Renewable and Energy for Rural Development in Zambia: Short Term Draft Report

By:
Mr. Abel Mbewe

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AFRICAN ENERGY POLICY RESEARCH NETWORK (AFREPREN)

RENEWABLES AND ENERGY FOR RURAL DEVELOPMENT THEME GROUP

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THE AFRICAN ENERGY POLICY RESEARCH NETWORK

AFREPREN is an African initiative on Energy, Environment and Sustainable Development supported by the Government of Sweden.

The African Energy Policy Research Network, AFREPREN, brings together 97 African energy researchers and policy makers who have a long-term interest in energy research and the attendant policy-making process. AFREPREN has initiated policy research studies in 19 African countries, namely: Angola, Botswana, Burundi, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Africa, Sudan, Tanzania, Uganda, Zambia and Zimbabwe. AFREPREN also maintains close collaborative links with energy researchers and policy makers from Cote D'Ivoire, Ghana, Nigeria, Sierra Leone and Senegal.

OBJECTIVE

The key objective of the African Energy Policy Research Network (AFREPREN) is to strengthen local research capacity and to harness it in the service of energy policy making and planning. Initiated in 1987, AFREPREN is a collective regional response to the widespread concern over the weak link between energy research and the formulation and implementation of energy policy in Africa.

AFREPREN 1999-2002

AFREPREN launched a new research programme in mid 1999 with the following key focal themes:

1. **Renewables and Energy for Rural Development:** New and innovative ways of delivering energy services to the rural areas.

2. **Energy Services for the Urban Poor:** Review and analysis of the energy needs of the urban poor for household purposes and small and medium scale enterprises (SMEs).

3. **Energy Sector Reform:** Analysing the legal and regulatory framework for promoting and ensuring reform.

4. **Special Studies of Strategic Significance for the Energy Sector Development in Eastern and Southern Africa (ESA):** New and emerging issues and trends on energy, energy investments and their implications for Africa.

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EXECUTIVE SUMMARY

This final draft report reviews the current status of rural energy initiatives vis-à-vis government's and utilities policies, programmes and institutional structures that affect the provision of modern energy services to the rural areas with particular emphasis on the small and medium scale enterprises.

The approach and methodology used in the study involved collection and analysis of primary and secondary data; case studies were also used in the analysis. In addition, field surveys, interviews with senior government and utility officials and some beneficiaries of modern rural energy services were conducted. The following are some of the major findings:

- Political commitment was lacking. Lack of disbursement of funds, ineffective administration of the Rural Electrification Fund and other lack of adherence to mechanisms for checks and balances contributed to failure of rural energy initiatives.

- Some of the rural welfare projects failed because beneficiaries did not observe simple operational procedures. In addition, lack of maintenance was cited as one of the key reasons for failure.

- Lack of appreciation and participation in the decision making process by the beneficiaries of some of the technologies led to the failure of some projects.

- The energy delivery system is ineffective. Energy planning is highly centralized with no institutional structures at local level for supervising of rural energy initiatives.

The study concluded that political commitment for delivery of modern energy systems to the rural areas is lacking and that rural energy initiatives fail because they are not implemented with vigour. Further, provision of modern energy services targeted at income-generating activities had a better rate of success than welfare focused projects. Policy on rural energy was inadequate and the absence of gender dimension in the energy policy did constrain the dissemination of rural energy technologies to the rural areas.

To minimize failure of rural energy initiatives, government could consider some of the following policy options:

a) Government and the utility should give up the responsibility of planning and implementing of rural electrification projects. An autonomous agency with sole responsibility of planning, designing and implementing rural electrification projects be created.

b) Government should also give up the promotion of renewable energy technologies based energy supply to the rural areas and consider the participation of the private sector. The government should provide incentives for commercialisation to a few carefully selected renewable energy technologies based on technical and economic viability under the current conditions prevailing in the rural areas.

c) Representatives of communities, local entrepreneurs and rural based NGOs should be involved in the planning, designing and implementation of future government led rural energy initiatives to promote the viability of energy for use in the rural areas for household, welfare and income generating activities.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ADB	African Development Bank
ADF	African Development Fund
AFREPREN	African Energy Policy Research Network
AIJ	Activities Implemented Jointly
CBR	Cost Benefit Ratio
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Lamp
CSO	Central Statistical Office
DOE	Department of Energy
ERB	Energy Regulation Board
ESCOs	Energy Service Companies
GDP	Gross Domestic Product
GIDD	Gender in Development Division
IPPs	Independent Power Producers
IRR	Internal Rate of Return
JICA	Japanese International Cooperation Agency
LPG	Liquefied Petroleum Gas
MEWD	Ministry of Energy and Water Development
MFED	Ministry of Finance and Economic Development
MW	Megawatt
MWh	Megawatt hour
NGOs	Non Governmental Organizations
NEP	National Energy Policy
NISIR	National Institute for Scientific and Industrial Research
NORAD	Norwegian Agency for Development
NPV	Net Present Value
PV	Photovoltaic
REF	Rural Electrification Fund
RETs	Renewable Energy Technologies
SADC	Southern African Development Community
SIDA	Swedish International Development Authority
SME	Small and Medium Enterprise
TDAU	Technology Development Advisory Unit
UNFCCC	United Nations Framework Convention on Climate Change
ZNOC	Zambia National Oil Company
ZRA	Zambia Revenue Authority

GLOSSARY

Biofuels	Fuels such as wood, charcoal, agricultural residues, dung, grass, leaves and so on
Biogas	Gas produced in a digester from animal waste under anaerobic conditions
Biomass	Organic wastes, natural forests, energy crops and crop residues
Briquette	A smokeless and compact fuel in the form of ball made from coal or biomass and has comparable combustion characteristics to charcoal
Commercial energy	Electricity, kerosene, liquefied petroleum gas, coal, wind, solar, etc
Energy ladder	Refers to a variety of energy carriers. Each rung on the ladder corresponds to a dominant fuel used by a particular income group
Household	Refers to the number of people living together in a home i.e. husband, wife, children and dependants.
Mbaula	Traditional charcoal stove
Modern energy	Electricity, kerosene, liquefied petroleum gas, coal, wind, solar, etc
Per-urban	Refers to areas outside the perimeter of the city or town
Poverty	A situation when individuals or households are not able to acquire specific level of consumption
Rural area	Country side areas that are far from urban centres
Rural electrification	Extension of national electricity grid to countryside areas that are not yet electrified
Traditional fuels	Fuels such as wood, charcoal, agricultural residues, dung, leaves and other biomass
Welfare projects	Projects targeted at community facilities such as schools and health centres where profit is not the motive

1.0 INTRODUCTION

1.1 Rationale and Motivation

Zambia is situated in central Africa with a land area of 750,000 square kilometres. It shares its borders with Angola, Botswana, Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania and Zimbabwe. In 1998, the country's population was estimated at 10.1 million with an estimated population growth rate of 3.1 per cent per annum. The urban and rural populations were estimated at 38.8 and 61.2 per cent respectively. The average population growth rates for urban and rural areas between 1969 and 1999 were 4.5 and 2.1 per cent respectively (CSO, 1999). Although these statistics show that urban population growth rate is higher than that of rural inhabitants, rural areas will continue to be a home for the majority of the Zambian people. Zambia faces an urgent need to provide adequate modern energy services to rural people.

Zambia is currently encountering a number of socio-economic problems such as rapid population growth, increasing poverty and high unemployment levels. The economic performance has been declining. The Zambian economy grew rapidly in 1960s and 1970s, primarily on the strength of booming copper prices. However, the international prices of copper fell sharply in 1974, weakening the economy. The decline in economic performance is illustrated in the Table 1.1 below:

Table 1.1: Zambia's Economic Indicators

Year	GDP US$ Billion	GDP/Capita	GDP Growth Rate	Exports US$ Million	Imports US$ Million	Population ('000)
1998	2.8	279	-1.97	670	700	10,036
1997	2.9	298	3.34	771	587	9,712
1996	3.3	351	6.54	1044	837	9,397

Source: Profit, 1998

The decline in economic performance has resulted in a shrinking formal sector. Formal employment reduced from 485,000 in 1995 to 465,000 in 1998 resulting in increased poverty (Profit, 1998). Poverty refers to the proportion of some population whose income or consumption expenditure falls below a specified level. Poverty in Zambia is defined as a "situation when individuals or households are not able to acquire a specific level of consumption." Levels of consumption often used are those covering both food and other basic needs such as a given quality of housing, water supply, sanitation, clothing and so on (CSO, 1996). In 1999, the government drafted a National Poverty Reduction Action Plan which provided strategies to priority development areas which would help reduce poverty levels from 72.9 percent to 50 percent during the period of 2000 to 2004 (Economic Report, 1999).

Previous studies indicate that energy and poverty are related. This is so given the fact that energy is central to the satisfaction of basic nutrition and health needs and that energy services constitute a sizeable share of total household expenditure in Zambia.

The decline in the performance of the economy has resulted in less disposable incomes for the majority of the rural people as shown in Table 1.2.

Table 1.2: Average Rural Household Income

Year	Per Capita (US$)	Per Household/Annum (US$)
1990	692.90	4,157.10
1991	450.00	2,699.80
1992	251.10	1,506.50
1993	140.10	840.40
1994	139.00	833.80
1995	139.40	836.60
1996	119.70	718.20
1997	147.70	886.20
1998	128.40	770.30

A major problem in Zambia is lack of equity. The imbalance in the provision of services between rural and urban areas is quite vivid. Development is biased towards the urban areas. Rural development has not been well understood and receives little political support. The link between energy and population is not taken into account when development plans are being formulated. The link is even less apparent when dealing with rural development. Although energy is not the only relevant factor for rural development, it is one of the prerequisites for improving rural productivity and enhancing the standard of the living of the rural people. According to European Commission and UNDP (1999), sustainable development is made up of three equally important factors; economic development, social development and protection of the environment. It is also worthy to note that development is a complex process with many of its components interwoven.

Observations across countries reveal that low-income households tend to rely on a significantly different set of energy carriers than the rich. People living in poverty primarily depend on wood, dung and other biomass for their energy services, and tend to use less electricity and liquefied petroleum gas (LPG) than do those that are better off (Reddy et al, 1997). Households use fuel for a variety of purposes including cooking, water heating, lighting and space heating. Firewood, dung, charcoal, coal, kerosene, electricity and LPG can be used for cooking; and kerosene and electricity for lighting. Together these energy carriers form what is commonly referred to as an “energy ladder”. Each rung of the ladder corresponds to the dominant fuel used by a particular income group, and different income groups use different rungs of the energy ladder.

Table 1.3: Energy Expenditure as a Percentage of Income

Income Group	Energy Form	Cost (US$)	Energy Percentage of Household Income (%)
Low Income between US$13 - 62	Woodfuel, Kerosene	1.00	2.70
Medium Income between US$62 - 248	Woodfuel , Candles Kerosene	2.52	1.60
	Kerosene, Charcoal, Candles	9.29	6.00
	Charcoal, Kerosene	7.80	5.00
High Income Above US$248	Electricity	12.40	5.00
	Electricity	52.50	21.20
	Charcoal Candles Kerosene	9.99	4.00

According to the Department of Energy (DOE), although Zambia has abundant energy resources and currently maintains an excess capacity in its electricity generating system, only 20 % of its population has access to electricity. The problem in Zambia is not shortage of energy but the inability to take energy resources to the areas of demand. Zambia's efforts to electrify rural areas have been hampered by huge costs of extending the electricity grid. Access to other commercial fuels is very low due to high costs of fuels exacerbated by high delivery costs from the refinery to the rural areas. In 1994, the Zambian government through, its broad based National Energy Policy (NEP), introduced a Rural Electrification Fund (REF) to supplement disbursement for rural electrification projects through grid extension. Between 1994 and 1998 about 13 rural electrification projects were financed, constructed and commissioned. These projects did not cover major parts of the rural areas of Zambia.

Biomass is the dominant energy resource in the rural areas accounting for about 72 % of total primary energy supply. The National Energy Policy provides measures on rural electrification by extending the national grid where feasible. The National Energy Policy also gives policy measures on provision of Renewable Energy Technologies (RETs), although it does not provide explicit guidelines on how they can be disseminated to the rural areas. The current energy scenario is such that rural areas have a high dependence on biomass energy for cooking and heating at household level. In addition, small and medium enterprises (SMEs) depend on biomass for their energy requirements.

Currently, biomass energy resources include organic wastes, natural forests and energy crops. In the rural areas, biomass is consumed as household energy for domestic cooking and provision of heat. Woodfuel is consumed in the form of firewood in rural areas while in urban areas it is consumed in form of charcoal. Latest statistics indicate that 95 and 5 % of firewood is consumed in rural and urban areas respectively (DOE, 1998). Charcoal consumption for rural and urban areas are 15 and 85 % respectively. Other important end-uses of biomass energy in the rural areas include income generating activities such as agro-related industries like grain milling, pottery, beer brewing, bakery, blacksmiths and so on. In rural areas, women and children face a number of health problems which are responsible for eye and respiratory problems. These problems are a result of smoke resulting from indoor air pollution due to the dependence on biofuels.

Although the use biomass has been linked to deforestation, the link between household energy consumption and deforestation is no longer as clear as originally assumed. According to Karekezi (XXXX), institutional biomass energy consumption, charcoal production, agricultural activities, construction and commercial wood for export are major causes of deforestation. The current consensus is that rural biomass is not a major contributor to deforestation. This situation is somewhat different in urban areas where large parts of land have been left bare due to harvesting of trees for charcoal production. Deforestation leads to soil degradation resulting in low agricultural productivity. In Zambia deforestation is largely caused by clearing land for agriculture and commercial logging. These two activities are major contributors to the problem. The deforestation rate in Zambia is very high with estimates ranging between 300,000–900,000 hectares per annum (ZFAP, 1996)

Another problem associated with the use of biomass is low efficiency compared to modern energy forms such as gas, electricity and liquid fuels.

Although biomass is used in its traditional and unprocessed form, there are attractive opportunities for using biomass energy in more modern, efficient and environmentally friendly ways. Biomass energy can be used to generate high quality electricity for use in rural industries and surrounding villages. Large-scale biomass applications include co-generation, ethanol production, large-scale briquetting, direct combustion for process heat and gasification. Biomass gasification is a technology that transforms solid biomass into gas for use in advanced conversion technologies. Of particular interest is the use of biomass energy to generate electricity from bagasse in sugar cane processing factories using saw dust and bark in wood industries.

Other rural energy options that are promising are Renewable Energy Technologies (RETs). These include solar energy, wind, biogas and small hydropower generation. These technologies have not experienced an impressive rate of dissemination despite their advantages over conventional sources of energy. The dissemination has been hampered by the lack of the following:

- Institutional development.
- Skilled human resources development and retention.
- Organizational, management and maintenance skills.
- Suitable financing.

Solar energy in Zambia has wide applications. The majority of solar systems are photovoltaic that have found wider applications in rural areas. Applications for solar systems in rural areas include lighting and refrigeration of vaccines in rural health centres. Other applications of photovoltaic systems include providing power for lighting and entertainment (music) in bars/taverns, water pumping for irrigation of vegetable gardens, power supply for petrol stations and battery charging stations. Solar thermal systems are used in hot water systems for tourist lodges in remote areas of Zambia. This application could be well extended to many households, boarding schools and rural health centres that can afford a solar water geyser. There are also great opportunities for other applications such as crop drying and cooking.

Very little has been done in the area of wind energy development. Studies conducted in the past reveal that the average wind speeds in Zambia range between 2.0–3.5 m/s. As a result wind power was only confined to water pumping. With recent developments in wind technology, there are great opportunities for exploiting this important energy resource.

Biogas has great potential especially in areas with high livestock population. The National Institute for Industrial and Scientific Research (NISIR) has contributed immensely to the dissemination of biogas technology in Zambia by setting up demonstration biogas plants in various parts of the country. Biogas can be used for applications in small and medium enterprises such as brewing of beer and traditional beverages, space heating for brooding of chicks and piglets, small bakeries, firing of pottery products and water heating for utensils used in milk processing.

The development of small hydropower schemes has been constrained by lack of financial resources. Government has provided incentives for development of hydro schemes by Independent Power Producers (IPPs). It is expected that IPPs will play a significant role in future development of small hydro power plants. Another possible option for development of these energy sources mighty come through financing mechanisms under the United Nations Framework Convention on Climate Change (UNFCCC) such as the Activities Implemented Jointly (AIJ) and the Kyoto Protocol particularly the Clean Development Mechanism (CDM). These financing mechanisms are used to finance projects which aim at reducing greenhouse gas emissions. It is important for the Zambian government to be careful in negotiating CDM projects in order to ensure that the acquisition of new technology is comprehensive and includes the development of capacities within Zambia to operate and maintain new equipment.

One of the factors attributed to lack of development in the rural areas is the absence of modern energy services. While energy is vital for development, the role of energy is not always clearly spelt out. The situation in Zambia necessitates development of a strategy that would make alternative sources of energy accessible to rural areas.

Conventional fuels, despite being expensive, are important in rural energy supply. Diesel is used in small agro-industries such as grain milling, cultivation and harvesting of crops using tractors and combine harvesters and rural transport.

The Theme Group is addressing issues in Renewable and Energy for Rural Development in Eastern and Southern Africa. The Theme Group comprises seven principal researchers from Botswana, Eritrea, Ethiopia, South Africa, Zambia (2) and Zimbabwe. Although energy issues and concerns may be specific from country to country in the region, experience has shown that the approach to manage these problems is similar. The approach to be adopted in the country studies is that each principal researcher will address problems in rural areas of his/her country within a common broad framework of issues and concerns in conformity with the AFREPREN Regional Proposal on Renewables and Energy for Rural Development. A crucial element to bear in mind is that these country studies will have vital links that will help to draw commonalities in the region. The links between the Zambian study and other country studies in the Theme Group are summarized in the Table 1.4.

Table 1.4: Links Between Zambian Study and Other Studies in the Theme Group

Country	Issues
Botswana	• Examine energy supply to the rural poor with emphasis on small and medium enterprises • Review of existing rural energy policies • Review rural income generating activities and technologies • Barriers to the use of RETs
Eritrea	• Assess present and future rural energy needs • Identify and evaluate range of energy resources available • Explore ways of ensuring equitable access to energy for rural communities • Suggest affordable RETs and assess their suitability • Identification of best end-user oriented local practices of RETs • Provide a basis for development of energy policies and programmes • Stimulate the spread of small and medium enterprises
Ethiopia	• Study barriers on introduction and dissemination of RETs in rural areas • Suggest energy policy for rural development • Capacity building in disseminating and managing RETs
South Africa	• Investigate current households, small and medium enterprises energy consumption • Process of energy delivery to rural households focusing on modern technology • Assess current aggressive commercial approach adopted by service providers in delivery of solar home systems to rural communities
Zambia	• Review of existing energy policy vis-à-vis rural energy provision • Review energy institutional framework • Suggest ways and means of removing barriers to dissemination of RETs • Suggest RETs as an alternative and a viable solution to energy needs for households, small and medium enterprises
Zimbabwe	• Assess rural household and community energy practices and technologies • Impact of rural energy policies and evolving National Biomass Energy Strategy • Review rural income generating activities and technologies used • Removal of barriers

Source: AFREPREN, 1999

The issues that have been studied in this short-term study are:

- *Analysis of the impact of government's utility's policy and programmes on the provision of modern rural energy services for household and income generating activities.*

Zambia's National Energy Policy was adopted in 1994 by government. A programme of action was developed after adoption of the policy to translate the policy into activities that would achieve policy objectives. A Rural Electrification Fund was established to augment financing of rural electrification projects. Rural electrification as defined in NEP refers to provision of electricity to the productive and social institutions in rural areas through the extension of the national grid where economically viable. Despite such a well-elaborated energy policy, implementation has not been successful in so far as provision of modern energy services to the rural areas is concerned.

- *Impact of government and utilities' institutional framework on the provision of modern energy to rural areas for domestic use and for income generating activities.*

The overall coordination of the energy sector lies in the Ministry of Energy and Water Development (MEWD). Other key institutions include the Department of Energy (DOE) which falls directly under MEWD. The Department of Energy has the responsibilities of planning, policy formulation, dissemination and implementation of various energy programmes. The energy institutional structure is centralised and there is no institution at local level to supervise implementation of energy projects.

The study will in the medium-term address the following:

- *Analysis of existing decentralized private sector energy production and distribution activities in rural areas.*

The Ministry of Energy and Water Development has no institutional framework at local level for supervising and implementation of energy programmes. The study will analyse this aspect drawing inference from experiences of private sector energy production and distribution such as petroleum products and dealers of generating sets.

Comparative analyses of demand for modern energy in rural areas (actually existing and future potential) created by income generation activities and domestic use will be done. The majority of small and medium enterprises depend on biomass energy for their energy requirements. There is no study that has been undertaken in Zambia to determine energy use and demand by small and medium enterprises in rural areas. The study will estimate energy requirements for each particular activity in order to determine the type of renewable technology that would suit the required applications.

Analysis of components for promoting the production and deployment of RETs by private entrepreneurs in the rural areas e.g. market research, financing mechanism, provision of infrastructure for production, repair and maintenance, training and technical back-up.

The study will examine various factors that are vital for promotion of production and deployment of RETs by private entrepreneurs to ensure success in taking modern energy services to the rural areas.

1.2 Brief Review of International and Regional Literature on Rural Energy

The current energy scenario is such that rural areas have a high dependence on biomass energy for cooking and space heating at household level. Energy requirements for the majority of small and medium enterprises (SMEs) also depend on the use of biomass. According to the latest statistics on energy consumption in Zambia during the year 1998, wood fuel was the principal energy source accounting for about 72 % of total primary energy supply. Woodfuel is the dominant household fuel and the nation's largest source of energy (DOE, 1998).

Zambia is one of the poorest countries in Africa. The high dependence of the country on biomass for its energy requirements constitutes one indicator of poverty. According to Doraswami (1996), poverty levels of a nation can be measured by using its per capita consumption of commercial energy or its final energy consumption from (non commercial) biomass fuels such as agricultural residues, wood and animal dung. Doraswami gives an example of Bangladesh where in 1996, biomass fuels accounted for about 73 % of its final energy consumption and at the same time its per capita consumption of commercial energy was about 2,400MJ.

1.2.1 Energy Uses in Rural Households

Most rural areas in Zambia lack basic infrastructure. The majority of the people are extremely poor and cannot afford the cost of modern energy services. Affordability is the main concern when choosing energy sources. As a result, they mainly use low-cost energy sources which are lower on the energy ladder. Essentially poverty determines their choice of household energy sources.

Rural household energy needs are essentially for cooking, lighting, space and water heating. These energy needs are principally met by biomass resources. Biomass energy resources may be classified into three categories: organic wastes, natural forests and energy crops. Organic wastes comprise animal and agricultural waste. Rural household energy sources are inexpensive but have an adverse impact on human health and the environment. Women and children spend considerable amount of time gathering firewood and they are the most affected by the indoor air pollution resulting from the use of biomass for cooking. The use of commercial fuels is limited as shown in Table 1.5.

Table 1.5: Fuels Used for Cooking by Households

Fuels Used for Cooking	Percentage Households	
	Rural	Urban
Electricity	4.12	17.99
Kerosene/gas	2.40	3.45
Wood fuel/coal	92.19	78.35
Other	1.29	0.21
TOTAL	**100.00**	**100.00**

Source: DOE, 1998

Common energy devices for cooking, water and space heating in households are the traditional charcoal stove, commonly known as the mbaula, and the open firewood stove (three stone cooking stove). In some households with higher incomes, kerosene stoves are used for cooking meals quickly when there is insufficient time. Lighting needs are generally met by using wick lamps, candles and fires in the house. Few households use candles and kerosene lamps.

1.2.2 Energy Use in Rural Welfare Projects

Welfare focused energy projects involve provision of energy technologies to social institutions that are non-income generating activities. The energy technologies disseminated are those that provide light and power for water pumping. Such projects include large village communities, schools, hospitals and clinics. The government mainly provides electricity to areas close to the grid and solar photovoltaic to places far from the grid. The National Institute for Scientific and Industrial Research has disseminated biogas units to rural areas as demonstration units in villages and in schools for cooking and producing methane gas for use in science experiments in the laboratory respectively. The former National Energy Council also disseminated biogas demonstration units in the rural areas mainly for use by households.

The donor community has also contributed immensely to provision of energy technologies for welfare use. For example the European Union has provided the Zambian government with a number of solar photovoltaic systems for use in rural health centres for lighting and vaccine refrigeration.

1.2.3 Energy Uses in Rural SMEs and Relevance to Zambia

The majority of the small and medium enterprises in Zambia depend on biomass for their energy requirements. Firewood is a major source of energy in enterprises that require heat for various applications. Charcoal is used in applications where smoke is avoided such as space heating for brooding of chicks and piglets. Diesel is used in machinery for mechanized agriculture, transport and agro-processing activities such as hammer mill operation. Other activities that use diesel include saw milling and water pumping (diesel pump sets). Solar photovoltaics are confined to entertainment (bars/taverns) while solar thermal is popular for water heating in guest houses and tourist lodges.

Agricultural activities seem to dominate the small and medium enterprises in rural areas. According to CSO (1996) about 90 % of rural persons were agricultural households engaged in income generating activities. This situation is similar to what is obtaining in Zimbabwe where not only are almost all rural households engaged in agriculture but a large majority (70%) also sell agricultural produce (ZERO, 1991).

According to personal interviews conducted with officials at NISIR, energy requirements for the majority of small and medium enterprises depend on firewood as shown in Table 1.6

Table 1.6: Type of Energy Used in Small and Medium Enterprises

Activity	Type of Energy Used
Small scale vegetable irrigation, hand water pumps, carpentry	Manual
Drying of groundnuts, oil seeds, cassava, tea, coffee, paprika, timber	Natural sunshine
Fish drying	Natural sunshine, firewood
Boiling of oil seeds for production of cooking oil, rural restaurants, boiling water for cleaning dairy utensils, brewing of traditional beer and beverages, bakeries, Calcining of gypsum for chalk production,	Firewood
Brooding of chicks/piglets	Charcoal
Bars/taverns	Solar PVs, dry cells
Production of burnt clay bricks, firing of pottery products	Firewood and coal
Refrigeration of drinks	Kerosene
Machinery for mechanized agriculture, transport, hammer-mill operation, saw milling, water pumping (pump sets)	Diesel
Water pumping (for vegetable growing)	Solar PVs
Water heating (guest houses, hotels and lodges)	Solar thermal and firewood

Source: Personal interviews with NISIR officials

Research undertaken by Karekezi (1992) reveals that numerous options for generation and distribution of energy for rural areas have been developed and tested in a number of developing countries in the past 20 years. He further highlights the following as available options:

- Diesel-powered machinery for mechanized agriculture, transport, agro processing and the generation of electricity.
- Fuel/wood fired cook stoves, kilns and baking ovens.
- Micro-hydro plants for electricity generation and shaft power.
- Biogas units for cooking and lighting.
- Wind power equipment for water pumping and electricity systems.
- Direct solar energy devices for water heating and crop drying.
- Photovoltaic equipment for lighting, refrigeration and communication.
- Grid electricity for lighting and for providing power to rural agro-processing and manufacturing units.

These options are used as energy sources for households, small and medium rural enterprises in Zambia. It is difficult to establish how important small and medium scale industries are to the Zambian economy. The majority of these industries operate on the informal sector basis and their activities are rarely captured in the national statistics. In Zimbabwe, Hehnsing's (1991) research work on small-scale rural industries provides similar observations. He explains that one reasons for not establishing the importance of the rural industries is the lack of systematic data. He adds that small-scale rural industries escape national accounts and employment statistics. Because of the aforementioned reasons, it is difficult to obtain published data on energy consumption in the rural industries of Zambia. However, annual turnover of small and medium scale industries is one of the indicators showing the levels of activities as shown in Table 1.7.

Table 1.7: Annual Turnover and Number of People Employed in SMEs

Activity	No. of People Employed	Income per Annum US$
Bakery	2-4	20,000
Bar/Tavern	2-6	4,300
Guest/Rest Houses	4-6	28,800
Fish trading	1*	13,500
Hammer mill	3-4	10,000
Poultry	2-4	4,500
Weaving (baskets, hats)	1*	3,800

Source: Surveys

*NOTE: * - one person owns the business this is a common feature but there cases where more than one person is employed.*

A comparison of the Zambian experience with other countries within the Theme Group shows that the situation is similar to that obtaining in Ethiopia where small scale enterprises depend to a large extent on biomass energy for their energy requirements (Wolde-Ghiorgis, 2001). In the case of Eritrea, rural enterprises also depend heavily on biomass for their energy requirements (Habtetsion, 2001)

1.2.4 Rural Energy Policies Regarding Energy Provision to SMEs In Zambia

The National Energy Policy is a broad based document that guides government on the implementation of the energy programmes in Zambia. The energy policy does not sharply focus on rural areas, for example no targets are set for rural electrification. Some of the policy measures that have been prescribed have not been implemented due to lack of human and financial resources required for the various programmes. This situation is similar to Eritrea where there is a general government policy pertaining to power, oil and renewable sub-sectors but not very specific to the rural areas (Habtetsion, 2001). Ethiopia is another country that faces inadequate energy policy guidelines in terms of rural energy implementation. The energy policy favours the harnessing of renewable energy technologies but it does not provide details of implementation (Wolde-Ghiorgis, 2001)

Conventional Energy Technologies

Grid Electricity

Electricity is the second most important indigenous source after woodfuel. About a quarter of available hydro potential has been developed. Despite the availability of installed excess power, only 20 % of the population has access to electricity. The policies related to grid electricity relevant to rural areas are:

i) Promotion of electrification of productive areas and social institutions (schools, clinics) by extending the national grid where economically feasible.

ii) Improving accessibility to electricity by encouraging the adoption of low cost methods of power distribution and reducing the capital contribution charged to customers before installation of power.

Arising from these policy issues, a programme of action was worked out and the Rural Electrification Fund (REF) created to augment funding of rural electrification projects.

Diesel/Petrol Generating Sets

There are no policies regarding diesel/petrol generating sets. Moreover, the policy document states that there should be a complete divestment of government in the refinery and distribution of petroleum products.

Renewable Energy Technologies

According to NEP (1994), efforts to disseminate renewable energy technologies on a wider scale have been hampered by the following:

- Lack of awareness about renewable energy technology.
- High initial costs.
- Inadequate adaptive research on renewable energy to suit Zambia conditions.
- Lack of end-user acceptability.
- Inadequate demonstration projects.
- Lack of specialised training.

The National Energy Policy describes several policy measures that have been put in place to address barriers. The measures that are relevant are as follows:

- Organising energy fairs, practical demonstration and pilot schemes.

  This will ensure that many people are made aware of the existence of the various renewable technologies.

- Offer of guarantees to banks willing to lend to income generating RETs projects.

  This measure is aimed at addressing the initial high costs of the technologies. The government will provide guarantee to any bank that lends money for purchase of renewable technologies. This will help entrepreneurs address the high costs.

- Research, development in renewable technologies, systems and components adaptation and/or manufacture.

  NISIR has done a lot of research on biogas technology. Activities undertaken include experimental studies to develop appropriate designs of biogas systems such as lanterns and stoves for lighting and cooking. These designs are used in biogas digesters being disseminated. NISIR produces biogas system components in their workshop that are used in their dissemination activities.

- Provision of fiscal incentives for renewable technologies.

  The Ministry of Energy and Water Development has succeeded in persuading the Ministry of Finance and Economic Development to remove duty on solar panels. In addition, the Energy Regulation Board (ERB) has removed license fees that had been imposed on solar dealers. This will result in reduction of prices. This has been done with a view to encourage the use of solar technology.

- Incorporating the use of renewable technologies where feasible in government projects in rural and peri-urban areas.

  Several solar energy projects for health centres, schools and water pumping for communities have been financed by the Ministry of Energy and Water Development as a way of promoting wider applications of RETs.

- Training in development and application of renewable technologies.

  NISIR has played a major role in training artisans in the production of improved cookstoves. In addition, they have provided training to various communities where biogas units have been installed. The University of Zambia, Physics Department has also conducted a number of courses on solar energy for its students and beneficiaries of solar energy systems acquired through ESCOs. These efforts are aimed at developing skills that would be required to maintain renewable energy systems and ensure their success.

Gender in Energy Policy

A major setback in the National Energy Policy is the absence of gender dimension regarding provision of modern energy services to the rural areas. The absence of gender dimension in the energy policy is a setback in planning and implementation of rural energy initiatives as there are no clear guidelines that address gender issues. Men and women have different energy needs, roles and priorities. Traditionally, women are responsible for energy needs of the household. Energy can contribute to widening opportunities and empowering people to exercise choices. Conversely, its absence can constrain both men and women from contributing to economic growth and overall development.

In Zambia females constitute 51% of total population, and the majority of them live in rural areas. According to CSO (1996), out of the total number of males and females living in rural areas 85 and 92 % respectively were engaged in agriculture, forestry and fishing. These statistics show that a larger proportion of women are engaged in a number of activities for their survival. Many income activities of women in the informal sector are fuel intensive and the viability of these activities is affected by energy availability and prices. Examples include food processing industries, kilns/oven for baking bread, fish smoking, pottery making, soap making and beer brewing.

Energy's relationship to women's work and well being in particular is evident in women's role as:

- Users of energy resources (both traditional biomass and modern fuels) for household, subsistence and income generation activities.

- Producers of traditional biomass fuels and providers of 'human energy' services.

- Those most vulnerable to energy scarcity, environmental damages from energy production and use, and adverse impacts of technological changes in the energy sector.

- Educators concerning collection, management and use of fuels and activists in energy and environmental debates and action (Reddy et al, 1997).

Similar studies conducted in Ethiopia, Eritrea and Zimbabwe show no evidence of gender being considered as an important factor in the dissemination of modern energy services to the rural areas.

1.2.5 Review of Energy Use in Small and Medium Scale Rural Enterprises in Zambia

Energy is a critical input in any activity of economic development. Thus development of a society inevitably raises issues related to energy consumption in which problems of availability and convenience of energy resources are of vital importance.

Over 80 % of the population of SADC region live in rural areas where agriculture and small-scale industries are the main economic activities. Most of these small-scale industries are informal and depend on biomass fuels as their major source of energy, in many cases lacking viable alternatives (Yolanda et al, 1995). This situation is similar to the one in Bangladesh where Doraswami (1996) notes that the entire electric power generation and distribution network is close to its capacity limits. He further notes that it is difficult to contemplate any significant increase in rural electrification given the financial constraints.

1.3 Energy Technology Options for Rural SMEs in Zambia

1.3.1 Conventional Energy Technologies

Available conventional energy options for small and medium enterprises are:

- Extension of national grid where feasible.
- Diesel power plants for electricity generation.
- Coal.
- Small generating sets for small and medium business enterprise applications.
- Diesel for hammer mill operations.

Currently, there is 6.4MW of diesel power plants for supply of electricity to rural centres. These power plants are owned and operated by ZESCO, the national electricity utility. Total installed capacity for micro and mini hydro power plants is 23.75MW. Some of the SMEs in the rural areas are supplied by these power plants.

There are sufficient coal resources that can be utilized in various industries that are far from the electricity supply grid. Coal can be used for applications such as drying of timber, process heat for bakeries and brewery industries.

According to dealers of power generating sets, demand of their products is on the increase. These generating sets are used for various applications such as power supply to taverns/bars for lighting and musical instruments, welding, water pumping and saw milling. Diesel is also used in hammer mill operations.

1.3.2 Renewable Energy Technologies

Renewable energy has very wide potential in Zambia. Research undertaken by Sampa and Sichone (1996) reveals that dissemination of renewable energy technologies has been hampered by lack of attention given by those in authority compared to conventional energy resources such as fossil fuels. They add that high initial capital investment is another barrier associated with renewable energy technologies. Some of renewable energy technologies that can be exploited to full potential include:

- Solar photovoltaics (PVs) and thermal
- Wind
- Biogas
- Biomass
- Micro and mini hydropower plants

a) <u>Solar PV and Thermal</u>

Zambia enjoys maximum exposure to the sun with maximum temperature of up to 36^0C and minimum temperature between 7 and 10 ºC during hot and wet and cool and dry seasons respectively. Sunshine hours vary between 2,600-3,000 per year. This is translated to 4kWh/m^2 per day.

The majority of solar systems are photovoltaic and have found wider applications in rural areas. Applications for solar systems in SMEs include photovoltaic systems for lighting and entertainment (music) in bars/taverns, water pumping, for irrigation of vegetable gardens, power supply to petrol stations and battery charging stations. Solar thermal systems are used in hot water systems for tourist lodges in the remote areas of Zambia (CEEEZ, 1997).

b) Wind

According to Sampa and Sichone (1996), in 1978 a feasibility study was conducted on the use of wind energy and this study revealed that the average wind speed in Zambia ranges between 2.0 m/s and 3.5 m/s. The study concluded that these speeds could only be suitable for water pumping systems. In contrast to this, there are now new wind systems that have been developed but operate on speeds of 3 m/s and have power output in the range 20-30kW (REW, 2000). With this latest technology, wind systems have great potential in Zambia for supply of power to various SMEs. In many cases it may be worthwhile to consider hybrid systems; a combination of wind, diesel and solar PV systems to ensure constant power supply during instances when wind speeds are low.

c) Biogas

Biogas has great potential in Zambia especially in areas where there is a high population of livestock. NISIR has contributed immensely to the dissemination of biogas technology in Zambia by setting up demonstration biogas plants in various parts of the country. Between 1980 and 1999, NISIR installed 18 biogas plants in various rural areas. NISIR has made local designs of the floating dome digester, gas stoves and lanterns. The potential for biogas production in Zambia is high in areas such as Southern and Western provinces of Zambia with high concentration of livestock. According to Agricultural Statistics Bulletin (MAFF, 1995/6), population of cattle stood at a total of 1.3 million in both Southern and Western Provinces. Biogas can be used for applications in SMEs such as brewing of beer and traditional beverages, space heating for brooding of chicks and piglets, small bakeries, firing of pottery products and water heating for utensils used in milk processing.

d) Biomass

Woodfuel will continue to be a dominant energy resource for a long time to come. An issue that raises concern is the low efficiency in both the production and utilisation of charcoal and utilisation of firewood. Charcoal is used in providing space heat in poultry and piggery. Firewood is a major energy source in a variety of applications for SMEs.

e) Micro and Mini Hydro Power Plants

Total installed mini and micro hydropower plants is 23.75 MW (DOE, 1998). Sampa and Sichone's (1996) research work on mini and micro hydropower in Zambia estimates the potential of mini and micro hydro to be about 45 MW. Development of mini and micro hydropower schemes has been inhibited by lack of financial resources by government and the national utility. Government has provided attractive incentives for development of hydropower schemes by Independent Power Producers (IPPs). It is expected that IPPs will play a major role in future development of mini and micro hydro power plants. Another possible option for development of these resources might come through Activities Implemented Jointly (AIJ) and the Clean Development Mechanism (CDM) which aim at reducing greenhouse gas emissions.

2.0 APPROACH AND METHODOLOGY

A major factor studied was the effectiveness of the modern energy delivery systems to the rural areas vis-à-vis the institutional structure. In this respect, a critical analysis of current energy institutional structure was done to identify institutional bottlenecks. In the analysis, factors looked at included;

- Effectiveness of energy institutions.
- Adequacy of the energy policy in so far as rural areas are concerned.
- Energy institutions.
- Manpower (staffing levels).
- Budgetary allocation.
- Influence of energy institutions on other key government institutions that are related to activities of the Ministry of Energy and Water Development.

After this analysis, the study proposed recommendations on how rural energy infrastructure could develop.

2.1 Hypothesis I: Rural Energy Initiatives by Government and Utility

Rural energy initiatives by governments and utilities have failed/are failing, because they were/are (i) not backed by full political commitment, and /or (ii) not implemented with vigour, and/or (iii) welfare focused, and/or (iv) uneconomic, and/or (v) not targeted at income generating activities.

Associated research Issue: Impact of government and utilities' institutional framework on the provision of modern energy to rural areas for domestic use and for income generating activities

The growth of modern energy services in the rural areas has been outstripped by population growth rate. Current statistics show that 80 % of the population has no access to electricity. Previous rural energy studies have identified a range of barriers to the successful implementation of rural energy initiatives, these include:

- Lack of appropriate institutional framework.
- Lack of explicit policy on rural energy.
- Lack of adequate financing and micro credit facilities.
- Inequitable explicit and implicit subsidies that favour centralized and conventional energy systems that serve the urban areas.
- Lack of private sector involvement.
- Lack of skills for operation and maintenance of rural energy systems.

This hypothesis addresses several of the aforementioned barriers with emphasis on the following:

- Lack of a clear policy on rural energy.
- Non-involvement of the private sector.

Methodology

This hypothesis can be sub-divided into the following three sub-hypotheses:

- Rural energy initiatives by Governments and utilities have failed/are failing, because they are/were (i) not backed by full political commitment; and (ii) not implemented with vigour.

- Rural energy initiatives by Governments and utilities have failed/are failing, because they are welfare focused, and /or not targeted at income generating activities.

- Rural energy initiatives by Governments and utilities have failed/are failing, because they are/were uneconomic.

Hypothesis 1(a)

Rural energy initiatives by Governments and utilities have failed/are failing, because they are/were (i) not backed by full political commitment; and (ii) not implemented with vigour

Associated research Issue: Impact of government and utilities' institutional framework on the provision of modern energy to rural areas for domestic use and for income generating activities.

Political commitment and vigour are difficult parameters to measure. In this hypothesis, it has been assumed that political commitment and vigour would be demonstrated by the way rural energy projects are implemented.

A qualitative analysis was used in this study to examine policy statements and documents to establish the level of priority given to rural energy initiatives. Policy documents were analysed to establish whether they were followed by a definitive plan of action, adequate budget allocation and disbursement of funds. If policy statements on rural energy were actually followed by a plan of action, budget allocation, funds disbursement and implementation activities, it would indicate significant political commitment.

A comparative assessment of policy statements was also done on policy statements and documents on rural energy with those covering other development issues such as education and health to demonstrate that the gender dimension of rural energy receives limited policy attention. It was found that education and health policies have explicit gender specific policies.

Comparative assessments of current and past levels of expenditure on rural electrification and urban electrification provided an indication of the level of political commitment. The level of expenditure included budget allocation for the Ministry of Energy and Water Development on rural electrification approved by the National Assembly, Rural Electrification Fund and ZESCO's expenditure.

Estimate per capita expenditure on urban and rural electrification were made to establish the level of priority given to rural energy initiatives.

The assessment included the examination of the complications associated with the disbursement of the Rural Electrification Fund. The method of collection and disbursement of other government's funds like fuel levy and license fee of the Energy Regulation Board was examined and compared to REF levy.

Qualitative interviews were conducted with current and past senior Government and utility officials to obtain an insight on the level of political commitment. Further, opinions of representatives of donor agencies, energy consultants, energy experts in University and NGOs were sought to assess the level of political commitment. In addition, views of potential and existing beneficiaries were sought during the surveys.

Data and Indicators

- Budget allocation and funds disbursements.
- Number of policy documents on rural energy.
- Number of keywords (rural, energy, RETs, etc).
- To what extent is there gender explicit energy policy.

Sources of Data

- The sources of data used to test the hypothesis were Ministry of Energy and Water Development submissions to the Committee on Energy, Environment and Tourism of the National Assembly. Ministerial Statements on rural electrification delivered at the National Assembly. Public Expenditure Review Report and Annual Reports of the Department of Energy.

- Budget allocation on rural energy obtained from the Ministry of Energy and Water Development Annual reports.

- Actual expenditure on rural energy available from the Public Expenditure Review Report. Department of Energy Annual reports.

- ZESCO Master Plans and Annual Reports to obtain budgeted and actual expenditure on both rural and urban electrification.

- Newspaper, magazine and journal articles on energy.

- Interviews with current and previous senior government and utility officials, energy experts in the University, NGOs, Fund agencies, consultants and sub-contracting agencies. Information was analysed qualitatively to determine the political commitment to rural energy.

Hypothesis 1(b)

Rural energy initiatives by governments and utilities have failed/are failing because they were/are welfare focused and not targeted at income generation

Associated Research Issue: Impact of government's utilities' institutional framework on the provision of modern energy to rural areas for domestic use and for income generating activities.

Little attention has been paid to the productive functions of rural energy such as the use of rural energy in medium and large scale agro-industries. As a result, enterprise development and job creation based on rural energy have not yet fully exploited and are poorly understood. In this hypothesis, rural energy initiatives targeted at income generation would be considered to be initiatives aimed at small and medium scale enterprises whose main objective is to make profit.

This hypothesis was confined to rural energy initiatives that were implemented by government and utility. Rural programmes implemented by the private sector and NGOs were not considered in this hypothesis.

This hypothesis addressed two separate elements (welfare-focus; and not targeted at income generation). A common methodology was adopted that simultaneously addressed the two elements and this yielded good results. To determine the importance of the two elements, a comparison of successful rural energy projects with those that had failed was done.

Methodology

Qualitative interviews of current and previous senior Government and utility officials, sub-contractors, energy experts in universities, NGOs, funding agencies, consultants were conducted to obtain an insight on the level of political commitment for rural energy initiatives.

Sample surveys of beneficiaries where done at Katondwe and Mpanshya Mission hospitals and Mpanshya Primary School near Luangwa district. Other surveys included areas in Lusaka rural like Shibuyunji and Kasisi.

Qualitative interviews were done to assess the vigour with which rural energy initiatives are implemented. In addition, comparison between urban and rural electrification was done using per capita estimates of urban and rural electrification.

Indicators of the success of the initiatives would include the number of modern energy devices disseminated and the number of devices that are still functional and currently in use. Using comparative qualitative analysis an attempt has been made to determine the importance of the two elements in determining the success and failure of rural energy initiatives implemented by government and the utility.

The Zambian study examined the following technologies:

- Solar photovoltaic systems.
- National electricity gird extensions.

Data and Indicators

- Seek opinions of interviewees whether initiatives were implemented with vigour or not.
- Extent to which targets are achieved within the allocated time frame.

Sources of Data

Hypothesis 1(c)

Rural energy initiatives by governments and utilities have failed/are failing because they were/are uneconomic

- Project Assessment Reports and Project Briefs and Status Reports for National Assembly, Study Reports such as Assessment of Solar Energy Dissemination and Application in Zambia and Zambia Country Solar Paper.

- Interviews with key persons from project implementing agencies and end users were carried out to fill important data and information gaps.

Hypothesis 1(c)

Associated Research Issue: Impact of Government and utilities' institutional framework on the provision of modern energy to rural areas for domestic use and income generation activities.

A rural energy initiative can be deemed uneconomic in strict financial terms or in broader cost/benefit ratio terms. In the financial terms, the project would be consistently loss making. In cost/benefit terms, the cost would outweigh all its benefits.

Methodology

Some rural energy initiatives that had been undertaken were examined and data was collected to test the hypothesis. These case studies contained issues that were analysed to test the hypothesis.

Data and Indicators

- Number of modern energy services disseminated.
- Number of devices still in use.

Sources of Data

- Energy prices in rural areas.
- Rural Energy Project Evaluation Reports to obtain data on revenue, expenditure, cost and benefits of rural energy initiatives.
- Internal rate of return (IRR) of rural and urban energy projects.
- Cost benefit ratio (CBR) of rural and urban energy projects.

2.2 Hypothesis II: Government and Utility Institutional Structures

Government and utility's institutional framework was/is not appropriate to the design and implementation of rural energy initiatives.

Associated Research Issue: Impact of the government and utilities policies and programmes on the provision of modern energy to rural areas for domestic use and for income generating activities.

The energy sector in Zambia is governed in a centralized fashion. Energy planning is done both at the Ministry of Energy and Water Development Headquarters and the Department of Energy (DOE). The Department of Energy is also responsible for implementation and monitoring of energy projects. Sometimes the Department of Energy sub-contracts companies to implement projects. There is no institutional framework at local level to monitor energy projects and programmes after they have been commissioned.

To assess the effectiveness of the current government and utility institutional energy sector structure, comparison has been made between existing institutional structure/linkages in the rural energy sector with an institutional structure/linkage that had proved effective in other energy sub-sector like petroleum.

Comparisons on findings between Theme Group countries are made in Chapter 3 with a view to establish regional commonality and establish the most effective institutional framework for rural energy development. The criteria used to measure the effectiveness of the structure could be the extent of rural electrification and the availability of modern fuels such as kerosene and LPG.

The analysis will also demonstrate limited links between the current government and utility institutional structure with women rural organisations.

Data and Indicators

- Turnover for businesses in the rural energy sector.
- Number of units disseminated.
- Number of units still in use (consider life span).

Source of Data

- Project evaluation reports: Important reports are those that contain information aimed at institutional reform of the energy sector.

- Energy sector reports: DOE Annual Reports, MEWD Submissions to National Assembly, ZESCO Annual Reports, Public Review and Expenditure Reports and Annual Economic Reports.

- AFREPREN Publications such as Energy Utilities and Institutions in Africa.

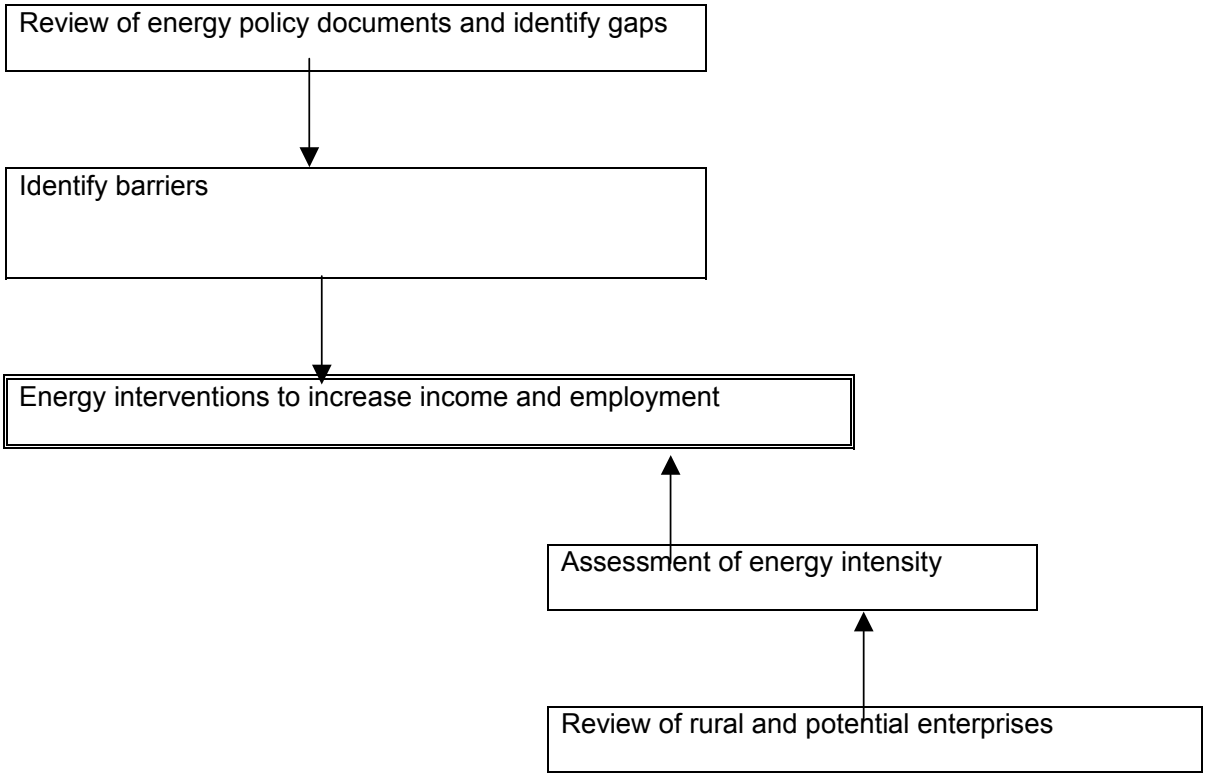
- Energy Policy Journals and Energy for Sustainable Development Journals.

- Statistics from dealers of gensets.

The methodology adopted in this study was top-bottom approach while in another parallel study, the bottom-up approach was used as shown in Figure 2.1. Field surveys and interviews were conducted to collect data required for analysis to fill gaps that had been identified in the literature review. Qualitative and quantitative methods were applied on data sets collected to analyse trends. e.g. case studies on projects that have been successful.

A stakeholder workshop was organized to present findings of the study to stakeholders for discussion and their input. In addition, an external review will be arranged in collaboration with AFREPREN Secretariat

Figure 2.1: Illustration of the Parallel Approach Methodology Used



3.0 FINDINGS AND CONCLUSIONS

3.1 Hypothesis I: Rural Energy Initiatives by Government and Utility

Hypothesis 1(a)

Rural energy initiatives by governments and utilities have failed/are failing because they were/are not backed by full political commitment

Political commitment and vigour are difficult to measure. The hypothesis assumes that political commitment and vigour would be demonstrated by prompt implementation of rural energy projects. Analysis of system of governance and policy implementation, policy statements and documents that relate to rural energy can help to establish the level of political commitment. Further, disbursements and definite plans of rural energy projects would indicate the government's level of priority.

System of Governance and Policy Implementation

Zambia's multi-party democratic system of governance is based on the doctrine of separation of powers. In this system, there are three organs of the state, which are independent of each other but act as a check on each other. These are the:

- Executive
- Legislature
- Judiciary

The Heard of Government and the Executive is the President. All government ministries and departments are part of the Executive. The ministries are responsible for policy formulation and implementation through their various departments and agencies. The Legislature is composed of the National Assembly which enacts laws, approves and supervises public expenditure. In addition the National Assembly scrutinizes government policy and activities through various Parliamentary Committees. This is a very important function that is aimed at ensuring that government policies are implemented.

The Committee on Energy, Environment and Tourism was set up by the National Assembly with the prime responsibility of scrutinizing policy and all activities being undertaken by the Ministry of Energy and Water Development and other ministries responsible for environment and tourism. The Committee's responsibility is to ensure that government policy and other activities are implemented without any hindrance. This includes all departments and agencies falling under the ministry's portfolio. The Committee makes recommendations to National Assembly on how best energy activities should be conducted.

The Ministry of Energy and Water Development is required to report its activities to the Committee on Energy, Environment and Tourism of the National Assembly. According to National Assembly (1999), the Committee held eighteen meetings during the Third Session of the Eighth National Assembly in 1999. The meetings were held to discuss outstanding issues, among other things, rural electrification. The Committee was concerned with the slow pace of electrification and directed the Permanent Secretary in the Ministry of Energy and Water Development and the Secretary to the Treasury to submit a detailed report on the following:

a) Specific dates on which the Ministry of Finance and Economic Development should release funds for the Rural Electrification Fund (REF) to the Ministry of Energy and Water Development.

b) The legal constraints that were hindering the direct release of funds for Rural Electrification from ZESCO without having to pass through many hands.

c) Progress made on the Ministry of Finance and Economic Development's attempt to retrieve the US$293,000 Rural Electrification Funds that had been locked up in the defunct Meridien Biao Bank. Some of the Rural Electrification Funds had been held up in the closed bank. This made it difficult for some of the Rural Electrification projects to be implemented.

In response to the Committee, the Permanent Secretary (MEWD) reported that:

a) It was difficult to specify the exact dates for the release of funds to the Rural Electrification Fund as this was dependent upon payment of excise duty by ZESCO. Since payments from ZESCO to the Zambia Revenue Authority (ZRA) were erratic, it was difficult for the Treasury to release funds to the Rural Electrification Fund. Currently, the Rural Electrification levy was regarded as an excise duty. The excise duty, once collected, is required by law to be channelled to government through ZRA which is responsible for, among other things, assessing and collection of all indirect and direct taxes due to government.

b) Under the current set-up, the Rural Electrification Fund money was collected as a share of the excise duty on electric energy under the Customs and Excise Act, implying that there was no other separate legislation under which the Rural Electrification Fund money could be collected. The Rural Electrification Fund had no legal backing for it to operate outside the existing government procedures and financial regulations.

c) The money was still held up since the matter was still in the hands of the liquidator and liquidation proceedings had not yet been concluded.

Although this whole process is clear demonstration that there are checks and balances within government set up to ensure that policy statements do not just end up as mere rhetoric, there is no evidence that there was a plan of action to deal with the above matters to achieve the required results.

Ministerial Policy Statement in the National Assembly

In December, 1998 during the Third Session of the Ninth National Assembly, the Minister of Energy and Water Development made a Ministerial Statement on the 1999 National Budget. In his address, the Minister informed the House about the Ministry's performance regarding the 1998 Budget Funding and National Energy and Water Policy Framework. He also gave an outline of the proposed plans for the year 1999. On Rural Electrification, the Minister bemoaned the lack of progress on electrification programmes due to lack of funds. He reiterated the Ministry's commitment to rural electrification as a means of making available electricity to the majority of the Zambian population who needed it for socio-economic development (MEWD, 1998). Despite making this Ministerial Statement which highlighted serious problems of disbursements of the rural electrification funds only US$419 was released during the year 1999.

In August, 2000 the Minister of Energy and Water Development made a Ministerial Policy Statement in the National Assembly on the status of the Rural Electrification Programme. The Statement gave an impression that high priority was given to rural electrification. However, what was obtaining on the ground was quite different as evidenced in Table 3.1.

Table 3.1: Funds Disbursed to Rural Electrification Fund

Year	Amount US$ ('000)
1994	1,410
1995	2,890
1996	Nil
1997	Nil
1998	360
1999	0.419
2000	-

Source: PERR, 2000

Committee on Government Assurances

Within the institutional structure of the National Assembly under the Standing Orders of the House, there exists a Committee on Government Assurances whose mandate is to scrutinize all assurances, promises and undertakings made by cabinet Ministers and Deputy Ministers on the floor of the House with the objective of ensuring that these are implemented. This Committee is a General Purposes Committee and as such its mandate is not confined to any specific Ministry as the issues they consider are applicable to all Ministries depending on situations and issues involved.

The Committee examines all contributions made by Cabinet Ministers and Deputy Ministers as recorded in the Daily Parliamentary Debates and extracts all statements which the Committee thinks amount to assurances. These are then referred to the Ministries concerned to find out what action was taken. Submissions from Ministries are complied in what is known as the Action Taken Report.

Upon receipt of the submissions from the Ministries and Government Departments on the assurances, the Committee then summons the respective Permanent Secretaries and Chief Executives of parastatal companies and statutory agencies to appear before the Committee and give updates on the implementation of the assurances under their respective portfolios (CGA, 2000).

Keyword Search

An additional methodology for assessing the level of political commitment was a thorough keyword search of a major newspaper the Times of Zambia. The search covered the period 1995 to 2000. This method was used to establish the number of times key Government/utility officials mention rural energy issues. In this methodology, it was assumed that the more the words "rural energy" are mentioned in speeches, the higher the political commitment.

Table 3.2: Keyword Searches for the Period 1995-2000

Word Searched	No. of Times Mentioned
Solar Energy	76
Energy	53
Rural Electrification	16
Rural Energy	0

Source: Times Newspapers, 1995-2000

From the results in Table 3.2, the words "rural energy" were not mentioned at all in a period of more than five years.

Although this approach has been criticized as an unsuitable way of assessing political commitment in some quarters, experience shows that political statements do influence implementation of energy projects. For example, in August, 2001, Kabwata suburb, a large township in the greater part of the city of Lusaka, had a by-election in which a Member of Parliament had to be elected. Top politicians in the ruling party mounted political campaigns in which promises for improving water supplies, resurfacing of the roads and provision of street lighting were made. All these facilities were provided in a period of less than two months before the by-election. These facilities were provided against the background of the usual excuses of lack of financial resources and adequate skilled human resources to implement projects.

Rural Electrification Levy

The Rural Electrification Fund is financed by a levy of 3% on all electricity bills. Current procedures regarding collection of government revenue are such that all government revenue must be remitted to the Treasury, the Ministry of Finance and Economic Development (MFED). The national utility, ZESCO, collects the levy as a share of excise duty on electricity under the Customs and Excise Act. The funds are then remitted by the utility to the ZRA which collects excise duty on behalf of government. ZRA remits the levy to the Treasury. This procedure is cumbersome and often results in delays. Experience has shown that the levy is often re-allocated to other government expenditures. This is the explanation for the non-release of funds in some years. The non-release of funds has prevented many projects from being completed on time. The Ministry of Energy and Water Development has made proposals to the Ministry of Finance for improving the administration of the REF so that ZRA remits the levy directly to MEWD. The proposals once accepted by MFED will be sent to Parliament so that a Statutory Instrument is issued to govern this new arrangement.

Bureaucratic and cumbersome procedures in collecting levies are not only confined to the rural Electrification levy. The government collects a fuel levy that is used to construct and repair roads. The fuel levy is also subjected to similar procedures as the Rural Electrification levy. A fuel levy of 15% is collected on all fuel sales. The Zambia National Oil Company (ZNOC) has the responsibility among other things of importing the petroleum feedstock and managing the bulk sales of products to registered oil marketing companies. The fuel levy is charged by ZNOC and is paid by oil marketing companies. The charge is then passed on to petroleum dealers and finally to the consumer. ZNOC remits the fuel levy to the Zambia Revenue Authority which in turn remits it to the Ministry of Finance and Economic Development. The Ministry of Finance and Economic Development disburses the levy to the National Roads Board.

There are few exceptions where government has granted autonomy to statutory institutions to collect money in form of levies and retain it for its operations. One such institution is the Energy Regulation Board (ERB). The ERB was created by an Act of Parliament as an independent body to regulate the energy sector through a license based system. This entails that all companies wishing to engage in business in the energy sector will have to meet the requirements set by the ERB in order for them to be issued with a license. The ERB raises money for its operations by charging fees for its licenses and this is paid directly to the Board. The Board is required by law to remit some of the money collected through license fees to the Ministry of Finance and Economic Development and retain part of it for its operations. Section 21 sub-section 2 of the Energy Regulation Act states that money paid as license fees will go to general revenue of government and under this section the money will be used to develop the energy sector in Zambia. The Board also receives a government grant for its operations as allocated by the National Assembly.

The Department of Energy has under its electrification portfolio funded many rural electrification projects through its rural electrification programme. The rural electrification programme is financed by government and in some cases donors assist in financing electrification projects that they think are vital to the economic development of the country. The main reason for creating the Rural Electrification Fund was to increase funding and improve the flow of funds for implementation of the rural electrification programme (DOE, 1994). Table 3.3 shows that although the Department of Energy is able to make budget provisions that would ensure that projects are completed on time, the non-release of budgeted funds from the Ministry of Finance and Economic Development frustrates the electrification programme. According to DOE (1994), the Department of Energy is made to comply with budget ceilings set by the MFED which further worsens the financial position.

Rural energy initiatives are not given high level of priority. According to PERR (2000), although the Rural Electrification Fund was established in January 1994, the first disbursement to the REF Account was only made in September 1994. Further, there were no disbursements to the REF Account in 1996 and 1997 despite ZESCO having collected and remitted to MFED a total of about US$7.72 million during 1997.

Available records show that there has been insufficient funding to the Ministry of Energy and Water Development. For example in 1993 although US$ 110,424 was authorized for the Ministry Headquarters, no money was released during the year. On the other hand the Department of Energy had an authorized budget of US$ 1.18 million, only US$ US$ 397,526 was released. This resulted in the Department of Energy financing 8 projects out of 24 that had been budgeted for. In 1994, the Ministry of Energy and Water Development requested for supplementary funding in the sum of US$ 310,726 and US$ 884,039 for the Ministry Headquarters and the Department of Energy respectively. Although the Ministry of Finance and Economic Development approved the Supplementary Funding, the amount of money released fell short of what was required to complete energy projects.

Table 3.3: Budgeted and Actual Releases of Rural Electrification Projects

Year	Budgeted (US$ '000)	Released US$ '000)
1993	985	256.00
1994	828	16.68
1995	5,345	1,736.00

Source: DOE Annual Reports; 1993; 1994, 1995

Government's Commitment to Electrification

The Zambian Government recognizes the need to increase accessibility to electricity which the country has in abundance. There are two electrification programmes namely; Rural and Township Electrification.

In an effort to increase accessibility to electricity, government plans to formulate a Rural Electrification Master Plan that will identify priorities and the least cost strategy for electrifying the whole country. The plan will be an integrated least cost blue print covering all provinces of the country. Consideration will be given to all electrification options, basic designs and economic/financial analysis (Mulenga C, 2000). The Rural Electrification Programme is targeted at government social institutions (schools and hospitals) and areas of economic activity. Where government recognizes that grid extension may not be technically and economically feasible in the rural areas, it has incorporated the use of solar energy.

ZESCO has initiated an electrification programme under the Township Electrification Project. In this ambitious programme ZESCO's target is to electrify about 20,000 households per annum. This initiative is in line with Government's plans to electrify urban households in townships that have not benefited from the use of electricity since independence. Government views township electrification as a deliberate exercise to increase accessibility of electricity to the population while ZESCO views this exercise as its commitment to increasing the customer's base. The main priorities in the power sector are to rehabilitate the existing infrastructure, attain financial viability for the national utility through commercialisation, increase accessibility to electricity by the majority of the population. Since 1995 a total of 16,100 households in the townships have been electrified as shown in Table 3.4.

Although decision makers see electrification in urban areas as a solution to energy problems, experience has shown a different picture. The majority of the urban poor whose households have been electrified use very little electricity; mainly for lighting and powering radios. The rest of their energy needs are met from kerosene, charcoal and wood. The majority of these households find it difficult to pay the electricity bill and can hardly afford electrical appliances for cooking and water heating. This situation is similar to the one obtained in South Africa where poor electrified households cover only 20-25% of their energy needs from electricity and the rest from kerosene, coal, charcoal, wood and other similar sources (Karottki, 1999)

Table 3.4: Township Electrification Since 1995

Township	Town	Number of Customers Connected	Year Commissioned	Project Cost US$ Million
Matero	Lusaka	5,000	1996	1.99
Chilenje	Lusaka	2,000	1996	1.59
Twapia	Ndola	1,300	1997	1.14
Chifubu	Ndola	5,000	1999	2.14
Buchi	Kitwe	2,000	2000	0.61
Kamitondo	Kitwe	800	2000	0.24
TOTAL		16,100		7.71

Source: ZESCO

Per Capita Expenditure on Urban and Rural Electrification

A comparison of urban and rural per-capita expenditure on electricity shows very wide disparities. Government and the utility spend huge sums of money on urban compared to rural electrification. Table 3.5 shows that urban electrification is more preferred that rural electrification.

Table 3.5: Per-Capita Expenditure on Urban and Rural Electrification

Year	Urban	Rural
1994	-	0.17
1995	-	436.00
1996	1,312.00	0.00
1997	423.00	0.00
1998	0.00	93.40
1999	1,350.00	151.00

Source: Adapted from CSO, 1999 and MEWD, 2000

A comparison of growth in customer base between urban and rural areas shows that the urban customer base grows faster than the rural base. Table 3.6 shows that between 1985 and 1996 the utility's customers' base for urban and rural areas grew by 41 and 38.5 % respectively. This further illustrates the point that provision of electricity is mainly concentrated in urban areas for medium and high income households.

Table 3.6: ZESCO's Number of Customers

Year	Urban	Rural
1995/6	132,726	53,225
1994/5	125,297	50,716
1993/4	117,048	47,700
1992/3	111,036	45,831
1991/2	113,067	46,677
1990/1	108,264	43,807
1989/0	106,084	43,661
1988/9	103,146	42,836
1987/8	100,823	42,192
1986/7	95,563	39,223
1985/6	94,174	38,425

Source: ZESCO Annual Report, 1996/7

Government and Utility Expenditure on Rural Electrification

The burden of financing rural electrification projects appears to be placed on the utility as evidenced by Table 3.7. This state of affairs has affected the financial viability of ZESCO. The financial stress is as a result of among other things non-payment of electricity bills by ZCCM (the former mining conglomerate) before its privatisation and Government ministries and departments. ZCCM had an outstanding debt to ZESCO of US$91.6 million as at 31 March 2000 and the Government owed ZESCO the sum of US$8.13 million as at 31 January 2000. Other customers owed ZESCO the sum of US$61.3 million (PERR, 2000).

Table 3.7: Expenditure on Rural Electrification Projects as at June 2000

Project	Total Project Cost US$ ('000)	Government Contribution US$ ('000)	Utility Contribution US$ ('000)
Chisamba	1,200	52	227
Gwembe	3,800	89	75
Chembe	655	52	145
Lukulu Farm Block	596	37	Nil
Tapa Lukona	477	40	159
Manyinga Sub-boma	507	48	13
Mphangwe, Mutetezi, Chioko	507	37	227
Chitembe,Mwansabombwe	31	15	15
Chilubi Island	1,500	254	856
Kale- Samfya	45	17	5
Matumbo-Phase 2	218	30	46
Lundazi	596	23	63
Chief Ndungu/Nshinde	256	Nil	17
Chiawa	78	24	84
Munyumbwe	447	149	334
St. Mary's	10	6	6.5
Mpika	31	Nil	23
Muzoka	138	Nil	136
TOTAL	**11,092**	**873**	**2,431**

Source: Department of Energy

Government Fiscal Incentives for Promotion of Modern Energy Services

Government has in an effort to promote the widespread use of solar photovoltaic technology, waived duty on photovoltaic systems with effect from the 1999 fiscal year. This measure is expected to increase the application of this technology especially in areas that are remote from the national grid.

Other Initiatives

Government has made some efforts in promoting renewable sources of energy. Activities in the renewable energy sector are aimed at promoting wider application of viable new and renewable sources of energy technologies. Solar photovoltaic systems are viewed as the only technology that is appropriate for use in rural areas for a number of applications.

The Zambian Government, with financial assistance from the Government of Sweden, has launched a large pilot project that will make it easy for rural communities in four districts of the Eastern Province to access solar electricity services through the Energy Service Companies (ESCOs).

Comparison of Rural Major Policy Statements with those of Education and Health

A comparison of major rural policy statements and government/utility statements on rural energy with those covering other developmental issues such as education and health shows that government's commitment is more to the latter. According to radio and newspaper reports, the government through the Presidential Fund has given large sums of money to rural schools, rural health centres and some churches in the urban centres. There is no evidence of the Fund having been given to promote rural energy initiatives. Perhaps there has been no initiative by potential beneficiaries to request for the Presidential Fund.

Comparison of Gender Dimension in Rural Energy Policy With Education and Health Policy

The centrality of women's contribution to national development underlines the importance of integrating gender concerns into all development interventions. The national goal of accelerated development cannot be attained without special attention to the needs of women.

Current educational and health reforms address the gender dimension very explicitly. The National Energy Policy is silent on the gender issues. However, the National Gender Policy advocates for increased dissemination of renewable energy for use by rural women.

The government has committed itself to the socio-economic improvement and empowerment of women through various programmes and affirmative actions. Within this framework, the National Policy on Education gives priority to the education of girls and commits the Ministry of Education to the elimination of all gender disparities within the education sector. Available statistics (EOF,1996) indicate that girls' enrolment in Grade 1 is almost equal to that of boys. In subsequent grades, however, the number of girls decreases steadily, with a noticeably high female dropout from Grade 4 onwards. For every 100 girls who begin primary school, only 70 complete the full primary course, 23 proceed into junior secondary school, 9 into senior secondary, and 7 sit for the school Certificate Examination in Grade 12. Opportunities for boys are considerably better with 87 out of every 100 Grade 1 entrants completing the primary course, 37 entering junior secondary classes, 16 going forward to senior secondary level, and 15 sitting for the School Certificate Examination.

In the past, girls were expelled from school if they fell pregnant. New policy measures allow girls to withdraw from school when they fall pregnant and are re-admitted after giving birth. In addition, girls' cut-off points for selection to higher classes are lower than that of boys.

Strategic interventions in the educational policy include the following:

- Education Boards prepare action plans for the promotion of equal opportunities for boys and girls of access to and participation in the various levels of school education.

- Adoption by the Ministry of Education and Education Boards of plans for improved gender balance in supervisory, managerial and responsibility posts.

- Formulation of strategies to encourage increased participation by girls in science and technology courses and programmes at all levels of education.

- The Ministry of Education and Education Boards to ensure that there are female teachers on the staff of every school to provide appropriate role model for girls.

- Creating more schools and places for girls.

- Establishment of special bursary schemes for girls.

The above policy measures are aimed at deliberately increasing the number of girls to advance in education.

In the health sector, the National Health Strategic Plan 2001-2005 prescribes measures that have been introduced for the people and government to share the cost of all health delivery systems except antenatal, maternity and menopause cases. Pregnant women are exempted from paying antenatal and delivery fees in the hospitals. These policy measures are very explicit and are meant to achieve better health for women.

Conclusions

From the foregoing, it can be concluded that political commitment for delivery of modern energy systems to the rural areas is lacking. Although the system of governance does provide for checks and balances, the status quo still remains the same. Ministerial statements made in the National Assembly have no impact on the release of funds for rural electrification. The results of the key word search show that key government and utility officials have not mentioned rural energy in the last five years. This goes to show the low priority and lack of political commitment to rural energy issues.

a) The Rural Electrification levy has no legal backing. Currently, it is regarded as an excise duty and therefore subjected to delays and in many cases it is never remitted to the REF. The erratic disbursements of REF has delayed completion of projects and in most cases project costs have escalated due to inflation.

b) From available records, it can be seen that Government and the utility pay more attention to urban electrification. Expenditure reports show that more money is spent on urban electrification than rural electrification. ZESCO spends more money on rural electrification than the Government. In some cases the burden of financing of rural electrification schemes is placed on the utility. The utility is disadvantaged as some of the rural electrification projects are not financially viable due to high costs of operation and maintenance. These costs are much higher compared to revenues collected due to low load factors.

c) The introduction of enabling programmes such as provision of fiscal measures by Government will help accelerate dissemination of renewable energy technologies. The dissemination of solar photovoltaics technology through the Energy Services Companies (ESCOs) is a good initiative for reaching rural people with modern energy services.

d) The energy policy does not address gender issues. This has resulted in women who are the majority in the rural areas being marginalized in various aspects of rural energy supply.

Hypothesis 1(b)

Rural energy initiatives by governments and utilities have failed/are failing because they were/are not implemented with vigour

In testing this hypothesis, it was important to bear in mind that vigour with which rural energy initiatives are implemented was closely related to political commitment. It was not easy to measure vigour, however, there were useful indicators such as interviews that were held with former and current utility and government officials. Another useful indicator was the analysis of the extent to which project targets were achieved within the allocated time frame.

Zambia has, since independence, spent huge sums of money on rural electrification. Rural electrification has been a general term with different meanings at different stages of development. In one context rural electrification may mean grid extension while in another it may include provision of isolated energy systems in rural areas. In other cases, rural electrification meant electrifying remote and peri-urban areas (Mbewe et al, 1992).

During the 1980s and the beginning of the 1990s, most energy and development projects were driven by a specific technology such as diesel, hydro, solar and so on. These projects were supply-oriented with focus on electrification. This approach was to some extent successful for large-scale projects that provide energy to national grids. It has however been much less successful in relation to energy for rural development. Numerous projects have left solar, wind and biogas plants, and stoves idle in rural communities without any infrastructure to maintain them and without any ability to take informed decisions at the local level on how to move forward.

Interviews conducted with current and previous senior Government and utility officials to establish whether rural energy initiatives where implemented with political commitment and vigour yielded mixed feelings. To start with, it was difficult to identify any rural electrification project that had been implemented quickly as a way of demonstrating political commitment and vigour. Current Government and utility officials feel that the level of political commitment is high as evidenced by heavy subsidy on rural tariffs. The generation, supply and sale of electricity to rural areas has proved to be a considerable financial burden to ZESCO. Since ZESCO is wholly government owned, the losses are regarded as part of government's commitment in ensuring that rural areas are supplied with electricity. Losses in the rural areas in 1997 financial year amounted to US$1.82 million. This is a huge sum of money that can be used to fund other areas of the utility to improve its operations. The officials felt that by supplying electricity to areas that have low load factors, the government was demonstrating its commitment to equity in the distribution of national resources.

Table 3.8: Budget and Actual Releases of Funds for Rural Electrification Projects

Project	1993 (US$' 000)		1994 (US$' 000)		1995 (US$' 000)	
	Budget	Released	Budget	Released	Budget	Released
Mkushi Farming Block	2.208	0	167.30	0	4,628	1,735
Chipata-Lundazi Power Line	2.208	0	83.66	0	64.79	0
Chilubi Island Boma	114.84	0	89.63	0	71.73	0
Chama Boma	172.26	0	89.63	0	71.73	0
Nyimba and Kachalola	37.54	0	55.27	0	41.65	0
Kalichelo, Feni and Chiparambai	66.25	110.42	55.27	0	41.65	0
Mulobezi	19.88	0	55.27	0	45.12	0
Chibuye Rural Health Centre	75.09	66.25	67.22	0	53.38	0
Siavonga Reinforcement	2.208	0	110.55	0	78.68	0
Rural Electricity Installations	2.208	0	5.98	0	157.35	0
Mambwe, Jumbe	8.83	0	16.43	0	12.73	0
Senga Hill	37.54	0	32.86	16.43	25.45	0

Source: Department of Energy Annual Reports – 1993; 1994; 1995

The extent to which targets are achieved within the allocated time frame is an important indicator that would help to measure vigour. All the rural electrification projects listed in Table 3.8 were formulated before 1993 and if adequate funding was made available most projects would have been completed in twelve months. Strangely enough, Kalichelo, Feni and Chiparamba projects received more than what was budget for during the year 1993. However, the subsequent years nothing was disbursed. As can be seen from the table these projects went beyond the allocated time frame. This is a clear demonstration that the rural electrification projects were not implemented with vigour.

Previous Government and utility officials feel that rural electrification initiatives are failing because there is lack of demand for electricity. Moreover, rural dwellers lack skills and initiatives to develop projects and schemes that would need electricity. Energy experts in Universities, consultants, NGOs and other agencies are generally of the view that rural energy initiatives are failing because there are no proper feasibility studies conducted. This view is exemplified by reports that the extension of the national grid in the Eastern Province from Chipata–Mwami to Feni village, a distance of 1 kilometre of 11kV line, and construction of a sub-station for distribution cost huge sums of money, but this whole infrastructure supplies only 3 customers (DOE, 1993). On the other hand, rural electrification projects that had proper feasibility studies like electrification of Mpongwe and Mukumpu in Ndola rural and Siavonga have yielded good results. Agricultural activities in Mpongwe and Mukumpu are increasing with related agro-industries being introduced. Siavonga is a renowned tourist resort town with many lodges accommodating both domestic and foreign tourists who frequent the place for holidays and conferences. The fishing industry has also developed significantly in Siavonga due to the availability of electricity for refrigeration facilities.

The government policies related to grid electricity relevant to rural areas are:

i. Promotion of electrification of productive areas and social institutions (schools and clinics) by extending the national grid where economically feasible.

ii. Improving accessibility to electricity by encouraging the adoption of low cost methods of power distribution and reducing the capital contribution charged to customers before installation of power.

Where government has found that grid extension is not technically and economically feasible, it has incorporated the use of solar. Available records show that many rural energy programmes in Zambia have concentrated on the social welfare dimensions. Welfare projects are those where profit is not a major issue. Welfare-focused initiatives are generally aimed at households and community facilities such as schools and hospitals while rural energy initiatives aimed at income generation are driven by profit maximization objective.

Biogas technology has been a major project that has been disseminated by the National Institute for Scientific and Industrial Research (NISIR). So far 18 biogas units have been installed; 4 units have been installed in rural schools for producing gas for science experiments. The rest are demonstration projects given to rural communities. These units provide energy for cooking and lighting. A similar biogas demonstration unit was installed at Lealui in Western Province. It is sad to note that some of these biogas demonstration units only worked for a short time and begun to experience problems and people abandoned them. Social and cultural attitudes have added to frustrating these projects. People's attitudes have also contributed to failure of these units. Some of the units are not operational because of simple problems such as not following operational guidelines resulting in insufficient gas produced, simple maintenance problems like leakages of the gas, clogged pipes and so on.

Other problems associated with biogas demonstration projects include lack of feasibility studies and appreciation by the beneficiaries. A biogas demonstration unit installed in one of villages in Namwala district of the Southern Province has ended up being used as a source of fertiliser (slurry) rather than energy supply. The slurry has proved to be a good cheap fertiliser for vegetable gardens. The methane gas is not utilised as people still depend on firewood for their energy needs. In this particular area, there is a lot of fuel wood and villagers do not see any need for using biogas.

All solar systems provided by government are welfare oriented targeted at community centres, rural health institutions and schools. At survey was conducted in Luangwa district to determine the number of solar energy devices that were still functional and in use. In addition, the survey was to identify reasons for failure of energy projects targeted at welfare systems.

The survey revealed that most solar systems had started to deteriorate. According to the users of photovoltaic systems in the areas visited during the survey, system performance was good at the time of installation but started to deteriorate later due to lack of maintenance. For instance, the solar system at Katondwe Mission Hospital operated very successfully after installation, however, after a few years later problems started as battery life had been exhausted. Up to the time of the survey, the hospital had been experiencing problems with the system due to expired solar batteries. Hospital authorities lamented at the lack of funds to enable them purchase new batteries. Another solar lighting system installed at Mpanshya Mission Hospital had problems with compact fluorescent lamp (CFL) fittings. The fittings had problems and the hospital could not trace the equipment suppliers and source spare parts that were needed for the system to continue operating. Moreover, these institutions were unable to call for after sales service, as they could not afford to pay for travel costs of the technician for the long distances traveled to the site.

According to the users of photovoltaic systems, one of the key problems attributed to failure of energy systems that have been provided by government is lack of maintenance and after sales service. The government through the Ministry of Energy and Water Development sub-contracts ZESCO and private companies to implement rural energy projects. For example, in the case of grid extension and construction of diesel power plants, ZESCO is contracted by government to implement the project and after commissioning, government responsibility ends there. ZESCO takes care of all maintenance of an electrification project once a project has been commissioned. In the case of a solar project, the recipients have to take care of maintenance themselves. The same procedures applies to solar energy projects and biogas projects that have been disseminated by NISIR.

The situation is somewhat different in cases where individuals have acquired their own solar systems. Another survey was carried out on solar systems used in income-generating activities to determine the number of devices that were still functional and in use. The survey revealed that the success rate in this case was high. According to a businessman of Chikanchila Village in Kasisi, Lusaka rural who owns a solar system that provides lighting for his grind mill business at night, power for a television set and lighting for his house, said that his solar system had been operating for more than eight years. Another businessman of Shalulwe Village in Shibuyunji Lusaka rural explained that he used his solar systems to provide light and power for a music system for his bar. The system had been operational for more than six years. These individuals explained that they looked after their systems well as their business could not function properly without solar power. Moreover, they were able to purchase any spare parts for the system whenever need arose as they put some money aside from the business for such a purpose. This was not the case with energy systems that had been installed by government for social welfare.

It is interesting to note that rural energy initiatives implemented by the private sector have a high rate of success. Power generating sets for a wide range of applications are widely sold in Zambia. Applications include electricity generation with power output in the range 1.2 – 100 kVA for various applications, welding sets, water pumping and battery charging. According to one supplier, the demand for gensets has been increasing. He revealed that his average sales per year were 30 and 50 units of 2 and 5 kVA respectively. He disclosed that sales for bigger units of gensets had gone up, for example in 1999 his company sold 3 and 2 units with capacities of 20 kVA and 75 kVA respectively. The high rate of success of gensets is attributed to the availability of after sales service and spare parts. In fact, dealers of gensets appoint agents in major towns where they have a large number of customers. These agents sell spare parts and carry out repairs and after sales service on behalf of the dealer. This facility does not only create confidence in the product but also enables the customer to get assistance easily whenever in need thereby contributing to the high rate of success.

While it has been easy to demonstrate that political vigour did not exist as rural electrification funds were not released on time, there are other factors that have contributed to failure of rural energy initiatives. These factors include lack of demand in some of the rural areas, lack of feasibility studies and social and cultural issues. One important issue that was identified as having contributed to failure of rural energy initiatives is lack of participation by local people in the decision making process regarding the rural energy systems that had been provided by government.

Conclusion

Available evidence shows that there is no rural electrification project that had been completed on time. Almost all the rural electrification projects that were implemented had been formulated more than three years before. The delay had been attributed to erratic disbursements of rural electrification funds. It is clear that vigour is not the only reason that has contributed to failure of rural energy initiatives. Although the hypothesis stated that rural energy initiatives failed because they were not implemented with vigour, interviewees had different views. They cited low load factors and lack of feasibility studies as some of the reasons why rural energy initiatives failed. Other reasons included social and cultural issues.

Hypothesis 1(c)

Rural energy initiatives by governments and utilities have failed/are failing because they were/are welfare focused and not targeted at income generating activities and/or uneconomic

It was suggested that this hypothesis be divided into two parts as follows

Hypothesis (i)

Rural energy initiatives by governments and utilities have failed/are failing because they were/are welfare focused and not targeted at income generating activities

and

Hypothesis (ii)

Rural energy initiatives by governments and utilities have failed/are failing because they were/are uneconomic

Associated Research Issue: Impact of Government and utilities' institutional framework on the provision of modern energy to rural areas for domestic use and for income generating activities.

This split was necessary for proper analysis to test this hypothesis.

Hypothesis (i)

To determine the importance of the two elements (welfare focus; and not targeted at income generation) that were presented by the hypothesis, a comparison was done between a successful rural energy project with less successful rural energy projects. Welfare focused projects are those where profit is not a major issue e.g. schools, hospitals, community development centres and so on.

Indicators of the success of the initiatives would include the number of modern energy devices disseminated and the number of devices that are still functional and currently in use. The Department of Energy has not carried out an evaluation exercise on projects that have been commissioned due to lack of funds. Data required for this exercise was mainly obtained through interviews and short surveys. Two technologies were examined in this study.

a) Solar Photovoltaic

Solar photovoltaic has mainly been used for lighting in rural areas. Government funds solar energy projects from funds released by the central government and funds from the Rural Electrification Fund. The national utility is not involved in dissemination of solar energy technology in the rural areas. Solar energy projects are welfare focused. In addition, the Ministry of Health has received funds from various donors for solar photovoltaics projects for rural health centres. The solar systems are for used for vaccine refrigeration and lighting.

To compare successful rural energy project with less successful ones, four solar rural energy projects were chosen. Two were welfare focused and the other two were targeted at income-generating activities. The projects are; Mpanshya Primary School in Luangwa, Katondwe Mission Hospital in Luangwa, Shalulwe Village in Shibuyunji and Chikanchila Village near Kasisi.

Welfare Focused Projects

The Government provided funds for a solar water pump at Mpanshya Primary School to improve sanitation. Renewtech Limited, a solar energy company, was contracted by government to supply and install the solar water pumping system. Government's involvement is this project came to an end when the water system was commissioned. The benefits derived from this project include clean water supply for the school children and the nearby villages. The solar water pumping system has improved sanitation and increased hygiene at the school. In addition, the school grows vegetables using the water pumping system for irrigation. The vegetables are sold to the community around the school.

According to school authorities, there are no funds for maintenance of the water pumping system in case of a break down. They explained that there was no provision in their school budget for maintenance of the water pumping system. The money realized from the sale of vegetables supplements school income and is spent on school requisites. Although at the time of the survey the water pumping system was working well, there are chances that in case of failure or breakdown of the system, it will not be repaired.

The government contracted BP Solar to install a solar system at Katondwe Mission Hospital. Apart from providing light and power for vaccine refrigeration, the solar system also provides power for water pumping and equipment in the operating theatre. Equipment operated by solar photovoltaics in theatre include; operating lamps, air conditioning equipment, suction machine, diathermy machines, oxygen concentrator and an autoclaving machine. Operations in the theatre are done during the day. Before the solar system started to experience problems, the theatre would operate at night in case of emergencies because of the energy stored in the solar batteries. This is no longer the case. Whenever there are emergencies at night, a diesel generator is used to provide power.

At the time of the survey, the solar system was not working properly because the battery life had been exhausted and there were some other operational problems that needed to be attended to. This state of affairs had frustrated hospital authorities who had acquired a diesel generating set for their power requirements. The hospital authorities explained that their budget could not meet the cost of a new set of batteries and maintenance charges. As a result, the solar system had failed.

Income Generation Focused Projects

The solar photovoltaic system installed at Chikanchila Village in Kasisi was purchased by a retiree and it is used to provide power for lighting for a grinding mill business at night. The solar photovoltaic system at Shalulwe Village in Shibuyunji is used to provide power for lighting and a music system. These two solar systems have been very successful. Business operating hours have been extended thereby generating more income. Both systems have been operating for more than six years. According to the owners of the solar systems, maintenance was a high priority.

b) Grid Extension to the Rural Areas

The electrification of Chiparamba, Feni and Kalichelo areas in the Eastern Province through extension of the grid was for welfare reasons. Although these areas have fertile soils for crop production, most of the farming is done on subsistence level. The electricity infrastructure is not utilized to the full as many households cannot afford to be connected. This is one example of rural energy initiatives that have failed.

The electrification of Mpongwe and Mukumpu in Ndola rural through grid extension has stepped up production of maize, wheat, coffee, soya beans and flowers. Expanding agricultural activities have given rise to local agro-industries such as maize and flour milling, oil extraction and coffee processing

Hypothesis (ii)

When choice of generation option has been made, it is vital to take a broader look at the proposed option for rural energy project and assess how its costs compare with the benefits it is likely to bring. In doing so two complementary approaches are normally used; financial and economic analysis. Financial analysis concerns expenditure and revenue while an economic analysis looks at broader costs and benefits to society.

To test this hypothesis, a field survey on Mkushi Farming Block was conducted to collect data. A major problem experienced during the survey was the reluctance by some farmers to provide data related to their sales. Most of the farmers were not willing to disclose income from their sales for fear of this information being passed on to their competitors and tax authorities.

Comparison of Energy Prices in Rural and Urban Areas

ZESCO has made tariff increases of between 28 and 55 % with a view to move from sub-economic tariffs to long-run marginal cost tariffs. ZESCO is not discriminative in the way it charges its customers. Rural and urban customers are charged the same tariff irrespective of the locality the energy charge does not differ; it is subject to amount of electricity consumed. This principle applies to all categories of customers. The Electricity Act enacted in 1995 has given autonomy to the utility to set tariffs which are then ratified by the Energy Regulation Board (ERB).

Background to Electrification of Mkushi Farm Block

Inspired by the success of Mpongwe and Mukumpu agricultural schemes, government decided to electrify Mkushi Farm Block to exploit its full agricultural potential. Plans to supply power to the area had been in existence since 1978. Several studies were conducted over the years on possible ways of electrifying the Farm Block. In 1984, ZESCO proposed a scheme to supply power to the block through a 66kV line from Serenje, which at that time would have cost US$11.8 million. CEI (an Italian company) in 1986 also produced a study which looked at the electrification of Mkushi Farm Block and building of water reservoirs for irrigation. CEI put the cost of electrification at US$14.6 million and US$19 million for 20-30 dams. In April 1985, Merz & McLellan presented a Phase II report on options for electrification of the Farm Block putting the cost at US$16.9 million.

Despite the number of studies carried out and the many donors e.g. European Union, African Development Bank through the African Development Fund (ADB/ADF) who had expressed interest in funding the project and Government willingness to provide counterparts funds, it was only in 1988 that a firm undertaking to finance the project was obtained from the Italian Government. By this time, the cost of the project had escalated to US$25 million. The Italian Government pledged to make available a soft loan amounting to US$40 million to be used for electrification (US$25 million) and irrigation (US$15 million).

The Italian Government later withdrew the pledge. The Government however, continued its resolve to source funds to implement the project whose cost was now estimated at US$30.6 million. Several financiers were approached and showed willingness. These included the Arab Bank for Economic Development in Africa (BADEA), Finnish International Development Agency (FINNIDA) and the Nordic Development Fund (NDF). However, all these withdrew their offer to finance the project. The Government was left with no choice but to mobilise local resources to implement the project on a stage by stage basis. The implementation of the Mkushi South-West was completed in 1997. Electricity is used for irrigation of crops and processing of agro-products. Other uses of electricity include running of farm workshops, meeting energy needs for farm workers' households and so on.

Objectives of the Analysis

The objectives of the financial and socio-economic analysis of the electrification of Mkushi South-West Farm Block are to assess to what extent electrification of the area had:

- Facilitated Zambia's developmental goals of enhancing agricultural activities.
- Facilitated the creation of agro-industries and micro enterprises.
- Promoted basic living standards of ordinary people by increasing access to modern energy services with benefits such as clean drinking water, proper sanitation and better health.

Methodology

The data was collected through the administration of a questionnaire and oral interviews with farmers and other key people in the area. The team also interviewed farm labourers and other residents to find out if the benefits of electrification had been extended to them. In addition, observation was also an important means of verifying whatever data was availed.

The sampling frame covered a total of 10 (ten) farmers out of the total 16 (sixteen) that were connected after the project was completed in September 1997. One of the limitations of the analysis was the unwillingness of some of the farmers to provide the actual information in terms of earnings from their agricultural activities after electrification. In addition, it was not possible to interview all the farm labourers who at the time of the survey were out busy in the field. This somehow compromised the quality of the data in terms of socio-economic analysis of the project.

Agricultural Activities Before Electrification

The Mkushi Farm Block covers an area of approximately 1,754 sq. km and comprises more than 230 commercial farmers. The area has one of the most fertile soils and with a high agriculture potential. The farm block has 67,000 hectares of land under cultivation with different crops such as maize, sunflower, soya beans, tobacco and wheat. The production levels of these crops over the period 1990 to 1994 are presented in the Table 3.9. Other crops that are grown include citrus fruits, coffee and vegetables of different types. The inability of the Farm Block to increase crop production was attributed to the unavailability of adequate irrigation schemes. The power supply capacity to the area was not adequate and as such was only sufficient for supplying Mkushi Boma and a handful of the farmers.

Table 3.9: Crop Production During the Period 1990-1994

Crop	1990	1991	1992	1993	1994
Maize (90 kg-bags)	137,450	530,000	938,000	822,000	600,000
Wheat (90 kg-bags)	-	-	30,494	1,008	2,750
Soya Beans (90 kg-bags)	53,430	-	71,000	75,000	150,000
Tobacco (kg)	823,000	-	-	-	-
Sunflower (50 kg-bags)	850	-	3,150	2,730	-

The total potential land that is available for irrigation is about 51,300 hectares. The total irrigated land had greatly reduced because most farmers had found it difficult to maintain or increase their hectarage as a result of escalating costs of diesel to run pump sets. The irrigated land as in 1994 was approximately 608.85 hectares. Lack of a cheaper energy source coupled with drought occurrences were the main limiting factors to expansion of irrigated land. The irrigation infrastructure at the time included 27 dams, 10 weirs, 18 km of furrows and 30 boreholes.

Before the area was electrified, farmers depended on diesel generating sets for their electricity needs and diesel pump sets for irrigation. Firewood was used for tobacco curing. Firewood was also used by some of the farmers and the local farm labourers for their daily domestic energy requirements.

Benefits of Electrifying Mkushi South-West Farm Block

At the time of the survey, 16 farmers in the Mkushi South West Farming Block were found to be connected to the electricity grid. The total number of transformers connected was 26 with capacities ranging from 50 kVA to 315 kVA giving a total installed capacity of 3,525 kVA. The total electricity use at the time of the study was 1,210 kVA. The electricity is mainly used for irrigation, workshops and domestic purposes, worker's compounds.

The benefits of electrifying the area were first assessed by comparing the average energy costs of agricultural production under the two scenarios, i.e. use of diesel versus use of electricity. It was evident from the study that average annual agricultural energy costs per farmer fell from US$13,400 to US$9,500. This signifies a reduction in energy costs of 29% arising from the switching from diesel use to hydro electricity. Average domestic energy costs per household also fell from US$ 328 to US$149 representing a decrease of over 50%.

Before electrification, the major crops under cultivation in the area were maize, tobacco and soya beans. Electrification of the area increased crop variety. New crops included wheat and paprika. In addition, there was an increase in hectarage of the existing crops. The switch from diesel to electricity has in fact presented the farmers with a wider choice of new crops since there is sufficient power for irrigation. As a result of electrification, farmers are now able to export tobacco and coffee.

Most of the farmers have electrified their worker's compounds. This has improved the standard of living of the workers because they now have access to modern energy. Due to increased agricultural output, some of the farmers are able to give bonuses and loans to their employees. The farm workers use the bonus and loans to purchase electrical equipment such as two plate stoves, music systems, television sets and so on.

Comparative Financial Analysis of One Urban and One Rural Electrification Project

Two electrification projects were compared, one urban and the other rural. These were:

- Twapia Electrification Project in Ndola
- Mkushi Farm Block Electrification Project in Mkushi.

These projects were financially assessed to ascertain the efficiency in terms of resource allocation. A comparative assessment of these two projects was chosen firstly on the fact they were both completed in 1997.

Twapia Electrification Project

This project was financed by the government. The project involved electrification of 1,300 households and small business facilities in Twapia, Ndola. The total cost of the project was US$1,149,000 as at September 1997. The average energy charge per kWh has been estimated at US$0.0568. The average consumption for each facility has been estimated at 900 units per month. The estimate was arrived at considering the fact that the area is basically medium income locality and also taking account of business activities that are available in the area. The total electricity consumption per annum for all the facilities is thus estimated at 14,040,000 kWh. This consumption level has been assumed to be obtaining over the last 3 years. The estimated total revenue from the sales of electricity in this area is US$239,242.

Mkushi Farm Block Electrification Project

The project was developed through a memorandum of understanding between the Government of the Republic of Zambia, ZESCO Ltd and the Mkushi Farmers Association with each party agreeing to contribute 62%, 23% and 15%, respectively. This project was also completed in September 1997 with a connection of 16 farmers to electricity. The total cost of the project was US$1,019,000. There exists a problem in terms of how much the farmers are supposed to pay for their electricity consumption. Basically, the average annual amount paid by all the farmers per annum for domestic and agricultural purposes is US$293,000

Financial Analysis

Financial analysis was performed on the two projects. The internal rate of return was calculated for the two projects in order to determine whether or not the two projects' contribution to the economy of Zambia is greater than the financial costs that have been incurred since the start of the project. The economic costs were valued in terms of the opportunity costs to the Zambian economy. The analysis was performed using energy charge for the Twapia project and the average monthly payments by the farmers to ZESCO in the case of the Mkushi Farm Block.

Once the concept of discounting future costs and benefits is adopted, it is clear that that the patterns of expenditure upon rural electrification programmes can have an important bearing upon their financial performance. A number of standard methods used to present the results of analyses using discounting techniques. One common method is called the Net Present Value (NPV). In this, all the project costs and revenues are expressed in their present-day discounted values. The difference between the total costs and the total revenues is called the NPV of the project. If it is positive, the project will have a profit over the period considered; if negative, it will have an overall loss. The greater the NPV, the more profitable the project.

The Benefit/Cost ratio is calculated by dividing the discounted benefits by the discounted costs. If the answer is more than 1, the project will show a profit.

Another approach relies on what is called the Internal Rate of Return (IRR). In this, the discount rate which will make the NPV of the project equal to zero is calculated. The IRR method therefore calculates the actual or "internal" rate of interest rather than using externally determined discount rate as in the case of the NPV. The higher the IRR, the more profit the project will make. One of the advantages of the IRR is that it allows a comparison to be made between projects in which the levels of investment are completely of different magnitudes. The IRR also allows rural electrification projects to be compared with other potential areas of investment. In practice, such wide-ranging comparative analyses are not usually carried out and the financial performance of the project is judged against a minimum acceptable IRR specified by the government of financing agency.

In these case studies, the approach used to present the results of the analysis was the Internal Rate of Return technique.

From the results presented in Table 3.10, it is evident that the Mkushi Farm Block has a negative IRR (-7%) indicating that the project is performing unattractively. The reason is that the farmers are not paying the real cost for the electricity that is being supplied to them. The IRR is of course expected to improve with farmers starting to pay the real price for the electricity that is being supplied to them. The farmers negotiated a tariff because of their capital contribution to the project of 15% of total costs.

Table 3.10: Results of the Financial Analysis of Twapia and Mkushi Farm Block

Project Name	Initial Investment	Cash-Flows ('000)			IRR
		Year 1	Year 2	Year 3	
Mkushi Project	-1,347,000,000	386,490	386,490	386,490	-7%
Twapia Project	-1,518,440,000	1,053,000	1,053,000	1,053,000	48%

The IRR for the electrification of the Twapia (48%) is quite attractive indicating a good financial attractiveness of the project. The Twapia project is showing a good financial return as compared to the Mkushi Farm Block project because of the economic tariffs that the people are paying in Twapia.

Comparative Cost Benefit Ratio: Mkushi South-West Farming Block and Twapia Electrification Projects

a) Mkushi Southwest Farming Block

Assumptions:

- Average collection rate from retail sales was assumed to be around 70%.
- Operational expenditure mainly includes maintenance including tools, machinery and equipment administration, transport, financial, insurance and remuneration costs for staff.
- Non-operating expenses include stores, tax and operational imprest.

Table 3.11 shows the cash flow for Mkushi South-west Farming Block project in 2000.

Table 3.11: Year 2000 Cash Flow for Mkushi Southwest Farming Block

	Jan/Mar-00	Apr/Jun-00	Jul/Sep-00	Oct/Dec-00	Totals
Total Revenue (US$ '000)	28,799	28,799	8,799	28,799	115,198
Total Operating Expenses (US$ '000)	30,635	30,635	30,635	30,635	122,540

The benefit cost ratio was determined by comparing the revenues collected with the operating expenses. It is evident from the table that the operating costs exceed the revenues. In this regard the cost benefit ratio (CBR) of the project is **0.940**. The poor CBR is mainly attributed to the fact that the farmers in the area are not paying the true cost of the electricity that they are using.

b) Twapia Electrification Project

Assumptions:

- Average collection rate from retail sales was assumed to be around 50%.
- Operational expenditure mainly includes maintenance including tools, machinery and equipment administration, transport, financial, insurance and remuneration costs for staff.
- Non-operating expenses include stores, tax and operational imprest.

The table below shows the cash flow for Twapia Electrification Project in 2000.

Table 3.12: Year 2000 Cash-Flow for Twapia Electrification Project

	Jan/Mar-00	Apr/Jun-00	Jul/Sep-00	Oct/Dec-00	Totals
Total Revenue (US$ '000)	39,232	39,232	39,232	39,232	156,928
Total Operating Expenses (US$ '000)	61,270	61,270	61,270	61,270	245,080

It is evident from the table that the revenues do not cover the operating expenses. In this regard, the cost benefit ratio (CBR) of the project is **0.640**. The poor CBR is mainly attributed to the low average revenue collection rate of 50% though the IRR shows a very attractive rate of 48%.

In comparing the two projects, it is evident from the results that the cost benefit ratios for the two projects are both below 1. The low CBRs are mainly attributed to the low average revenue collection rates of the two projects and in the case of Mkushi, the farmers are not actually paying the true cost of the electricity that is being supplied to them.

A conclusion can be drawn from these results to the effect that improvements of revenue collection rates will have a very positive impact on the cost benefit ratios of the two projects. Furthermore, payments by the Mkushi farmers of the true tariff will also positively impact on the project's CBRs.

Benefits of Electrifying Mkushi Farm Block

Status

Before the area was electrified, generated electricity using diesel generating sets. Firewood was used for tobacco curing and farm labourers for their daily domestic energy requirements.

Thirteen (13) farmers (including Masansa Area-a Farming Co-operative) in the Mkushi South West Farming Block were found to be connected to the national electricity grid. The total number of transformers connected was 26 with capacities ranging from 50 kVA to 315 kVA giving a total installed capacity of 3,525 kVA. The total electricity use at the time of the study was 1,210 kVA. The electricity is mainly used for irrigation, workshops and domestic purposes, worker's compounds and community use in the case of Masansa.

Four farmers in the area have not been connected. The lack of connection to electricity is mainly attributed to their inability to provide basic equipment such as transformers, meters and so on.

Benefits

The benefits of electrifying the area were first assessed by comparing the average energy costs of agricultural production under the two scenarios, i.e. use of diesel versus use of electricity. It was evident from the study that average annual agricultural energy costs fell from US$13,413 to US$9,538. This signifies a reduction in energy costs of 28% arising from the switching from diesel use to hydro electricity. Domestic energy costs also fell from US$328 to US$149 representing a decrease of over 50%.

Before electrification, the major crops under cultivation in the area were maize, tobacco and soyabeans. The electrification of the area saw the coming of new crops such as wheat and paprika and the increase in hectarage of the existing crops. The switch from diesel to electricity has in fact presented the farmers with a wider choice of new crops since there is sufficient power to induce irrigation activities.

Most of the farmers have connected the worker's compound to electricity. This has promoted the living conditions of the workers because they are now able to purchase and own equipment such as stoves, television sets, etc. This has arisen as a result of the increase in the amount of loans the farmers are availing to the workers because of higher production resulting in increased earnings.

Tobacco is one of the crops which is being exported by some of the farmers. As a result of electrification, the farmers will soon be exporting coffee to Europe once it matures.

Conclusions

a) From the analysis in this study, it can generally be concluded that provision of modern energy services targeted at income generating activities have a better rate of success than welfare focused projects. Benefits of providing modern energy services do not only accrue to the beneficiaries but to many other people living in the community and the economy as a whole.

b) Rural energy initiatives focused on welfare schemes such as schools and clinics have failed whereas projects that are targeted at income generating activities have succeeded. Lack of maintenance has been cited as a major cause of failure of rural energy projects. Without maintenance, nothing is sustainable. When government departments are responsible for rural maintenance, they often encounter huge problems such as inadequate transport, unreliable budgets for maintenance, shortages of well trained maintenance staff and poor communications between rural areas and the district centres.

c) Rural electrification through grid extension is expensive. According to Mbewe (1992), transmission lines can cost as much US$79,800 per kilometre and associated switchgear. It is, therefore, important that proper feasibility studies are done before the national grid is extended to the rural areas. This will ensure success of the rural projects.

d) Two case studies regarding the electrification of Mkushi Farm Block and Twapia were used to carry out a financial analysis in order to determine whether the projects were viable. The objectives of the analysis were partly achieved because of the following reasons:

- Electrification of Mkushi Farm Block facilitated enhancement of agricultural activities.
- Electrification resulted in establishment of agro-related industries such as milk processing and flour plants.
- The standard of living of the people had improved as they were able access modern energy.

e) The Internal Rate of Return is better on projects where correct tariffs are applied. This is very important for the success of the projects.

Table 3.13: Comparison of Rural Energy Initiatives within Theme Group Countries

Country	Rural Energy Initiatives
Eritrea	• Rural energy has high priority although there is no explicit rural energy policy • Expenditure on rural energy initiatives is small compared with urban energy expenditure
Ethiopia	• Political commitment and vigour lacking • Investments in rural energy initiatives limited and unfocused while in other sectors like education, health and agriculture have been maintained at reasonable levels • Majority of rural energy initiatives have not targeted income generating activities
Zambia	• Political commitment and vigour lacking • Rural energy initiatives targeted at welfare activities have failed • Rural energy initiatives targeted at income generating activities have been successful
Zimbabwe	• Political will and vigour exist but there is failure in implementation of rural energy initiatives • Rural energy initiatives targeted at welfare activities have failed • Rural energy initiatives spearheaded by government have been uneconomic

Source: Habtetsion, 2001; Wolde-Ghiorghis, 2001; Mapako, 2001

3.2 Hypothesis II: Government and Utility Institutional Structures

Government planning is highly centralised and done in Lusaka, the capital city. Implementation of various government plans/programmes is done by government departments and/or agencies (statutory institutions) which are based in Lusaka. In some cases, government institutions are decentralised and programmes are implemented by government institutions that are based at provincial and district levels. For example, the Office of the Provincial Permanent Secretary supervises a number of government departments in the province. Some of the government departments include agriculture, water affairs, forestry and so on.

The Ministry of Energy and Water Development (MEWD) has the overall responsibility of the energy and water sectors. The energy sector is governed in a centralized fashion as shown in figure 3.1. The Department of Energy under MEWD has the responsibilities of energy planning, policy formulation, dissemination and implementation of various energy programmes. There is no institution at local level to supervise implementation of energy projects. The electricity utility is responsible for generation, transmission and distribution of electrical power in the country. The interconnected electricity network covers major towns of the country. Rural towns that are not connected to the national grid are supplied by isolated networks of diesel generating sets (gensets) and mini hydros. Unlike the government institutional structure, the utility structure is decentralized as shown in figure 3.2. The entire electricity network in the country is run by the national utility except Mulungushi mini hydro scheme which is owned and operated by a mining company.

Figure 3.1: Government Energy Institutional Structure

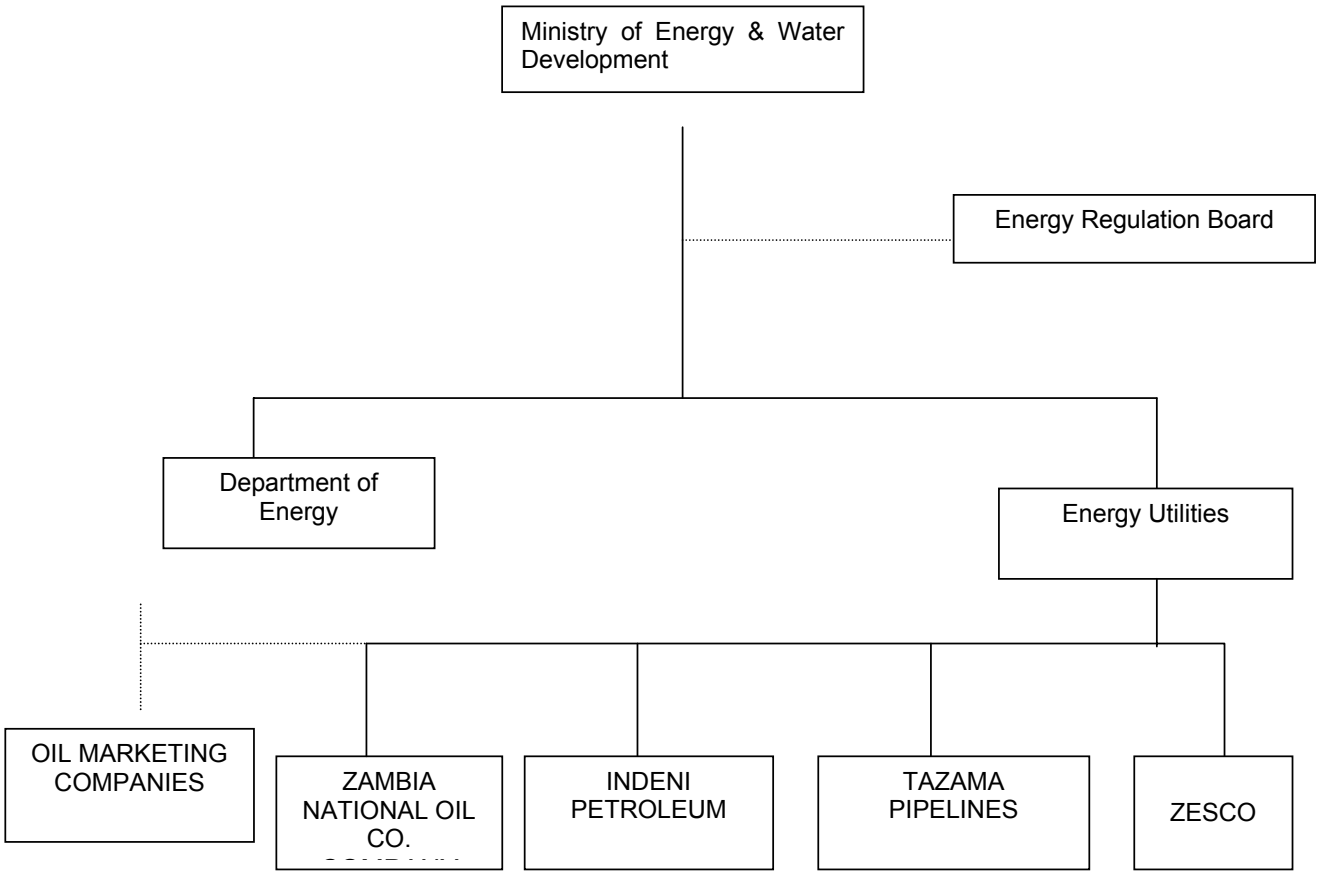
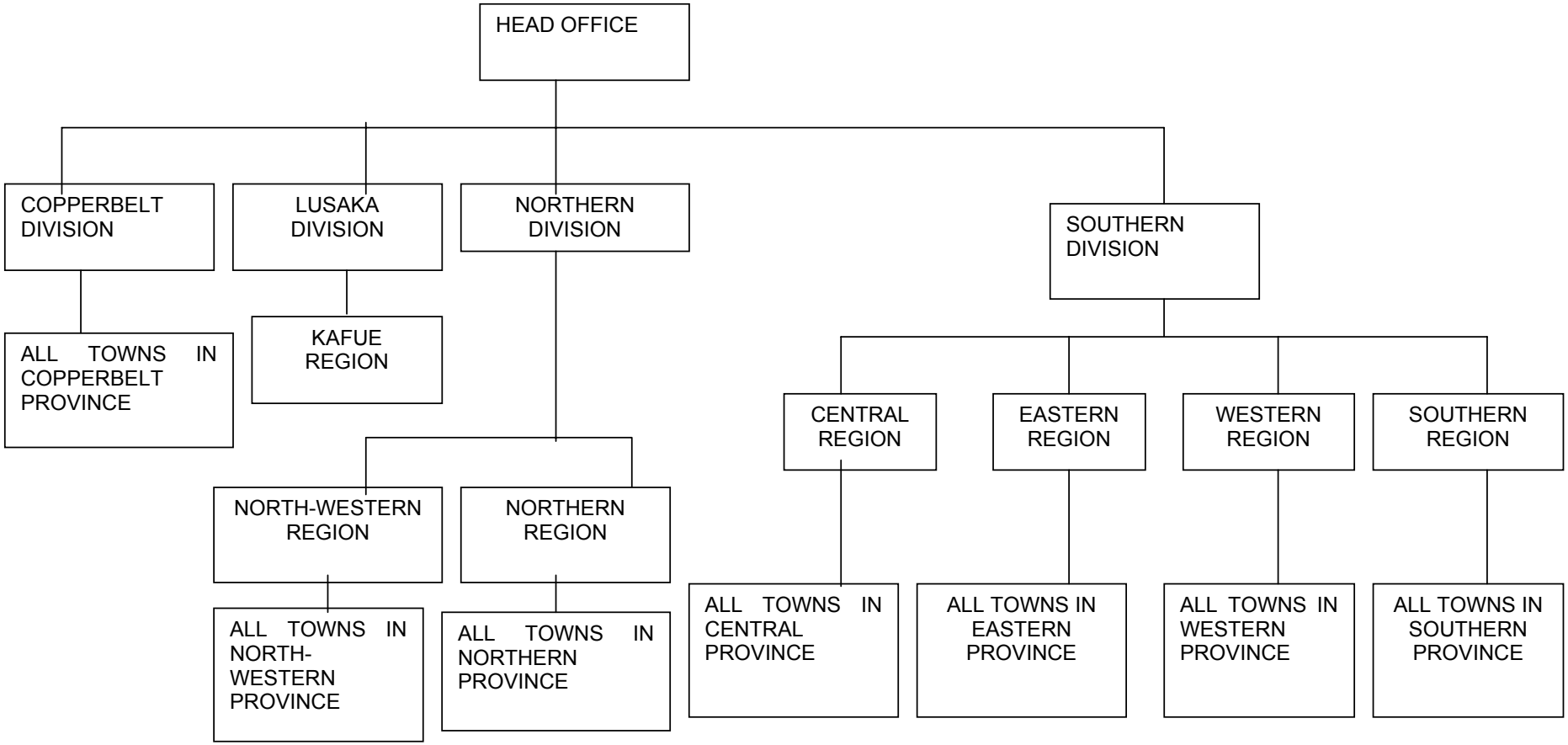


Figure 3.2: ZESCO Institutional Structure



Zambia's energy institutional structure is largely characterized by monopolistic and oligopolistic tendencies of parastatal electricity utilities and multinational oil companies. As a result, the existing institutional structure is largely designed to serve the interests of large-scale electricity and oil companies. The institutional structure of oil marketing companies in Zambia is such that they have representation throughout out the major centres of the country. The oil marketing companies own service stations and appoint dealers who run the stations on their behalf. The oil companies purchase their petroleum products from Ndola or sometimes import from South Africa and store the products in their bulk storage depots which are later distributed throughout their network as shown in figure 3.3. This structure facilitates access of petroleum products to people in remote areas of the country. The oil marketing companies' institutional structure is similar to that of genset dealers who appoint agents in major towns where they have a large number of customers (Figure 3.4). The agents sell spare parts and carry out repairs and provide after sales service on behalf of the genset company.

Figure 3.3: Institutional Structure of Oil Marketing Companies

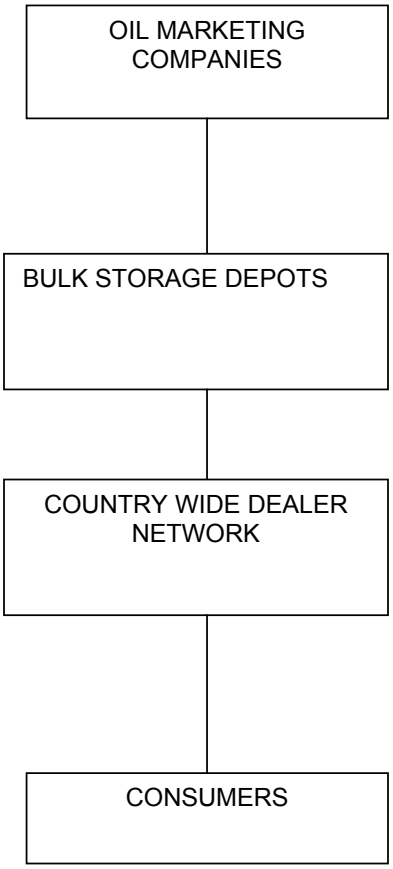
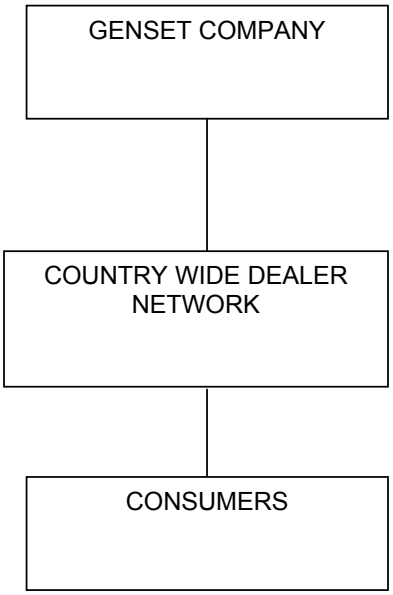


Figure 3.4: Institutional Structure for Genset Companies



Rural and renewable energy issues receive limited attention as rural development is not well understood and has little political support as emphasis is placed on development of urban areas. This state of affairs has led to existing energy infrastructure not providing for an adequate institutional framework structure for dissemination of modern energy services to rural areas. It is, however, interesting to note that although there are no associations in rural areas responsible for addressing important developmental issues, political structures exist at grass root levels that are occupied with political matters such as party organisation/ activities, local and national elections.

The following have been identified as institutional bottlenecks:

a) Inadequate Energy Policy

Government policy on rural energy is inadequate. Current energy policy, as it relates to rural areas, is to promote electrification of productive areas and social institutions by extending the national grid where economically feasible. Grid extension to the rural areas is not always feasible. Extension of the grid to the rural areas has been undermined by various factors such as long transmission distances, high costs of transmission lines and associated switchgear and low load factors. While it may be easier to provide renewable energy to rural areas than extending the national grid, the National Energy Policy does not emphasize renewable energy technologies as an energy option for the rural areas. However, the Ministry of Energy and Water Development has disseminated solar photovoltaic systems for lighting and water pumping.

b) Ineffective Energy Institutions

The government through the Department of Energy contracts private companies to undertake installations of the solar systems for its programme of providing modern energy to community facilities. The Department of Energy's responsibility ends when it has verified that the contractor has installed the system and it is working properly. The lack of institutional representation at local level and the inadequate skilled human resources have contributed to the ineffectiveness of energy delivery system. Recently the Department of Energy has out sourced follow-up activities on these projects. The University of Zambia has been contracted to train recipients and monitor the projects. Inspection of systems to ensure that they are not of sub-standards will be done by the ERB. Inspection is one activity among other things that falls under the ERB's mandate.

Even though the utility has an institutional structure that represents it in many rural areas, experience shows that some of the diesel power plants have not performed well. For example, Kabompo a rural town in the North Western Province was electrified in 1972 with a diesel power plant rated at 99 kW. However, during the period 1972 and 1986, there was very low power output due to heavy plant wear, lack of spare parts and insufficient plant maintenance. Another example is that of Lundazi a rural town in the Eastern Province which was electrified in 1976 with an installed capacity of 2,245 kW of diesel power plant. In 1991 plant availability was only 400 kW as the utility experienced difficulties to acquire spare parts to maintain the plant. These two examples clearly demonstrate the level of priority given to rural energy initiatives.

c) Insufficient Budget Allocation

Budget allocation is not sufficient to finance rural electrification. The Rural Electrification Fund was established as an additional means of increasing funding for rural electrification projects. However, this Fund is not always available. The way the Rural Electrification Fund is administered is not appropriate to the design and implementation of rural energy initiatives.

d) Ineffective Government Institutional Interaction

Analysis of the existing institutional structure in the rural energy sector shows lack of effective interaction among government institutions dealing in renewable energy technologies. This view is supported by Chitala (1997) who observes that although the policy on renewable energy promotion have been in place for sometime, the policy is still ineffective in dealing with aspects of taxes and duties imposed on renewable energy technologies. This he attributes to the fact that relevant government institutions outside the realm of the Ministry of Energy and Water Development do not understand the role of renewable energy technologies in the improvement of the living standards of the people. He explains that this problem stems from the absence of effective institutional interaction and consultation on matters of common and national interest.

In order to assess effectiveness of current government and utility institutional energy structure, a comparison is made of the existing institutional structure/linkages in the rural energy sector with institutional structure/linkage that has proven effective in other energy sub-sectors. A good example from the private sector is the sales of gensets as explained in Chapter 3, Hypothesis 1(b). One of the reasons attributed to the success of dealers of gensets is that they decentralise their after sales service and stock adequate spare parts. Another private sub-sector institutional structure that has proved to be successful is that of petroleum distribution. Petroleum products are distributed widely throughout the country by oil marketing companies. At the retail level, the infrastructure (fuel depots and service stations) is wholly owned by private petroleum marketing companies. The oil marketing companies retail petroleum products through dealers who are appointed to run the service stations in urban and rural areas. Retail prices of petroleum products differ from place to place as a surcharge is made to cover transportation costs of products from the refinery. Retail prices of petroleum products are very high in rural areas because of transportation costs. This is one example of a successful institutional structure that covers the supply of petroleum products to rural areas.

The current energy institutional structure does not link to women organizations. This is not surprising because the National Energy Policy does not address gender issues. Women organisations such as Women Finance Trust, Zambia Women in Agriculture and many such other organizations could benefit if they were linked to energy institutions.

The analysis of the prevailing institutional structure in Zambia and other countries in the Theme Group is compared with other developing countries' rural energy structures. Examples include India, Indonesia and Malaysia as shown in Table 3.14. The analysis includes comparisons across the countries represented in the Theme Group.

Table 3.14: A Comparison of Institutional Arrangements for Rural Energy

Country	Institutional Set-Up
Botswana	• Energy Affairs Division is centralized • No local presence in rural areas
Eritrea	• Rural energy planning is centralized • Department of Energy has no linkage with rural communities • Institutional framework is not conducive to rural energy planning, implementation and follow up
Ethiopia	Institutional framework is not conducive to the design and implementation of rural energy initiatives
Zambia	• Rural energy planning done by MEWD • Implementation of rural energy projects done by contractors (includes the utility) supervised by DOE • No technical back-up for systems that have been provided by government. • Government and utility institutional structure is not appropriate to dissemination of rural energy initiatives
Zimbabwe	• Rural energy planning is centralized in the Dept of Energy • No separate institution exists for rural energy planning • Government institutional structure is ill suited for design and dissemination of rural energy initiatives
India	• Integrated rural energy planning at the village level guided by the National Commission • Technical back up units at the State and District level for devices such as biogas plants, improved woodstoves and solar cookers. ▪ National Training Centre in Delhi, regional training and R&D centres in districts.
Indonesia	• Directorate General of Electric Power and New Energy combines rural electrification and alternative energy development
Malaysia	• No separate institutional mechanism exist for rural energy planning, nor any for the promotion of decentralised renewable energy systems • The diffusion of alternative energy technologies, for example, small-scale hydro and solar photovoltaics fall under the power utilities as a part of their rural electrification programmes

Source: RERD, 2000; Habtetsion, 2001; Wolde-Ghiorghis, 2001; Mapako, 2001

e) *Other Related Issues*

Availability of proper rural infrastructure is a factor that will augment proper economic and financial approaches to provision of modern rural energy initiatives. Butcher (1999) argues that infrastructure is “growth supporting” rather than “growth generating”. Infrastructure such as roads and telecommunication facilities support growth by facilitating the flow of materials and information between the economic base and the economic hinterland. It is therefore necessary that government and local authorities should improve rural infrastructure to promote an enabling environment for rural industries, as well as improve the mobility of the entrepreneurs. Although this factor is not feasible in the short and medium term due to financial constraints the government is facing, it very important for institutional structures at local levels to operate effectively.

Conclusions

a) It can be concluded from the foregoing that there are inadequacies in the way the energy sector is organized and managed. Energy planning is highly centralized with no institutional structures at local level for supervising of rural energy initiatives. There is little institutional interaction of relevant organizations that have something to do with energy. Women have been marginalized in all aspects of energy. There is no linkage between women organizations and energy institutional structures.

b) Policy on rural energy is inadequate. The National Energy Policy does not explicitly address renewable energy technologies. RETS may be appropriate for some applications in the rural areas.

c) The energy delivery system is ineffective. The Department of Energy has no financial and human resources to monitor rural energy projects. The national utility, ZESCO, gives low priority to rural power stations. This evidenced by the low output of Kabompo and Lundazi power stations. Reasons for low power output have been cited as lack of maintenance and spare parts.

d) Private sector institution structure has a better rate of success. This has been attributed to the fact that the profit motive is the driving force behind the success.

4.0 DRAFT POLICY OPTIONS

This Chapter presents draft policy options which aim at providing solutions to some of the problems that have been identified in Chapter 3 regarding dissemination of modern energy services to rural areas. Several policy initiatives are recommended, examined and subjected to a filtering process regarding the current situation in the country using the following factors:

- Institutional and Management.
- Legal Framework.
- Economical and Financial.
- Human Resource and Technical Capability.

After the filtering process, draft policy options are presented for each of the hypothesis.

4.1 Hypothesis I: Rural Energy Initiatives by Government and Utility

4.1.1 Hypothesis 1a

The major finding from the study is that political commitment for delivery of modern energy systems to the rural areas is lacking. In order to enhance political commitment, the following policy initiatives are recommended:

- Introduction of measures to ensure that that recommendations of the Parliamentary Committees and Ministerial Statements are implemented.
- Effective administration of the Rural Electrification Fund.
- Review of the National Energy Policy.
- Inclusion of the gender dimension in the National Energy Policy.

1. Introduction of Measures to Ensure That Recommendations of the Parliamentary Committees and Ministerial Statements are Implemented.

This policy entails that recommendations of Parliamentary Committees, Ministerial Statements and Speeches made in the National assembly are followed up and acted upon.

Institutional and Management

Although there is no problem with institutional linkage, there are institutional gaps that affect implementation of some of government programmes successfully. These gaps include lack of follow up and action on recommendations of Parliamentary Committees and Statements made by ministers. This has led to lack of accountability by those whose duty is to ensure that activities are implemented on time and successfully. What is required is for the Committee on Energy, Environment and Tourism and the Committee on Government Assurances to introduce measures such as loss of remuneration and dismissals of officers that fail to carry out directives. These measures will ensure that chief government officers carry out directives and recommendations of these two Parliamentary Committees and ensure that government programmes are implemented without fail. It is feasible to implement this initiative as institutional and management structures exists.

Legal Framework

There is no legal barrier to implementing this initiative. Pursuant to the Constitution Provisions which creates the three arms of government namely; Executive, Legislative and the Judiciary and empowers them to act as a check on each other, Parliament has enacted the Standing Orders which establish Parliamentary Committees and mandates them, inter alia, to follow up, direct and ensure that government policies are properly carried out by government ministries and departments. It is clear from the foregoing that an elaborate legal framework already exists for effective implementation of government policies and programmes.

Economical and Financial

Government has a financial system that supervises collection of revenue and allocates it to budgeted items to run government programmes.

The Ministry of Finance and Economic Development is responsible for the macro-economic management of the country. The Ministry of Finance and Economic Development ensures that Zambia pursues appropriate fiscal and monetary policies that will reduce inflation, maintain a stable financial sector, and boost economic development. The Ministry of Finance and Economic Development is also responsible for collaboration with cooperating partners on bilateral and multilateral programmes for implementing the economic and structural reform programme. The Ministry of Finance guides all line ministries, government departments and institutions in arriving at estimates of expenditure based on prudent implementation of appropriate fiscal and monetary policies.

Every line ministry, government department and institution has competent officers who develop budget proposals in close collaboration with officers dealing with various government programmes in that particular ministry. These officers constitute a Ministerial Budget Committee. Each Ministerial Budget Committee or department has to develop budget proposals based on what the relevant officers submit as anticipated recurrent and capital expenditure. Recurrent expenditure refers to money spent on day-to-day running of government affairs while capital expenditure refers to money spent on existing and future projects. These budget proposals are then presented and discussed at a budget workshop convened for Ministry Budget Committee and officials from the Ministry of Finance and Economic Development. At the workshop, budget proposals are discussed and limits set for expenditure. This workshop produces estimates of expenditure for that particular ministry or department.

One of the functions of Parliament is to approve public expenditure. This is done by scrutinizing and approving estimates of expenditure for government institutions brought before Parliament. Once the estimates of expenditure are approved, the Ministry of Finance and Economic Development is expected to release funds to implement government policies and programmes.

With this elaborate framework for developing budget proposals, preparation of estimates of expenditure and allocation of budgeted funds, it is feasible to implement this initiative.

Human Resources and Technical Capability

Parliament has designated support staff to guide Committees on issues that arise as a result of implementing government policies and programmes. The staff are qualified and have the necessary expertise to guide the Committees in arriving at appropriate decisions. In addition, Members of Parliament who are appointed to sit on these Committees usually have some relevant experience in matters that the Committees deal in. On the side of government ministries and departments, chief officers are summoned to appear before the Committees to answer on issues that are being queried on. In situations where the chief officers are not well versed on the issues being discussed, professional officers dealing with particular issues are allowed to accompany the chief officers to appear before the Committees. The professional officers help their chief officers to provide appropriate responses to the Committees.

Conclusion

It is feasible to implement this recommendation

2. Effective Administration of Rural Electrification Fund

The Rural Electrification Fund is not managed properly. The procedure for collection of the Fund is bureaucratic and often results in delays. The non-release of funds affects completion of projects on time.

Institutional and Management

Collection of Rural Electrification Fund needs to be streamlined. The existing structure is cumbersome. The fewer the institutions through which the funds passes the better. The utility can collect funds and pass them on directly to the Rural Electrification Fund. This can eliminate delays and the mis-allocation of funds. It is possible to implement this initiative by reducing the number of institutions through which the money passes before it reaches the REF.

Legal Framework

Although the Rural Electrification Fund was introduced through the programme of action to implement the National Energy Policy, there is no legal backing for its existence and effective implementation. It is strongly recommended that legislation be passed which should provide for collection and management of the Fund to ensure proper management and accountability. Experience shows that a fund supported by legislation will not easily be tempered with because the relevant law will clearly spell out who collects the fund, its intended purpose and the penalty for any abuse. One such fund which is supported by legislation is the license fees charged by the Energy Regulation Board. This fee is not open to manipulation as the law clearly states how it is collected and spent. Legislation can be enacted easily to support this initiative.

Economical and Financial

The national electricity utility and private contractors have adequate tools and working capital to carry out the projects. Moreover, government through the Ministry of Finance would provide funding to implement projects as approved by Parliament. This initiative can be implemented.

Human Resource and Technical Capability

There are no barriers in implementing this initiative in terms of human resources and technical capability. Skills exist for collection and administering of funds required for project implementation. In addition, the contractors have knowledge about estimating project costs. This information would be useful for those who are responsible for planning, funding and supervising implementation of government projects.

Conclusion

This recommendation can be implemented

3. Review of the National Energy Policy

In view of recent developments and anticipated privatisation of the energy sector, policy reform is necessary to provide new direction to the energy sector. The National Energy Policy is more than six years old and needs to be reviewed so that it is current and explicit on rural energy issues.

Institutional and Management

This initiative will entail making changes to existing energy policies. Expertise to undertake this exercise exists locally. The Ministry of Energy and Water Development can make necessary changes to the existing policies in consultation with all stakeholders in the energy sector.

Legal Framework

There is no barrier to the implementation of this initiative.

Economical and Financial

There are no economic and financial problems related to the implementation of this initiative.

Human Resource and Technical Capability

There would be no need for additional skills other than those that are currently available.

Conclusion

It is feasible to implement this recommendation

4. Inclusion of Gender in the National Energy Policy

The study brings out the lack of gender aspect in the National Energy Policy as a constraint to the effective dissemination of rural energy initiatives. Lack of energy can constrain both men and women from contributing to economic growth and overall national development.

Institutional and Management

The institutional framework exists for implementing this initiative. Gender in Development Division (GIDD) was established to ensure that there is gender equity in ownership and management of resources and in the share of decision-making authority particularly in the decisions concerning resource allocation and utilization. An added responsibility for GIDD could be data collection on gender issues that affect energy for planning and policy purposes. For example, it would be useful to have detailed information about the activity and resource profiles of women and men in areas/locations targeted for rural energy initiatives. This would assist in formulation of project designs that are gender sensitive. GIDD would have to work in close collaboration with the Department of Energy in achieving some of these objectives.

Legal Framework

There are no legal barriers for implementing this initiative.

Economic and Financial

There are no economic and financial barriers for implementing this initiative

Human Resources and Technical Capability

There are no barriers as far as the implementation of this initiative. The GIDD is a fully fledged institution with adequate expertise in the relevant fields that can handle the various issues. In addition, the Department of Energy would be available to offer expertise to GIDD.

Conclusion

It is feasible to implement this initiative

4.1.2 Hypothesis 1b

Another important finding of this study is that dissemination of rural energy initiatives by governments and utilities has not been successful because they were not, among other things, implemented with vigour. To redress this situation, the following policy initiatives are recommended:

- Increase funding for rural energy initiatives.
- Conduct feasibility studies before implementing projects.

1. Increase Funding for Rural Energy Initiatives

Inadequate funding has been cited a one of the main reasons why many rural electrification projects had not been completed on time. Experience has shown that most of the rural projects take more than three years to complete.

Institutional and Management

Institutional framework for implementing this initiative exists. This initiative will entail the Ministry Finance and Economic Development to increase budget allocations under the vote of the Ministry of Energy and Water Development for the sole purpose of implementing rural energy initiatives. The government could continue contracting ZESCO to implement electrification projects. Private contractors could also be sub contracted to speed up completion of the projects.

Legal Framework

There are no legal barriers towards the implementation of this recommendation. Legislation exists under the Energy Regulation Act of 1995 for government to collect surplus funds from license fees collected by the Energy Regulation Board. According to the legislation, excess funds collected from license fees should be used for development of the energy sector.

Economical and Financial

Given the government's financial difficulties due to economic problems, one practical way of increasing rural energy funding would be to utilize surplus funds collected by the ERB as license fees. This money could be channelled to fund rural energy initiatives. This initiative can be implemented.

Human Resource and Technical Capability

There are no barriers to implement this initiative. ZESCO has the capacity to implement some of the projects. Private contractors have adequate skills to enable them carry out some of the projects.

Conclusion

It is feasible to implement this recommendation

2. Conduct Feasibility Studies Before Implementing Projects

Despite many benefits that modern energy services can offer, it is evident that attempting to disseminate these to some rural areas may be a waste of resources if proper feasibility studies are not conducted. There are examples of projects which at least with the benefit of hindsight, could be seen to have been doomed from the beginning.

Institutional and Management

Skills for conducting feasibility studies are available in the country. ZESCO has the expertise to conduct feasibility studies of rural projects. The Department of Energy can contract these organisations and qualified individuals to conduct feasibility studies of rural energy initiatives.

Legal Framework

There are no legal barriers in implementing this initiative.

Economic and Financial

There are no economic and financial barriers to implement this initiative as the cost of the feasibility surveys would be minimal. The government is capable of mobilising the required resources.

Human Resources and Technical Capability

Human resources and technical skills exist for implementing this initiative.

Conclusion

It is feasible to implement this recommendation.

4.1.3 Hypothesis 1c

The main finding of hypothesis 1c is that energy projects targeted at income generating activities are more successful than those focused on welfare activities. Lack of participation by beneficiaries and lack of maintenance have been cited as major reasons why welfare focused projects fail. There is need, therefore, for government to come up with initiatives that are appropriate for dissemination of rural energy. It is important that the beneficiaries of projects are made aware of benefits that they can enjoy from adopting certain rural energy initiatives. Beneficiaries should be consulted on energy projects that are targeted towards them so that they participate, further projects must be tailored to suit local situation. To achieve these objectives the following policy initiatives are recommended:

- Carry out awareness campaigns regarding benefits of rural energy initiatives.
- Involve beneficiaries in the design and implementation of rural energy initiatives.

1. Carry Out Awareness Campaigns Regarding Benefits of Rural Energy Initiatives

Institutional and Management

It is possible to implement this initiative. The key players in dissemination of modern energy services to rural areas are the Department of Energy, ZESCO and oil marketing companies. These institutions should organise energy fairs, practical demonstration and pilot schemes. These activities should aim at making people aware of the existence of the various energy technologies that are available. In addition, the Department of Energy can carry out public awareness campaigns on the use of modern energy services through the print and electronic media which can reach many people.

Legal Framework

There are no legal barriers preventing the adoption of this initiative.

Economical and Financial

The cost of carrying out the suggested public awareness programmes is minimal. Moreover, the government owns the electronic and print media. The major newspapers are government owned and offer free space for publication of developmental issues. Business Times is a newly introduced newspaper owned by the state which publishes business news. Business Times pays for any article that is published in their newspaper. In addition, there are a number of community radio stations owned mainly by the Catholic Church which can disseminate information on modern rural energy initiatives at minimal cost. This initiative can be implemented without difficulties.

Human Resource and Technical Capability

All the key institutions identified have adequate human resources and skills to implement the initiative.

Conclusion

It is feasible to implement this recommendation

2. Involve Beneficiaries in the Design and Implementation of Rural Energy Initiatives

Past experience shows that 7 communities based solar projects for water pumping, medical refrigeration and lighting initiated and funded by the Department of Energy have been difficult to maintain as there has been no lead institution among local groups which have taken ownership of the projects. A number of difficulties have been encountered with the sustainability of these projects. It is now recognized that participatory approach is crucial to the successful implementation of rural energy programmes. According to World Bank (1996), previous case studies in Karnataka State in India have shown that local community organisations can be effective channels for supporting delivery of energy services of all kinds. It must be noted, however, that participatory approach alone cannot guarantee success. Other factors such as identification of the local community, understanding of the community, and knowledge about interests of the local community need to be taken into consideration.

Institutional and Management

The Department of Energy and ZESCO are the main institutions that are involved in dissemination of rural energy projects. These institutions can consult the rural people before initiating projects targeted at the rural people. This can be done through Constituency Development Committees.

Legal Framework

There are no laws that prevent institutions from consulting the potential beneficiaries of modern rural energy technologies.

Economic and Financial

The funds required to implement this initiative are minimal. The Department of Energy and ZESCO are capable of mobilizing the required resources. In addition, the Constituency Development Committees have a Constituent Development Fund which is provided by the government for investing in any developmental activity that may be identified. This initiative can be implemented easily.

Human Resources and Technical Capability

The human resources and skills needed to implement this initiative exist. However, technical capability at local level to repair energy systems is lacking. Recently, the Department of Energy in collaboration with the University of Zambia, Physics Department has introduced a pilot training programme for local people in Eastern Province to be trained as artisans in basic maintenance and repair techniques for solar energy systems. This initiative should be supported by all and extended to other parts of the country.

Conclusion

It is feasible to implement this recommendation

4.2 Hypothesis II: Government and Utility Institutional Structure

The major finding of hypothesis 2 is that energy planning is highly centralized and biased towards urban areas. The study reveals that rural energy policy is inadequate and rural energy delivery system is ineffective. Emphasis on provision of modern energy to marginalized groups is placed on urban people who live in peri-urban areas. In view of these findings, the following policy initiatives are recommended:

- Review of Energy institutional Structure.
- Create an agency with sole responsibility of rural electrification.
- Improvement in the effectiveness of energy institutions.
- Inclusion of private sector in the delivery of modern energy services.

1. Review of Energy Institutional Structure

Institutional and Management

The institutional framework for implementing this initiative exists. Institutions in the energy sector will include the Department of Energy, ZESCO, financial institutions, private sector (mainly suppliers of renewable technology equipment), donors, non-governmental organizations, and community based organisations. Awareness programmes should be introduced to increase awareness for all stakeholders to enhance understanding of various issues related to modern rural energy services. There is need for strong linkage of these key institutions so that energy issues are not dealt with in isolation.

Legal Framework

There are no legal barriers impeding implementation of this initiative. In fact, the current energy sector legal framework provides for private sector participation.

Economic and Financial

There is need to develop strategies that should consider and integrate all key issues and priorities that are necessary to steer development of rural energy initiatives. In formulating the strategy, it should be clear that rural energy initiatives cannot considered in isolation from the context of overall national development. The success of this strategy will depend on its ability to address the energy problems in an integrated approach, which reconciles energy, income and employment, local environmental concerns and other priority needs of rural communities.

Since lack of resources has been identified as a serious problem regarding dissemination of rural energy initiatives, the rural agenda should provide different models of options for energy. The models should be adapted to suit specific conditions and different financial models as follows:

- Direct sale of individual PV systems to end-users.
- Cooperative models of ownership and maintenance.
- Energy Service Companies.

New approaches to financing rural energy programmes need to be introduced. The government can stimulate this by providing an enabling environment that will attract energy entrepreneurs to go to rural areas. A starting point would be for government to provide more fiscal incentives to promote rural energy initiatives. Such measures could include exemption of duty and value added tax on all renewable equipment and accessories. In addition, government could offer company tax concessions for rural energy entrepreneurs in order to encourage them to do business in rural areas. These measures if implemented would result in reduction of prices of renewable energy technologies to enable more people have access to modern energy services.

Although some of the people in the rural areas are willing to pay for modern energy costs, the majority are poor and cannot afford. There is need therefore to establish financing schemes that will promote dissemination of rural energy technologies. Innovative credit schemes should be explored, tested and implemented by both government and non-government agencies working with rural industries. Other schemes could be designed in form of credit provision for inventory to small energy retailers that serve the rural community. Schemes could also include leasing of energy systems on attractive terms. For those that want to engage in income generating activities, they could form cooperatives and raise some money from contributions by members and this would help in obtaining loans from financial institutions.

Although it is possible to implement all these measures, some of them may take long due to current economic problems. It may not be feasible to implement this initiative.

Human Resources and Technical Capability

The success of rural energy initiatives is strongly linked to capacity of institutions and availability of skilled human resources. The Department of Energy is understaffed and unable to recruit and retain professional staff. Out of the Department of Energy's current professional establishment of 24 only 8 positions have been filled. This initiative is difficult to implement by the Ministry of Energy because the recruitment of government officers is done by the Public Service Commission which sets salaries and conditions of service.

Conclusion

Although some of the initiatives can be implemented, it may be difficult to implement this recommendation due to economic and financial reasons.

2. Create an Agency With Sole Responsibility of Rural Electrification

Rural electrification tends to be a low priority in the way the government disburses funds. The utility also gives low priority to rural electrification. The government and the utility should be absolved from the responsibilities of implementing rural electrification programmes. A good approach may be to create an agency whose sole responsibility is rural electrification.

Institutional and Management

The rural electrification agency should be a key institution in the delivery of electricity services to the rural areas. The existing institutional structures of the energy sector are adequate to accommodate the agency. The agency should be given autonomous powers and operate free from government interference.

Legal Framework

There are no legal barriers to implement this initiative.

Economic and Financial

Rural electrification programmes can be financed by the Rural Electrification Fund. Additional funds could also be provided by the government as before..

Human Resources and Technical Capability

Human and technical skills exist in the utility. Currently, the government contracts the utility to implement rural electrification projects. What may be required is to transfer a full complement of technical staff for planning, designing and implementation of the projects.

Conclusion

It is feasible to implement this recommendation

3. Improvement in the Effectiveness of Energy Institutions

The National Energy Policy has identified a number of barriers to the dissemination of renewable energy technologies. The policy also provides measures that address the barriers. Some level of success in implementation of these policies has been recorded but a lot more could have been achieved if there was effective institutional capacity at government level.

Institutional and Management

This initiative can be implemented. What is required is to identify all the factors that affect institutional performance of all key stakeholder institutions and prescribe measures to eliminate them.

Legal Framework

There are no barriers regarding implementation of this initiative.

Economical and Financial

As highlighted before, adequate funds are required to implement government programmes for rural energy initiatives. This initiative will entail provision of adequate funds to monitor various projects. Experience has shown that while some projects may receive funding and be completed on time, there are no funds for monitoring of projects. It is possible for funds to be made available.

Human Resource and Technical Capability

Currently, the Department of Energy which is responsible for implementation and monitoring of government energy projects is understaffed. It is not possible for Department of Energy to hire staff.

Conclusion

It is not possible to implement this recommendation

4. Inclusion of Private Sector on the Delivery of Modern Energy Services

This recommendation mainly refers to the Energy Service company delivery approach where the energy service companies provide electrical services to rural communities based on photovoltaic electricity. The institutional structure to be set up should be similar to that of the oil marketing companies or diesel genset distributors which have a high rate of success.

Institutional and Management

The institutional framework required for this initiative exists. In this approach, key institutions will include solar energy companies, financial lending institutions, local communities and individuals working together.

Legal Framework

There are no legal barriers to implement this initiative.

Economic and Financial

Some of the existing solar energy companies have experience and working capital to carry out rural projects. Where companies face working capital problems, credit schemes could be introduced through financial lending agencies and the government provides guarantees as provided for in the energy policy. Studies have show that people in the rural areas are willing to spend a significant portion of their incomes on higher quality energy services that improve their quality of life to enable them become more productive. The studies have further shown that if energy services are available and reliable, rural people are willing to use many different types of energy and given a choice, they would generally select a combination that is appropriate to their daily energy demands.

Human Resources and Technical Capability

There would no barriers in terms of technical skills. The Department of Energy has competent personnel to manage this kind of programmes. The solar energy companies have competent technicians and other skills required o carry out the tasks.

Conclusion

This recommendation is feasible to implement

5.0 FINAL POLICY OPTIONS

This Chapter presents final policy options based on the filtering process in Chapter 4. The policy options that were not feasible have been left out. The following are final policy options for each hypothesis presented by ranking for consideration by policy makers:

5.1 Hypothesis I: Rural Energy Initiatives by Government and Utility

Hypothesis 1a

Full political commitment regarding implementation of rural energy initiatives by government can be demonstrated by:

- Effective administration of the Rural Electrification Fund.
- Introducing measures which will ensure that recommendations of the Parliamentary Committees and Ministerial Statements are implemented.
- Reviewing the National Energy Policy
- Including gender in the National Energy Policy

Hypothesis 1b

Government could l show vigour in the implementation of rural energy initiatives by:

- Increasing funding for rural energy initiatives.
- Conducting feasibility studies before implementation of projects

Hypothesis 1c

Government's could minimize failure of its initiatives in dissemination of rural energy by targeting income-generating activities. For government to succeed in disseminating rural energy for welfare activities it must ensure that it:

- Carries out awareness campaigns regarding benefits of rural energy initiatives.
- Involves beneficiaries in the design and implementation of rural energy initiatives.

5.2 Hypothesis II: Government and Utility Institutional Structure

Government and utility's institutional framework is not appropriate for the implementation of rural energy initiatives. To improve the delivery of modern energy services to the rural areas, it is important that:

- An autonomous agency is created with a sole purpose of planning, designing and implementing rural electrification projects
- The private sector is included in the delivery of modern energy services

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7.0 APPENDICES

7.1 Appendix I

7.1.1 Questionnaire 1: Demonstration of Political Commitment and Vigour on Rural Electrification

Respondents: Senior Government Officials, Utility Officials, Energy Experts, NGOs

1. Which organization do you represent or represented? _____

2. If government/utility; are you still in employment? Yes/No (tick which is applicable)

3. Political commitment would be demonstrated by policy statements on rural energy being followed up by a plan of action, budget allocation, funds disbursements and implementation of activities. From your experience would you think that there has been political commitment in implementing rural energy projects in Zambia? Yes/No Please give reasons for your answer

   _____

   _____

   _____

   _____

   _____

4. What factors do you think would demonstrate political commitment in rural energy projects? Explain why you think these factors are important. (You can use the attached paper if more writing space is needed)

   _____

   _____

5. In reference to Question 4, what do you think government and/or the utility must do to address these problems?

   _____

   _____

THANK YOU FOR YOUR ASSISTANCE

7.1.2 Questionnaire 2: Beneficiaries of Modern Energy Services

Name of Area _____

Type of energy technology _____

Name of donor if technology is for welfare reasons _____

Answers to the questions below can be provided on extra the paper provided if required

1. When was the project implemented? _____
2. What is the main application of this energy system? _____

   _____
3. Is the system still functioning properly? Yes/No If not what are the reasons for failure?

   _____

   _____

   _____
4. In your view, what are some of the solutions to the problems cited in Question 3?

   _____

   _____

   _____
5. For income generating activities, what do you think has contributed to the success of this project?

   _____

   _____

   _____

THANK FOR YOUR ASSISTANCE

7.1.3 Questionnaire 3: Survey Area: Mkushi Farm Block

General Information

1. Name of Farmer_____

2. Area of Farm_____

3. Prevailing Land utilization situation/type and pattern of cropping: _____

Status Prior to Electrification

4. What were your sources of energy before the area was electrified?
   _____

5. What was the source of these types of energy resources? _____

6. What was the cost per month/annum of the type of energy used for domestic purposes?
   _____

7. What was the cost of energy used per month/annum for agricultural production and other uses? _____

8. What was the energy mentioned in (5) above used for? _____

9. What type of crops were you growing before being electrified? _____

10. What was the tonnage per annum?
    _____

11. Where you processing any of your produce, if so, what type of products were processed?
    _____

12. How many employees did you employ before electrification?
    _____

13. Of those employed, how many where permanent and seasonal workers?
    _____

14. Are there any community activities you are involved in, if any, what type?
    _____

Status After Electrification

13. When was your farm connected to electricity? _____

14. What equipment, if any, were you required to purchase to facilitate electricity connection?
    _____

15. What was the cost of these equipment? _____

16. Has the number of employees, both permanent and seasonal, increased?
    _____

17. Now that you are connected to electricity, what are you using it for?
    _____

18. What is the cost of energy used per month/annum for domestic purposes?
    _____

19. What is the cost of energy used per month/annum for agricultural production and other uses?
_____

20. Have you introduced any new crops since electrification, if yes, what type?
_____

21. Do you have any plans to expand your farming activities, if yes, what are they?
_____

22. Are there any additional infrastructure built as a result of being electrified, if yes, mention them. _____

23. Are you exporting any of your produce, if yes, what is the quantity exported per month/annum? _____

24. Are you exporting to any of the countries in the SADC/COMESA region, if yes, mention them and the tonnage exported to each country _____

25. Are you exporting to any countries in Europe and other western countries, if yes, mention them and the tonnage exported to each country?
_____

7.2 Appendix II: Summary Sheet for Responses

8.0 BRIEF RESUME OF RESEARCHERS

Abel Mbewe

Abel Mbewe holds a Bachelor of Engineering degree in Electronics and Telecommunications. He has worked in both private and public sector in Zambia. He is the Executive Secretary of the Centre for Energy, Environment and Engineering Zambia where his main duties include collection and interpretation of energy and environmental data.

Mr Mbewe has attended several short courses on energy and environmental issues. Courses on energy included analysis, planning and management. Notable on these was a course on Executive Development on Power Sector Planning and Management. Environmental courses were mainly confined to climate change issues. He has also attended local and international meetings, conferences, workshops and seminars on energy and environmental matters in many different countries.

Mr Mbewe is currently seconded to the Environmental Council of Zambia where he is coordinating a climate change programme funded by the Global Environment Facility (GEF) through the United Nations Environment Programme (UNEP). His duties include supervising the national study teams working on Greenhouse Gas Emission Inventory, Mitigation Analysis and Vulnerability and Adaptation

Mr Mbewe is a principal researcher in AFREPREN's Renewables and Energy for Rural Development Theme Group and he is the Theme Group Coordinator of the Renewables and Energy for Rural Development. Mr. Mbewe has published papers on energy for international journals and has contributed several working papers to AFREPREN.

Mirriam Simasiku

Mirriam Simasiku is a research assistant and is a biochemist by profession. She is an Environmental Officer in the Environmental Council of Zambia. She is currently working on a project that is testing samples of water collected from various boreholes in Lusaka.

Annie Nsenduluka

Annie Nsenduluka is a research assistant and second year undergraduate student at the University of Zambia. She is studying for a Bachelor of Laws degree.