes and fears** of the possibilities of fire accidents. During the monitoring and evaluation stages, further challenges and constraints to the dissemination of this technology included the lack of **access to fuel source** which wasn't close to the community and the absence of continued **sensitisation and awareness raising** campaigns at household and community levels on how the stoves can be used safely and economically, among other things. At the time of the evaluation less than 50% of the distributed stoves were still in use (MEWD, 2009).

- **Promotion of substitutes for charcoal and electricity for cooking and lighting – The SNV/Hivos National Domestic Biogas project.**

First introduced by FAO through the National Council of Scientific Research (NCSR), supported by the national commission for development planning, the projects objectives were to provide an alternative domestic energy; use biogas as a decentralized energy in rural & peri-urban areas; reduce the burden of rural & peri-urban dwellers in woodfuel collection; to study the cultural and socio-economic parameters that would assist in coming up with a sustainable and workable approach to popularizing the biogas technology; provide cheap organic fertilizer from biogas plant slurry affluent and

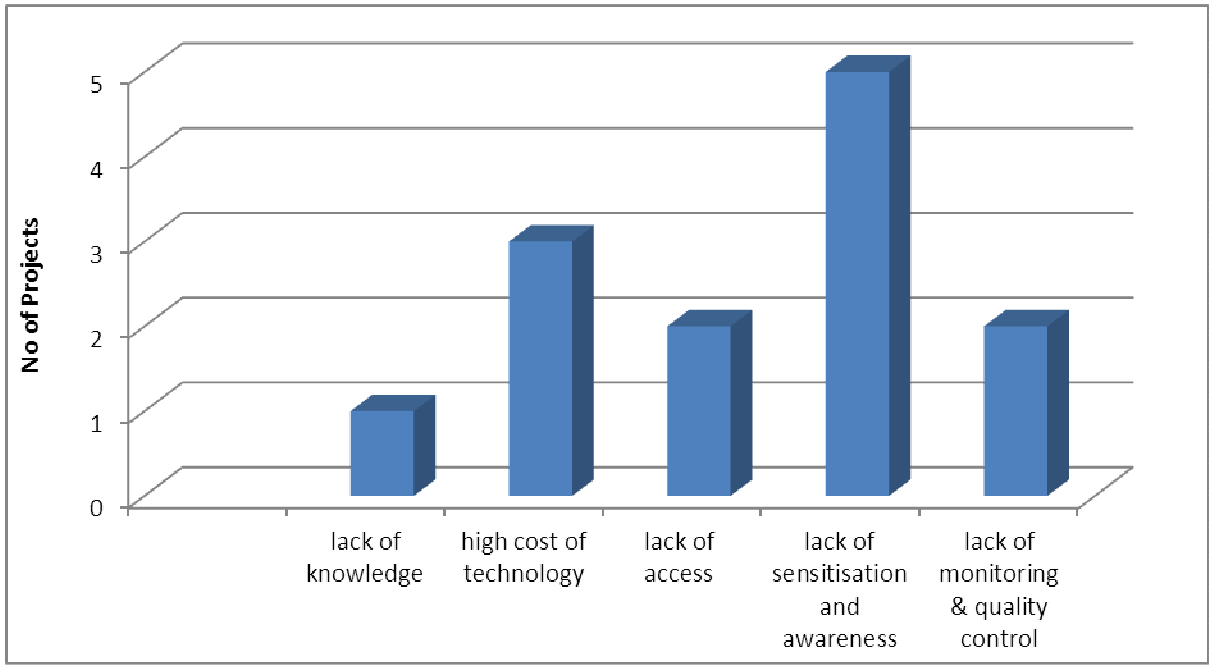
improve health and nutrition. Their strategy was to identify people in the selected areas that would influence the acceptability of biogas technology and then promote it in appropriate localities where there's enough livestock production. By December 2003 biogas plants had been set up in Lusaka, Monze, Kasisi, Lealui, Pemba, Chisamba, Maamba and Mukondi. These preliminary attempts however were facing challenges and have not led to demand for the technology from target groups which have suited conditions. The challenges included among other things, the fact that firewood shortage is not among the alarming problems of the rural areas (even though nowadays deforestation rate seems dramatic). The availability of know-how and experience was limited. Limitations were also noted in that the availability of ample biomas (which is not dung) was not considered in feasibility thoughts. The technology has been understood as rural, a view that can be changed if the broad application spectrum can be demonstrated (MEWD 2003).

In 2012 a feasibility study of a National Domestic Biogas Programme in Zambia was conducted by SNV/Hivos in conjunction with stakeholders such as the Department of Energy, with a view to start implementation by 2013. Recommendations from the feasibility studies indicated that though the feedstock is readily available especially in areas with a lot of livestock production, the **cost of construction of the digesters** is too high (the need for smart subsidies from the government if possible); quality control and **monitoring** of construction of biogas digesters was necessary and most importantly, a need to overcome people's negative perception of using waste (especially human waste) in biogas digesters (through **information dissemination and awareness** campaigns) (SNV/Hivos 2012).

- **Summary of government's past efforts in disseminating alternative energy sources at household level**

It can be deduced from the foregoing that most of government's efforts to promote and disseminate alternative sources of energy have not performed as desired.

Figure 5: Challenges faced by government so far in project implementation



Data Source : MEWD 2013

Figure 4 shows the main challenges highlighted during the dissemination of the selected RET's. As can be seen from figure 4, lack of sensitisation and awareness raising has been a major challenge in most, if not all the cases in which government has attempted to disseminate alternative energy sources. It should be noted that information dissemination and public awareness needs differ according to projects. While some technologies need public awareness for acceptability and adoption, others may need it for knowledge (that the technology exists) and/or sustainability (understanding the benefits for continued use). This challenge is closely followed by the challenge of not being able to meet the cost of RET's. As earlier alluded to, one of the reasons highlighted in the NEP for the

heavy dependence on woodfuel is the low income levels of energy consumers with access to supposedly abundant woodfuel resources (NEP, 2008, p.2). With over 64% of the population living below the poverty datum line, it is difficult for one to think of investing for the future when they cannot even meet their present day-to-day needs.

5.3. The appropriateness and effectiveness of the policies currently in place

In Zambia, energy management is guided by the National Energy Policy which seeks to provide well developed, managed, reliable and sustainable energy services for the improvement of the quality of life of all Zambians (National Vision 2030). The policy draws its guiding principles from the National Development Plans, Millennium Development Goals, National Conservation and Poverty Reduction Strategies and the United Nations initiative 'Sustainable Energy for All (SE4ALL)' launched in 2011 which, if effectively implemented, should adequately cover the policy requirements needed to address the energy situation in the country. In 2008, the NEP was revised to address emerging cross-cutting issues such as the HIV/AIDS pandemic and its effect on the energy sector, the different energy needs and requirements of men and women and their different responses to development initiatives (gender mainstreaming), the need to promote sustainable development through adequate measures that take environmental issues into account and government's desire to promote alternative energy sources and encourage more players to be involved in the development of the electricity industry.

Table 6: Synthesis of the Policies, Strategies and National Plans

Policy, Strategy and National Plan	Priority Area	Key actions/Activities
Vision 2030	**Energy**	a) Increase renewable alternative sources of energy b) Reduce the share of wood fuel to 40 %.
Fifth National Development Plan	**Sustainable environmental management** (To reverse environmental damage, maintain essential environmental and biological processes and ensure sustainable use of natural resources for the benefit of the people)	a) Mainstream environmental issues into national development programmes and enforcement of existing policies and laws to protect the environment; b) Institute economic incentives/disincentives which seek to influence the behaviour of producers and consumers by enabling them to choose the most appropriate measures based on own assessed costs and benefits; c) Promote implementation strategies that focus more on establishing an economic environment for promoting environmental protection and less of the government implemented environmental protection initiatives.
	Energy efficiency and conservation (To promote energy efficiency and conservation)	Develop and implement programmes that promote increased energy conservation and management practices in households and the industrial sector.
	Renewable and alternative energy development and promotion (To provide and disseminate up-to-date information on renewable and alternative energy resources for effective planning and awareness, development, management and utilization.)	a) Undertake a comprehensive assessment of renewable energy potential in selected parts of the country in order to develop a resource map and bankable project proposals; b) Conduct awareness campaigns.
Sixth National Development Plan	**Renewable energy, alternative energy and biomass** (To expand the use of renewable and alternative energy in the country's energy mix;	a) Promote the development and use of solar technology systems; b) Introduce an appropriate cost-effective renewable energy feed-in tariff; c) Promote the production of electricity from geothermal energy; d) Promote the use of bio-gas for cooking, lighting and electricity generation, e) Promote the use of radioactive energy minerals for long term energy production.

	To increase the use of bio-fuels as a substitute to mineral fuel; To develop a rational and implementable approach to improve sustainability of biomass energy supply and raise end-user efficiencies)	a) Promote the use of bio-fuel switches for all stationary engines; b) Establish bio-fuels blending ratios; c) Develop innovative financing mechanisms; and d) Promote the manufacturing of oil extraction technology
		a) Develop a Bio-mass Energy Strategy; and b) Promote bio-mass gasification electricity generation and co-generation
National Conservation Strategy	**Energy** (To satisfy the basic needs of all the people of Zambia, both present and future generations, through the wise management of resources)	Encouragement of transfer from non-renewable, polluting and foreign exchange-dependent energy forms towards renewable Forms.
National Energy Policy	**Biomass** (To ensure environmentally sustainable exploitation of the biomass resource by ensuring efficiency through better management and introduction of new sources such as bio-fuels.)	a) Raising public awareness on the benefits and opportunities of other modern biomass energy sources and develop capacity for their implementation; b) Improve the technology of charcoal production and utilization; c) Promote appropriate alternatives to woodfuel and reduce its consumption through encouraging the use of alternative renewable sources of energy.
	Renewable energy sources (To address barriers to wider dissemination of renewable energy sources and also to increase their deployment.)	a) Ensure availability of data and information on market demand, resource; b) Assessment and applicability of renewable energy technologies; c) Promote renewable energy technologies for electricity generation through encouraging research in utilization of available technologies and encouraging pilot projects.
	Energy management (To promote efficient use of energy resources, and substitution).	a) Promote efficient energy use practices in all sectors of the economy by mounting publicity campaigns on energy conservation; b) Substitute, wherever possible, local energy resources for imported ones by increasing the contribution of renewable energy in the country's energy mix; c) Popularize energy management through liaising with training providers to incorporate energy conservation concepts and practical activities in education curricula; d) Encourage the use of energy efficient equipment.

Source: Vision 2030

The aforementioned shows that the National Energy Policy, coupled with the other supporting plans and strategies, adequately covers the policy needs necessary to address the country's energy situation. Encompassing cross-cutting issues such as gender, HIV/AIDS and sustainable development has not only made the policy appropriate for the different sectors of society but shows that if properly implemented, the policy can actually be quite effective.

5.4. Implementation and communication strategies currently being used by the government

The Department of Energy (DoE) under the Ministry of Mines, Energy and Water Development is mandated to be the overseer of the development and usage of all the energy resources in the country. The effective implementation of the NEP, however, is greatly enhanced through the participation of stakeholders such as ERB, ZEMA, REA, Research institutions, Zambia Chamber of Commerce and industry (ZACCI) and its affiliates such as Consumer Competition Protection Commission (CCPC) and private institutions involved in development of energy resources. DoE's activities are planned and implemented under specific sub-sectors namely Electricity and Power Development, Petroleum and Renewable Energy. These subsectors are further supported by the Energy Management and Informatics sub-sectors. Though these activities are structurally supposed to be done in collaboration with the Department of Planning and Information (DPI) whose job it is to also monitor and evaluate the projects, this has not been the case as was revealed in the interviews conducted by this researcher with officers in the Department of Energy.

Electricity is the country's second most important energy source. The NEP seeks to increase access to electricity through expansion of generation and transmission, improved service delivery through energy efficiency and private sector participation. Guided by the Rural Electrification Master Plan (REMP), the **electricity and power**

development sub-sector pursues these policy objectives through implementing partners like REA, ZESCO, OPPPI and ERB which regulates energy pricing especially in the private sector (NEP, 2008).

Also in the pipeline, is a planned resource mapping exercise funded by the World Bank, to identify potential Hydro and Wind Energy Resources in the country for possible development. This was revealed in the interviews with officers in the department conducted by this researcher.

According to the NEP, petroleum provides for approximately 9% of the country's energy demand and consumption. The **petroleum sub-sectors** mandate is to ensure adequate, reliable and affordable supply of petroleum products at competitive and fair prices, while reducing on importation costs. Like the electricity sub-sector, implementation of policy objectives such as decentralizing the storage of petroleum products, blending petrol and diesel with cleaner biofuels and moving towards producing cleaner low sulphur diesel and unleaded petrol is done through partners like INDENI Refinery and OMC's.

The renewable energy sources sub-sector includes wind, solar and geothermal. The NEP seeks to address barriers to the wider dissemination of renewable energy sources and increase their deployment. At departmental level the NEP's policy objectives and strategies are being articulated as follows:-

Wind technology is being promoted mainly for water pumping. Wind energy conversion systems convert the energy in moving air to mechanical or electrical energy. For example, a wind turbine converts kinetic energy of the wind into rotational or mechanical energy which is then either converted into electrical energy using a generator or used directly for driving mechanical loads such as water pumps. According to the information at DoE (obtained from the

metrological department), the wind speeds in the country are insufficient for electricity generation which requires wind speeds of at least 6m/s. So far the only areas identified as having sufficient enough wind speeds (resource availability) for at least water pumping are Central, Lusaka, Southern and Western Provinces, as can be seen in table 6. However, because the cost of the equipment is too high for individuals in the target area to procure for personal use, dissemination is being done through public institutions such as schools and hospitals.

Table 7: Areas identified to have average wind speeds of about 5m/s and above

Station	**Wind (m/s)**
Kabwe MET (Central Province)	5.9
Mongu (Western Province)	5.9
Mkushi (Central Province)	5.5
Chipepo (Southern Province)	5.2
Lusaka Hq (Lusaka Province)	5
Lusitu (Southern Province)	5
Kalabo (Western Province)	4.9

Source: CSO, Zambia Energy Statistics 2000-2011 Final Draft

Apart from resource availability, the criteria used to select actual sites for implementation of this technology include:-

- The need (for example in Western Province there has been need for readily available clean potable water). While water resources exist in the area, these are sparsely distributed and are not developed.

- The non-availability of other energy sources that can be used for the same purpose such as electricity (little to no electricity grid coverage). Consequently this technology is almost exclusively promoted in rural areas.

- Consider the number and type of beneficiaries (the greater the number the higher the priority). The communities in Western province for example, are reasonably sized to justify the investment.

- The cost of implementation compared to the socioeconomic status of the target community.

According to the officers in-charge of the sector, the information needed to make such decisions is collected by the officers themselves, from sources such as the Metrological department, general public and previous reports, as each project is being implemented. Evaluation of the implemented projects is also done by the Energy Officers who implement the projects while promotional efforts are mainly done to create a sense of ownership among the communities for the maintenance, viability and sustainability of the projects.

Solar energy is one of the most popular renewable energy sources being promoted by the Zambian government. Second only to hydropower, solar energy is being disseminated through implementing partners such as the Rural Electrification Authority (REA) guided by the (REMP) and the Energy Service Companies. Once again due to the high capital outlay required for solar energy utilization, focus has mainly been on rural growth centres such as hospitals and schools where government provides solar systems with the hope that the rural communities will benefit. The Zambia PV Energy Service Companies (ESCO) project in Nyimba, Chipata and Lundazi districts of Eastern Province is one of the very few projects targeted directly at individual households (MEWD 2013).

Geothermal energy is still in its infancy but is nonetheless being explored for possible inclusion in the country's energy mix. It is energy generated from the pressure escaping from fault lines on the earth's surface a number of which have been identified such as Kapishya (CSO, Energy Statistics 2000-2011 Final Draft).

Biomass, though a renewable energy if sustainably used, is managed under a separate sub-sector. The **biomass sub-sector** includes energy in form of energy from matter such as Wood fuel (firewood and charcoal), agricultural wastes, forestry waste, industrial/municipal organic wastes, energy crops and products and animal waste. The NEP seeks to promote the efficient production and utilisation of this source of energy in form of biofuels, woodfuel/charcoal and biogas.

(i) Biofuels

The development of the biofuels sector at the moment is driven by the Ministry of Energy and Water Development (MEWD) and the private sector through the Biofuels Association of Zambia (BAZ). The National Energy Policy provides the general guidelines for the development of the biofuels sector while the National Biofuels Industry Strategy Paper adopted by the MEWD in 2008 provides the specifics of how the country wants to develop the sector (MEWD, 2008). Statutory Instrument No. 42 of 2008 provides the basis for inclusion of biofuels on the Energy Regulation Act and gives power to the Energy Regulation Board as the agency to regulate production and utilization of biofuels. In terms of standards, Zambia Bureau of Standard has included the ZS E100 and ZS B100 standards for ethanol and biodiesel respectively.

Bioethanol and biodiesel are the two biofuels currently being promoted in Zambia. While the main driver for biofuels development in the developed world is to curb greenhouse gas emissions responsible for global warming and climate change, the main driver in most developing countries in sub-Saharan Africa is energy security, employment creation and rural development (MEWD, 2011). They also offer an alternative to woodfuel whose

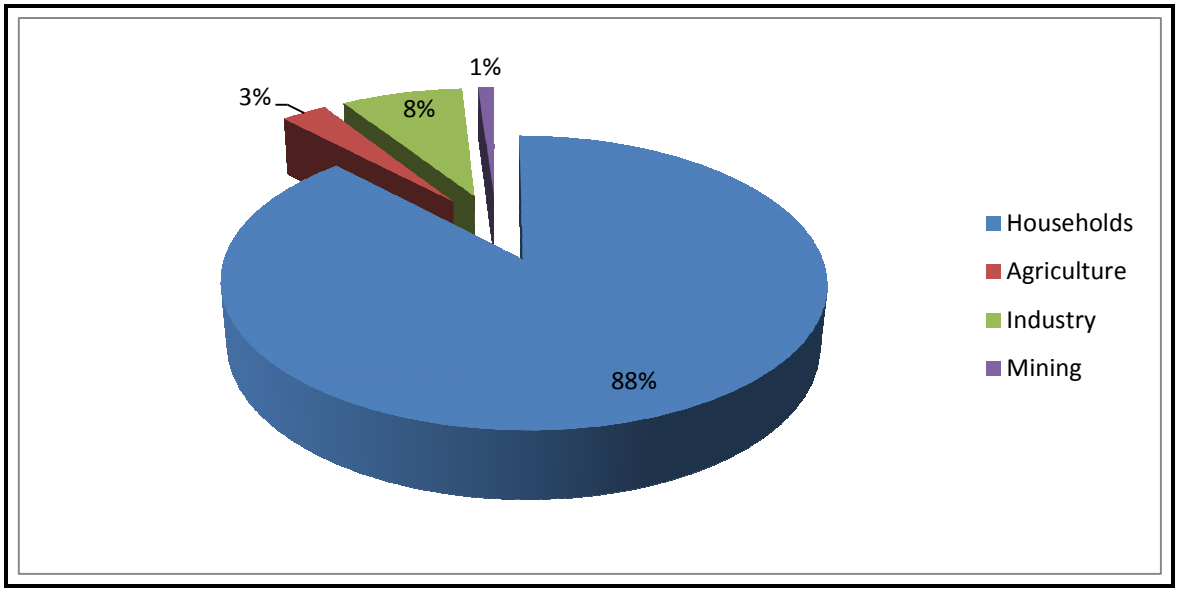
excessive consumption is a cause for concern. Bioethanol is produced from energy crops such as cassava, sugarcane and sweet sorghum, while Biodiesel is produced from vegetable oil producing plants. DoE's strategy has been to promote crops which are not used for food as they would compromise the food security in the country.

The International Institute for Sustainable Development (IISD) in 2010 however noted that out of the total land area of Zambia's 70 million hectares, 42 million hectares is estimated to be suitable for cultivation. Currently, only 14 per cent of this land is under cultivation and only 0.25 per cent is being cultivated for energy production (Walimwipi, 2012, p.7).

(ii) *Woodfuel and Charcoal*

Over 70% of the country's energy demand is serviced by woodfuel and charcoal, 88% of which is used in the household sector for cooking and heating.

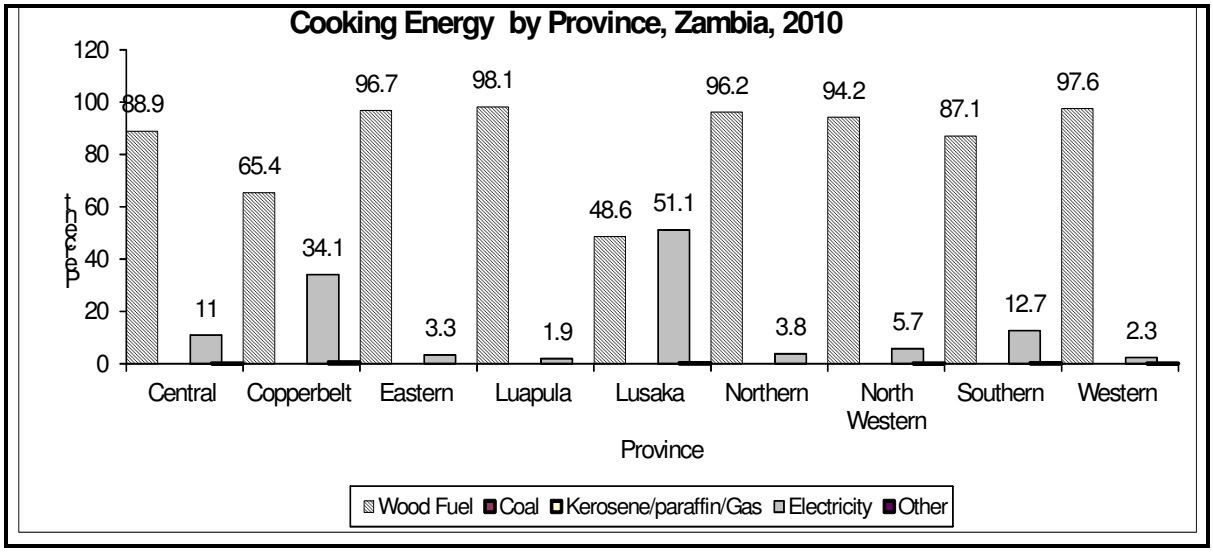
Figure 6: Woodfuel Consumption by Sector



***Source**: Department of Energy, Statistical Bulletin 2000-2010 Final Draft*

Energy production and consumption in this sub-sector is largely informal posing challenges in terms of monitoring, regulation and control.

Figure 7: Percentage Distribution of Households by Main Type of Cooking Energy



Source: CSO, Living Conditions Monitoring Survey, 2010

As depicted in figure 6, more households in Zambia use charcoal for cooking than other energy source including electricity. Strategies currently being used by DoE to contain the use of woodfuel within sustainable levels include the promotion of improved production processes (through the charcoal manual) and utilization (by providing alternatives in the form of improved cook stoves and alternative sources of cooking and heating energy such as biogas and biofuels). This promotion is done indiscriminately among the Zambian population with feasibility studies being done per project. Promotion is also being done simultaneously with implementation of technologies by the Energy Officers through trade shows, billboards, stakeholder meetings and television documentaries. Projects are usually only carried out with Technology developers and other consultants when they are initiated externally. Monitoring and evaluation however, is not particularly evident as the department mandated to carry out this exercise which is the Department of Planning and Information could not provide any information pertaining to this exercise. The only available verified data on the country's bio-energy status is from the ESMAP

done over 20 years ago under World Bank, which poses a challenge in the planning of projects. Considerations are however being made to generate an up-to-date database using external consultants to carry out a National Woodfuel Study in 2014.

(iii) ***Biogas***

Produced from animal waste (organic matter digested or fermented anaerobically in the absence of oxygen), this energy source is cheap and readily available especially among livestock farmers. Biogas has many benefits, including: freeing time previously spent collecting fuelwood, reducing deforestation, improving the fertility of agricultural land through the use of digested manure (bioslurry), reducing greenhouse gas emissions, improving hygiene and sanitation conditions through better manure management, reducing air pollution-related ailments through smoke free kitchens, reducing cash outlays for lighting, firewood and charcoal, and chemical fertilisers, and creating employment opportunities in the field of biodigester construction (SNV Feasibility Study Report, 2012, p.2). Promotion of this energy source has been done mainly through NGO's and other collaborating partners such as bio-digester producers. However, apart from the major bottleneck of the high cost of the bio-digesters, challenges such as cultural barriers, technology transfer, low levels of awareness, capacity building, and unconcerted efforts among stakeholders are still being faced. This has resulted in the failure by the Department of Energy to disseminate this technology even in areas where the feedstock is readily available such as Southern Province. Enquiries and proposals have been presented to the department, but no tangible progress has been made in the sub-sector.

Two (2) support sub-sectors also operate in the department of energy namely Energy Management and Informatics. The **Energy Management** Unit's mandate as provided for in the NEP, is to promote the efficient use of energy and substitution. To do this, the sector needs:-

- Clear understanding of the operations of all the other sectors in the department in order to improve on what is currently prevailing.
- To be aware of and understand the technologies in the offing so as to be better able to match these with the country's energy situation.
- To have up-to-date information on the countries demographics such as population distribution, energy needs, available energy resources, socio-economic status and literacy levels to name a few.

Currently, energy efficiency under electricity for example, is promoted through utilities like ZESCO and dealers by way of incentives such as the exemption of import taxes on energy efficient products, with the hope that this will translate into a reduced cost of energy efficient products for the end user. In the biomass sector however, being a largely informal sector, interventions have had to be done on a consumer level making information dissemination and public awareness, the major factors of success for the implemented projects.

Informatics is a sub-sector whose formation was necessitated by the inability of the DPI (whose mandate it is) to provide and maintain an adequate information system to support DoE's operations. According to the officers in this sector, this in-house information gathering on the production, consumption, import and exports of different types of energy from the various stakeholders such as ERB, ZRA and ZESCO, is maintained in an electronic library together with information on projects carried out by the department. Though the researcher was not privy to the information in the electronic library, the data, once verified by the department heads, is supposed to be published in the Energy Bulletin' and passed onto CSO for the public use. When there is need, the sector also produces brochures for the energy week which is run annually and other conferences. Though the data collected so far is updated up to 2012, the publication of the information was last done in 2004 with the 2014 copy of the bulletin still in draft form awaiting

verification. The whole scenario has subsequently affected the MMEWD website which has become dormant.

The Department of Planning and Information is another support organ in the Ministry whose mandate is to participate in the formulation of DoE's sector plans (though the sectors are their own drivers in coming up with programs and activities to achieve their mandate as outlined in the NEP), monitor and evaluate DoE's projects. However, since according to the DPI officers, DPI does not take part in the planning, monitoring and evaluations (M&E) 'project inspections' are based on the submissions made by the implementer's to DPI. To be effective in M&E, one needs to be involved and have full information of a project from inception - planning through to implementation. Structurally DPI is also supposed to be the custodian of information systems for the various departments under the Ministry. However when interviewed, DPI officers intimated that since there are no systems in place to compel the various departments (Energy, Mines and Water Development) to share information and use DPI as a reservoir, this objective is quite difficult to achieve. The officers also reiterated that there's no written public awareness strategy. DPI in conjunction with DoE carryout promotions as the need arises. For example, exhibitions are made at the Agricultural Shows and the Trade Fair each year. During the Energy Week, stakeholders in the energy sector are invited to exhibit clean energy sources in Road Show setups in Lusaka, Livingstone, Kitwe and Ndola. Documentaries and presentations are also run on television and radio during the Energy Week.

Though there are no laid down or written communication strategies, it can be seen that a general trend is followed annually which includes exhibitions at the Agricultural Shows and Trade Fair as well as road shows, documentaries and television presentations (with accompanying t-shirts and brochures) during the Energy Week. In isolated cases, product-specific promotions are carried out such as the billboards promoting improved cookstoves in Lusaka's medium and high density areas.

On assessing these communications, however, the researcher noted that the language used for most of the promotional materials, which she was privileged to see, was English, which more or less implied that communication was targeted at a English literate audience. The main channels used which included Television, Agricultural Shows and Trade Fairs as well as the Road Shows held in places like Arcades and Government Complexes also capture an audience with a reasonably good socio-economic status, capable of affording electricity and only considering alternatives at insignificant levels. People in peri-urban areas and those in the low income bracket who depend on woodfuel, rarely have access to these channels and/or events. This homogeneity in promotional material gives the impression that the government assumes that the Zambian citizenry is homogenous and has therefore not considered necessary, promotional strategies like market/audience segmentation. Another point of great importance was the fact that these promotions were mainly annual events. Borrowing from the agenda setting theory, the lacking in frequency could appear to the public that alternative sources of energy are not exactly a priority on the government's agenda.

5.5. Target audience's current energy source and their knowledge of their impact on the environment

A sample of 150 households was randomly selected and interviewed using a structured self-administered questionnaire, to establish the current energy sources in Fisenge area. As depicted in figure 8 and figure 9 the majority of the target population who do not earn regular income, such as the farmers and charcoal burners, largely depend on candles for lighting and charcoal or wood for cooking and heating requirements. In a few cases, solar energy is utilized for lighting and entertainment among households that dwell in their own (not rented) houses. The charcoal and wood is normally collected by the household members thereby reducing the pressure on the limited cash available.

Regular income earners, such as nurses and marketeers, use electricity for lighting and entertainment while alternatives like gel fuel, kerosene and charcoal are used for cooking

and heating. All of this energy is purchased from vendors such as ZESCO, Filling Stations, charcoal burners and wood collectors.

Figure 8: Current energy sources

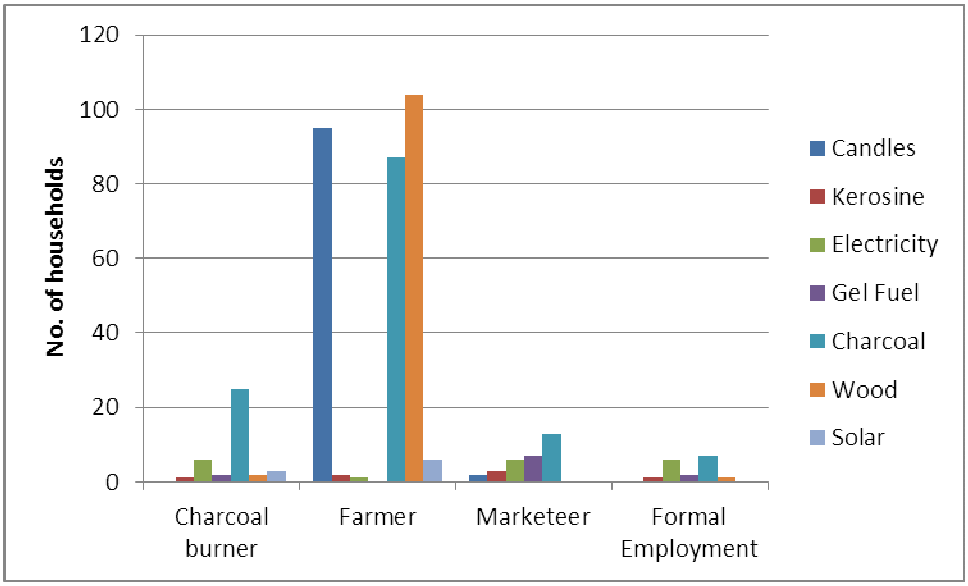
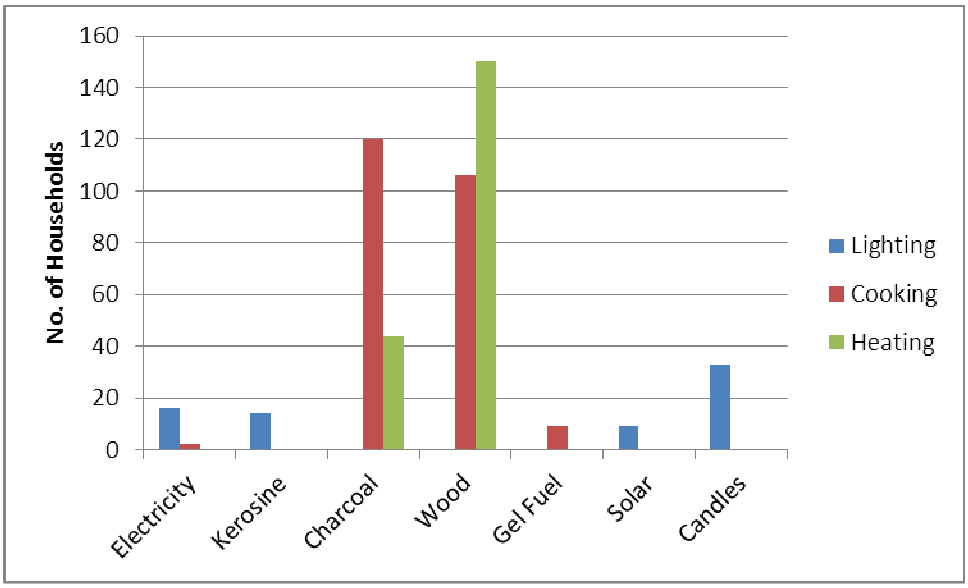
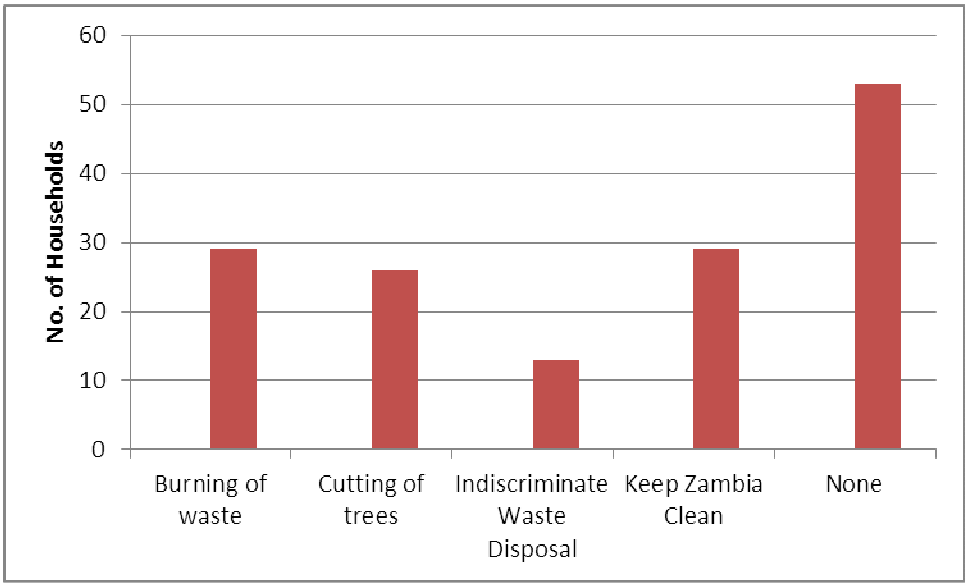


Figure 9: Current energy uses



Apart from noting that the charcoal and wood was becoming scarce and therefore expensive, over 30% of the respondents showed ignorance when asked about the environment and the laws associated with it (see figure 10). Most of the knowledge was career related for example, laws related to the indiscriminate disposal of waste was mostly known by the Marketeers, who were reminded by market officials, as was the cutting of trees by the charcoal burners who occasionally encountered forestry officials as they conducted their business.

Figure 10: Knowledge of environmental laws



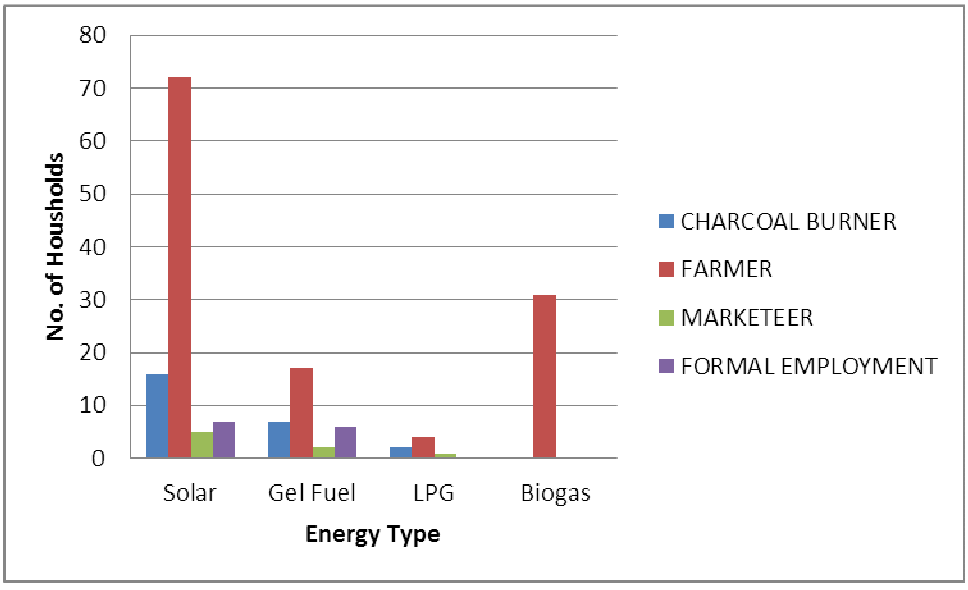
5.6. Target audience's perceptions, knowledge and attitudes towards the use of alternatives such as biogas for household cooking and heating energy.

Among the problems faced in sourcing for energy in the current scenario in Fisenge are scarcity, high prices and sometimes non-availability. Based on these problems, the majority of the population is ready to consider alternative energy sources provided they are cheaper or at least affordable and more accessible.

Knowledge of alternative energy sources is closely linked to social groupings and interpersonal networks as can be seen in figure 11. For technologies such as Solar, knowledge is widespread with information being passed on by word-of-mouth or direct observation of those who already have it. The attitude towards this technology however, is that the equipment is too expensive and can only be acquired by one earning a relatively high income. Another factor raised is the aspect of transferability. Respondents feel solar home systems are permanent once installed and cannot be transferred (without being damaged) thereby making them unsuitable for households dwelling in rented houses.

Biogas, which was introduced to the farming sub-community through the Fisenge Dairy Co-operative, is yet to be adopted as the innovators and early adopted have not yet been equipped with full information on the technology such as where it can be found, initial cost and repair and maintenance , to name a few.

Figure 11: Known alternative sources of energy



CHAPTER SIX

6. CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

This chapter is divided in two (2) sections. The first section outlines the conclusion deduced from the findings of the study, while the second part offers recommendations based on the findings of the study. This is in order to help improve on the efficacy of government efforts to communicate and disseminate alternative energy sources among the energy poor in the country.

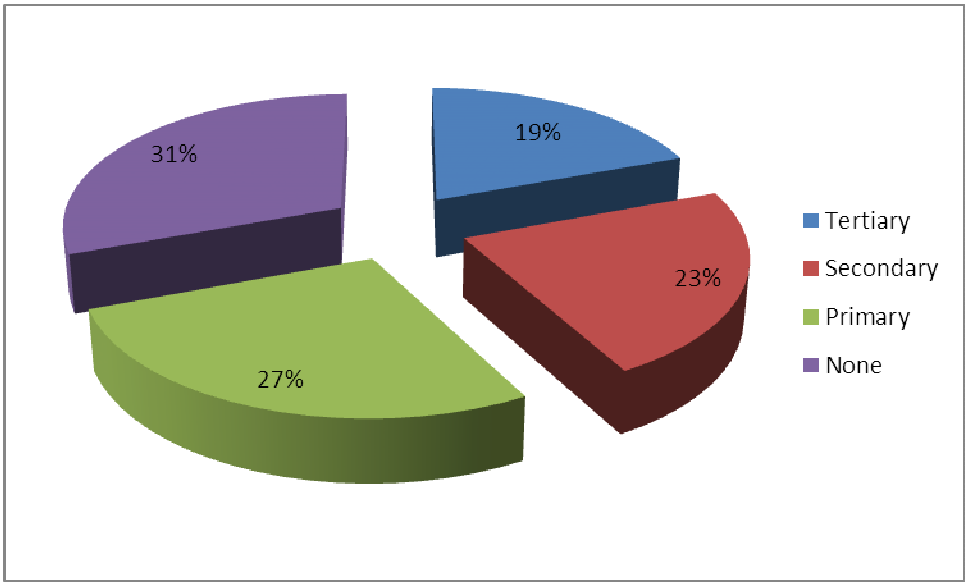
6.2. Conclusion

The foregoing clearly shows that government through the Ministry of Energy, has not communicated effectively the incentives, benefits associated with, and the polices supporting the use of alternatives such as waste biomass for household cooking and heating requirements, neither has it communicated the negative effects of the current levels of wood fuel and charcoal consumption among the affected communities. The conservative approach of only communicating over a limited period of time, (such as the energy week), and through media and fora which are not accessible to the affected population (such as television and trade shows), are among some of the reasons why their communication has not been effective. As earlier alluded to, in communication the agenda setting theory posits that the more salient certain features are in the media, the more importance people perceive them to be and the more likely they are willing to consider them.

While the policies may be adequate, government has not met the people at their level (economic and social status) to enable them exploit the available resources in an environmentally friendly and sustainable manner. An example of this is illustrated in the quantitative survey conducted in this research, where over 50 percent of the target population had little to no education (see figure 12.) yet almost all of government's information on alternative sources of energy is being disseminated in English.

On the economic front, an example can be seen in governments attempt to promote biofuels through the cultivation of the Jatropha plant despite its long yielding period in the face of the high poverty levels in the country. As stated in Maslows scholarly works on the 'hierarchy of needs', the energy poor population is more likely to consider RETs offering immediate returns with little to no running costs than anything else.

Figure 12: Educational levels in Fisenge, Luanshya (May 2014)



The current focus on highly-skilled expert knowledge and technology presents the developed countries as the ones with the solutions for the problems caused by climate change. However, according to Gupta (2009, p.211) "promoting transfers of existing technologies and practices in the West may be less beneficial than designing more appropriate technologies and practices that fit better with the conditions of the developing world". Gupta (2009, p. 211) offers a valuable perspective in her summary about the future of development and development co-operation, which is worth citing at length:

> "If we are to address climate change, climate change needs to be mainstreamed into development processes. Such mainstreaming is not easy in the developing world nor in the developed world where it challenges existing consumption and production processes and lifestyles: nor is it easy to integrate into existing global trade and investment processes."

Though fossil fuels and electricity grid extension inevitably continue to play a major role in expanding energy supply, this researcher found out that decentralized, low cost environmentally friendly energy sources such as waste biomass, have huge potential for providing reliable, sustainable and affordable energy services for the energy-poor, particularly in peri-urban areas of developing countries like Zambia. If properly harnessed through government supported initiatives, small scale renewable energy technologies can have a significant impact on the 70% energy demand currently being sourced from wood fuel and charcoal. Further, through effective sensitization and supportive policies, waste biomass, such as agricultural and wood industry waste, can guarantee long-term, sustainable energy sources for these sub-communities, whilst generating income and preventing environmental degradation through maximization of resources and proper waste management.

As outlined in the review of the impact on livelihoods of interventions providing access to renewable energy in developing countries, conducted by the Policy and Operations Evaluation Department (IOB) of the Dutch Ministry of Foreign Affairs in March 2013, households' motivations to change to other fuels for heating can be either the decreasing availability of the staple fuel (and related to that the increase in price), the wish to use cleaner and healthier fuels, external incentives to change (subsidies), or even environmental awareness. The price of the fuel is among the major determinants for the household's decision on fuel use. Government may influence the citizen's choice by applying subsidies and taxes on different types of fuel. The economic viability for example, of production or construction of assets like improved stoves, biogas digesters or solar home systems depends largely on the volume of the demand. This demand in turn depends on the availability of credit or subsidy facilities, at least in rural areas. Whether a household adopts a given energy source depends on the availability in the first place and the affordability (price) in the second place. Continued use of an adopted energy source however, depends largely on existing alternatives for energy and the service delivery

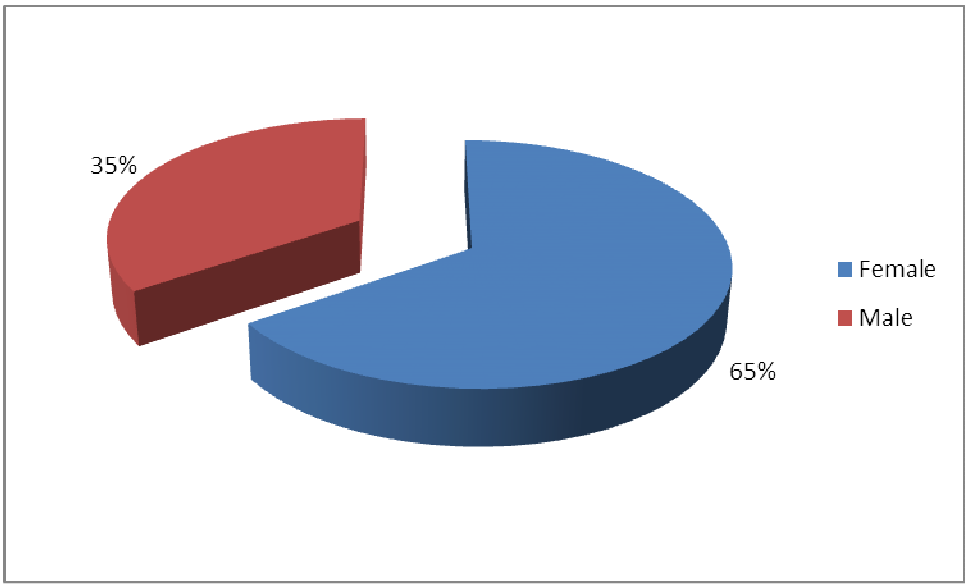
systems among other things (Ministry of Foreign Affairs, 2013, p.11). Strong quality control, including setting up of standards and a certification scheme to ensure proper operation and maintenance, are necessary if use of alternatives is to be sustained (IRENA, 2013, p.59).

The International Conference on Environment and Society: Education and Public Awareness for Sustainability in 1997, was the first to point out the importance of education and public awareness in sustainable development. Among the recommendations made is the need for national leaders to demonstrate that there is political will to give priority to sustainable development in every sector and that they see public awareness raising and education and training as essential means for achieving national objectives. The meaning and vision of sustainable development should be disseminated, discussed and debated in order to promote understanding and win community support. While local needs will evidently determine local priorities and actions, it is important, however, for the local community, in consultation with national leaders and national government, to understand its place in the 'big picture' of national and global action for sustainable development. Practices that are not sustainable should be identified and possibilities for correcting them discussed and explored. It is critically important that entire communities, especially women, be involved in the discussions. The local community and the household are important entry points for messages on sustainable development, especially for adults and out-of-school children.

There is also need to value and consider women's role and contribution to national development through their various small scale and backyard economic activities, and develop policy and projects to support these efforts using various energy options. The Zambia Energy and Gender Mainstreaming Strategy paper recommends, among other things, that it is necessary to have a specific legislation in the energy sector which will stipulate the basic energy services required for women in households and small business.

It also proposes that statutory bodies with regulatory functions such as, REA, ERB and ECZ have closer links with the community and incorporate the gender and energy needs of the communities in their work.

Figure 13: Gender analysis of heads of households in Fisenge, Luanshya (May 2014)



As can be seen from the area of research (see figure 13), the majority of households are headed by women. And even in cases where the household head is a man, it is the woman's job to ensure that meals are prepared by whatever means she can come up with.

6.3. Recommendations

- Government should do more advertisements and awareness programs through all the media, (especially that which is accessible by the energy poor) not just once in a while but continuously, to show political will as well as influence people's thinking and attitudes towards alternative energy sources (agenda setting).

- Government should take advantage of traditional authorities and churches and work together with the communities to campaign for cleaner energy usage (adopt a participatory approach).

- As DoE is centralised, NGOs seem to be better placed to deal with the people in peri-urban and far flung areas. Government should, therefore, partner with such stakeholders in order to penetrate populations which really need cleaner (more sustainable) energy solutions.

- Energy should be mainstreamed in all sectors using all possible fora as it affects all areas of human endeavour. For example energy issues (such as sources, efficient use) can be introduced through schools in the Education sector, while Under Five clinics can be used in the Health sector.

6.4. Future research

While this study has proved that lack of knowledge and awareness have been great deterrents to the dissemination and adoption of alternative energy sources, other factors have also emerged from the study which can be researched to help make the Vision 2030 goal of Sustainable Energy for All (SE4ALL) a reality.

Access, cost of technology as well as monitoring and quality control systems are but a few areas that can be researched and addressed to help find a solution to the problem of deforestation and the resulting climate change.

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APPENDIX 1- QUESTIONNAIRE