IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

# AN ASSESSMENT OF THE EFFECT OF ENERGY MIX ON ENERGY DEFICIT IN ZAMBIA: A CASE STUDY OF 10 MILES IN CHIBOMBO DISTRICT.

**BY**
**RODGERS PHIRI**
**(+260 979 609484, Phirirodgers3661@gmail.com)**

**SUPERVISED**
**BY**
**Dr. KASONDE MUNDENDE**
**(+260977 109372, kasonde.mundende@unza.zm )**

**UNIVERSITY OF ZAMBIA**
**LUSAKA**
**2023**

## Abstract

This abstract is based on the study conducted in 10miles of chibombo district of central province. 10 miles experiences energy deficit just like many parts of Zambia. Zambia largely depends on hydroelectricity but hydropower has a fatal flaw. Drought has lowered water levels to the point where power production is severely curtailed. Droughts in recent years have produced electricity shortages estimated at nearly one-third of Zambia's total installed hydroelectric capacity of 2,380 megawatts. Despite these studies, little attention, if any, has been paid to the effect of the mix of different energy technologies on energy deficit in the study area.

The extent of the effect of energy mix on its accessibility and availability at 10miles was not known to the researcher. This created a problem worth investigating. Previous studies such as Kaela's (2018) predicted the energy mix levels of Zambia by the year 2050 but did not discuss the extent of its effect on its accessibility and availability in the study area, the gap this study wished to assess. If the extent of the energy mix on energy deficit was not investigated, 10 miles area would have continued exploiting detrimental activities such as charcoal production.

The aim of the study was to determine the influence of energy mix on energy deficit in 10 Miles, Chibombo District, which was achieved through the following objectives: to ascertain types of energy used at 10 miles, to establish the drivers of types of energy used at 10 miles and to explore the effects of energy mix on energy deficit at 10 miles.

The energy mix in 10 miles can have a significant impact on the energy deficit. Over-reliance on traditional biomass fuels and fossil fuels may contribute to environmental degradation, health issues, and energy insecurity, while diversifying the energy mix with renewable energy sources can provide a sustainable and clean solution to meet the energy demand and reduce the energy deficit in the long term. Planning and implementing a balanced and sustainable energy mix that considers the availability, reliability, affordability, and environmental impacts of different energy sources can play a crucial role in addressing the energy deficit in 10 miles. So, it is essential to carefully assess and plan the energy mix to ensure energy security, sustainability, and resilience in 10 miles. Additionally, proper policies and interventions may be needed to promote renewable energy adoption, improve energy efficiency, and address socio-economic and environmental challenges associated with energy deficit in 10 miles. This could include initiatives such as promoting the use of clean cooking stoves, investing in renewable energy infrastructure, improving energy access in rural areas, and raising awareness about sustainable energy practices among local communities. Furthermore, engaging local stakeholders, including communities, businesses, and government agencies, in decision-making processes related to energy mix and energy deficit can help ensure that the energy mix is enabled.

**Keywords**: Energy Mix, Biomass, energy sources, Environment, Renewable.

## Introduction

At global level, the collective segment of coal, oil and gas in the energy mix in 2018 was close to 85%, with hydro (6.8%), other renewables (4%) and nuclear (4.4%) struggling far behind (Energies, 2020). In Europe, renewable energies (15.5%) and nuclear (10.3%) are more developed, but fossil fuels remain the dominant energy source (74.2%) (Energies, 2020). While the figures differ essentially starting with one region then onto the next, petroleum derivatives rule the energy mix at the worldwide level, representing more than 80% of the aggregate (Energies, 2020).

Africa has undergone rapid economic and population growth this century, with an equivalent increase in the demand for energy. Keeping pace with rising energy needs is at the top of the agenda for policy makers such as Ministry of Energy (Energy, 2019), to enable economic growth and extend access to modern energy to those lacking it now. Rising energy needs are not easy challenges as supply lags demand, and in as many as 30 countries in Africa recurrent electricity outages and load shedding are the norm (Azizalraman & Hasyimi, 2019).

Africa's current energy needs are met through a mix of biomass and fossil fuels (Azizalraman & Hasyimi, 2019). Biomass accounts for approximately 50% of Africa's total primary energy supply (Azizalraman & Hasyimi, 2019). Coal and natural gas account for about 14% each, and oil approximately 22%. Hydropower represents about 1% of

the total primary energy supply in Africa (Azizalraman & Hasyimi, 2019). Zambia on the other hand, is potentially self-sufficient in sources of electricity, coal, biomass and renewable energy (Energy, 2019). The only energy source where the country is not self-sufficient is petroleum energy (Energy, 2019). Zambia is confronted with an increasing energy demand, resulting from demographic and socioeconomic factors, at an average of 6% or 150-200 MW per annum (Energy, 2019).

In terms of policy guideline, the Energy sector in Zambia comprises both public and private actors (Energy, 2019). The Ministry of Energy supervises the following statutory bodies: Energy Regulation Board (ERB); Zambezi River Authority (ZRA); and Rural Electrification Authority (REA) (Mwape, 2015). The Ministry also provides guidance to the following State-owned enterprises: Indeni Petroleum Refinery Company Limited; Tanzania Zambia Mafuta pipelines Limited (TAZAMA); and ZESCO Limited (Mwape, 2015).

Energy mix refers to a blend of various essential energy sources from which auxiliary energy for direct use like electricity is produced (energies, 2020). Energy mix alludes to all direct uses of energy such as transportation and housing, so it is not be mistaken for power generation mix, which alludes to generation of electricity (Energies, 2020).

To meet its energy needs, every nation utilizes the sorts of energy accessible to it, in varying extents (Mudenda, Makashini, Malama, & Abanda, 2018). This is what is referred to as energy mix.

Zambia largely depends on hydroelectricity but hydropower has a fatal flaw. Drought has lowered water levels to the point where power production is severely curtailed. Droughts in recent years have produced electricity shortages estimated at nearly one-third of Zambia's total installed hydroelectric capacity of 2,380 megawatts.

Despite these studies, little attention, if any, has been paid to the effect of the mix of different energy technologies in the study area.

This paper comes in seven major sections including the introduction, conclusion and recommendations. The next section is dedicated to addressing methodological foundations. Section three focuses on literature review of the influence of energy mix on energy deficit in 10 Miles of Chibombo district.

The results from the focus group, interviews and legislative frameworks are outlined under section four. The results are discussed under section five. The sixth section is the conclusion. It revisits the main points from the paper. The last section outlines the recommendations, it outlines the suggestions from the key informants on how energy mix can used to solve energy deficit.

## Research Methodology

The research adopted a qualitative research approach because most of it was narratives from the respondents. The research design which was used in this research is case study because of multiple methods of collection of data (Hamel, Durfour, & Fortin, 1993) which facilitated the in-depth study of the assessment of energy mix in 10 miles of Chibombo district. This research study useed purposive sampling, specifically critical case sampling as it is particularly useful in exploratory qualitative research, research with limited resources**,** as well as research where a

single case (or small number of cases) can be **decisive** in explaining the phenomenon of interest (Palys & Atchison, 2008).

The research study used convenience sampling which assisted in identifying other potential subjects or different energy users in the research area. Convenience sampling involves using participants who are convenient to the researcher. There is no pattern in acquiring these participants (Saunders, Lewis, & Thornhill, 2012). They may be recruited merely asking people who are present in the street, in a public building, or in a workplace. Convenience sampling is mostly used for qualitative research because it is not costly, not as time consuming as other sampling strategies, and simplistic. The research respondents for this study comprised households and business houses at 10 miles. Focus group discussions (FGD) were used for headmen/ headwomen and council officials. Interview guide were used for churches, schools and households (Bless, 1990). The collected data was analyzed using thematic and content analysis, in a way that made them address the objectives of the study and answer the research questions.

## LITERATURE REVIEW

Energy mix undoubtedly constitutes one of the basic factors of economic development for global development (Commission, 2003). Europe is increasingly dependent on oil and gas imports, with a constantly growing demand for these raw materials. Therefore, the problem is the lack of diversification of energy sources, as well as the issue of security of its supply, directly related to the dimension of European Union (EU) member activities (Commission, 2003). At the same time, there is a need for Member States to build competitive internal energy markets and increase energy efficiency, thereby prioritizing energy mix.

The problem of low usage of modern forms of energy and widespread dependence is one that is not peculiar to Zambia alone but is a developing country phenomenon (Masini & Menichetti, 2012). Sub-Saharan Africa is said to be the most energy-poor region on the planet with electrification rates which are much lower than the rest of the developing world (Barnes, 1990). About 80% of the population in this region still depends on traditional biomass, with the main indicator for this trend being the number of households where biomass is the main fuel for cooking (Barnes, 1990). It is interesting to note that biomass itself is a source of renewable energy if used efficiently and sustainably. However, it is often harvested unsustainably (woodlands, in particular) and used inefficiently (Khambalkar, Kathede, Dahatonde, & Korp, 2010), resulting in faster rates of forest depletion than regeneration. This source of energy has been overexploited in Zambia to levels where even the rainfall pattern has been affected. Marked degradation of forests and woodlands surrounding major cities such as Lusaka has been observed (Atteridge, 2013), which signifies a positive correlation between urban energy demand and excessive harvesting of wood for charcoal production.

### Determinants of the drivers of types of energy use.

### Consumer Preferences

Drivers for energy starts with the various decisions consumers make in their daily lives. These inclinations can move as new innovation empowers choices that better address a consumer's energy needs, for example, lower

energy expenses and lower emanations (Allen & Janda, 2006). Consumer inclinations can likewise be changed after some time by strategies that boost decisions, like a carbon tax that encourages lower carbon electricity supply (Allen & Janda, 2006).

**Policy**

Changes in policy can stimulate new innovation and impact consumer decisions (Banda & Bass, 2014). For instance, approaches can energize reception of new innovation (free importation of solar products or debilitate the utilization of a current innovation (limitations on coalbased power). The culmination is additionally evident: approach not empowered by aggressive innovation or not lined up with shopper inclinations can be hard to execute on the grounds that it is difficult to command something that isn't superior to current choices according to the consumer (Banda & Bass, 2014).

### 2.1.3 Technology

Conveying new innovation permits society to accomplish more with less. Best advancements regularly have the supporting approach and business systems to accomplish scale (Agency, 2014). An approach, similar to burden motivating forces, can prod improvement of new innovation, yet these advancements eventually need to contend without sponsorships to arrive at an enormous enough scale to affect worldwide business sectors (Miciula & Miciula, 2014). Customer inclinations can likewise make a "pull impact" that expands request in the commercial center for new advances.

**The effect of energy mix on energy deficit.**

The energy mix is more efficient especially in the energy extraction process, less energy is consumed and the negative effects caused by pollution reduce due to the greater weight of renewables and natural gas, at the expense of coal, which is less efficient and more polluting (Roula , 2016). Energy efficiency due to energy mix may bring various economic benefits, such as savings on energy bills for consumers, although it also reduces production in some economic sectors such as dairy companies (Roula , 2016). Nevertheless, the net result is expected to be positive (Roula , 2016). For example, according to estimates by Roula-Inglesi Lotz (2016), an increase in the share of renewables in the energy mix at the global level generates a positive impact on GDP growth of 0.089%.

**Evaluate constraints in accessing energy.**

The prevailing focus on industry, transport, and household energy issues has obscured the fact that most people in developing countries continue to rely on traditional biofuels, such as wood, crop residues, and animal dung (Barnes, 1988). In fact, one third of all energy consumed in developing countries derives from biofuels (Barnes, 1988). Two billion people remain dependent on biofuels for cooking and equal number lack electricity. Annual biofuels consumption in developing countries exceeds 1 billion tons of oil equivalent (btoe), which is more than three times the amount provided by coal in Europe (0.28 btoe) and twice that provided by coal in the United States (0.47 btoe) or China (0.5 btoe) (Barnes, 1988).

Developing countries are facing two crucial and related problems in the energy sector (Barnes, 1990). The first is the widespread inefficient production and use of traditional energy sources, such as fuel wood and agricultural residues, which pose economic, environmental, and health threats. The second is the highly uneven distribution and use of modern energy sources, such as electricity, petroleum products, and liquefied or compressed natural gas, which raise important issues of economics, equity, and quality of life. Simply expanding supplies of modern energy will not solve the problems in practice, because even under the most optimistic growth scenarios, many rural and urban poor people in the developing world are likely to depend for the next 20–30 years on traditional fuels produced in rural areas (Barnes, 1988). Hence, an energy strategy for the developing world should be designed to make production and use of traditional energy more sustainable and efficient while expanding and accelerating a broader social transition to clean and efficient use of modern fuels (Barnes, 1990).

**Energy Consumption and Availability in Zambia**

Main fuel source in the country's power has been developing at a normal rate of around 3% per annum essentially because of the expanded financial action in the country particularly in the farming, assembling and mining areas, just as expanded economic activity in the surrounding countries (Agency, 2014). Besides the nation's developing economy has similarly lead to an expansion in the interest for different types of energy like petrol and coal, as these are key components of production and operations in most financial areas (Banda & Bass, 2014). The interest for sustainable power sources has similarly seen critical development in the new years as the market investigates alternative sources of energy, with sustainable power sources ending up being a feasible other option (Banda & Bass, 2014). The chart below outlines energy consumption by sector in Zambia:

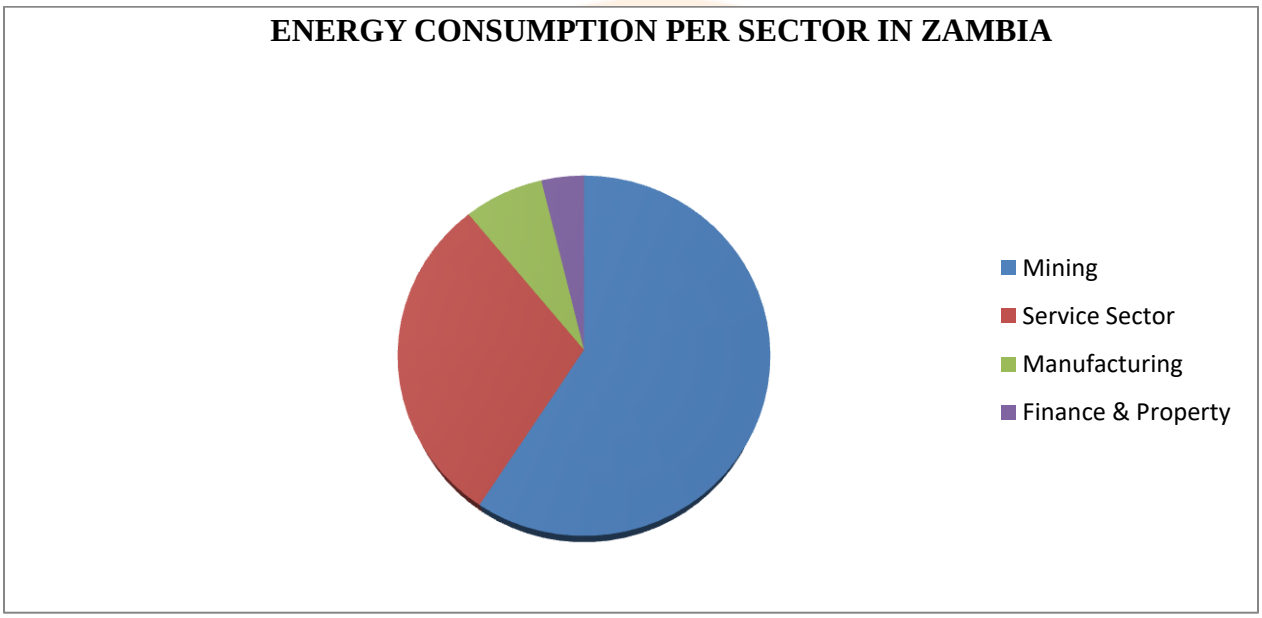


**Figure 1: Energy Consumption in Zambia (Banda & Bass, 2014).**

Renewable energies provide attractive environmentally sound technology options for Africa and Zambia's electricity industry. Common Renewable Energy Technologies options for providing energy include wind energy

primarily for pumping water; biomass for cooking, solar Photovoltaic (PV) systems which convert sunlight into electricity and small-scale hydropower plants which generate electricity (J, 2010). At household level, energy is required for lighting, cooking, heating of water and space conditioning, as well as powering appliances. RETs in Zambia available on the market include solar water geysers, solar lights, solar cookers, improved cook stoves, hot bags and water pumps (REN21, 2015). The SADC Renewable Energy and Energy Efficiency Status Report of 2015 (REN21, 2015) shows that although the SADC region is faced with challenges such as energy access, many of the country members are making strides in the adoption of Renewable Energy Technologies.

In addition, The Energy Regulation Board (ERB) in Zambia waived duty and fees for solar products to encourage more investors to enter the energy sector and help reduce the power deficit (Phiri, 2015). ERB Northern Region Manager Allen Polito said "*the move is aimed at increasing the capacity of private companies to contribute to the production and supply of energy in the country*".

This paper reviewed the effect of energy mix in 10 Miles of Chibombo district, found out the determinants of the drivers of energy use and evaluates the constraint to accessing energy. The existing knowledge gap is that the types of energy technologies in 10 miles are not known, together with people's motives and constraints to access and using energy.

## Results

### Types of energy that exist at 10 miles

The study targeted households, business owners and institutions in 10 miles. The research study had a total of 50 respondents. Of the 50 respondents interviewed through interview guides and focus group discuss, 67 percent were female, and 33 percent were male. 68% of the respondents have lived in 10 miles for more than 10 years. Figure 4 illustrates the educational level of the respondents. It can be seen from the figure that the highest percentage (65%) of the respondent's level of education is Primary. Education level influences an individual's understanding and preferences on development choices and even their ability to participate effectively ( (Malanda, 2019)).

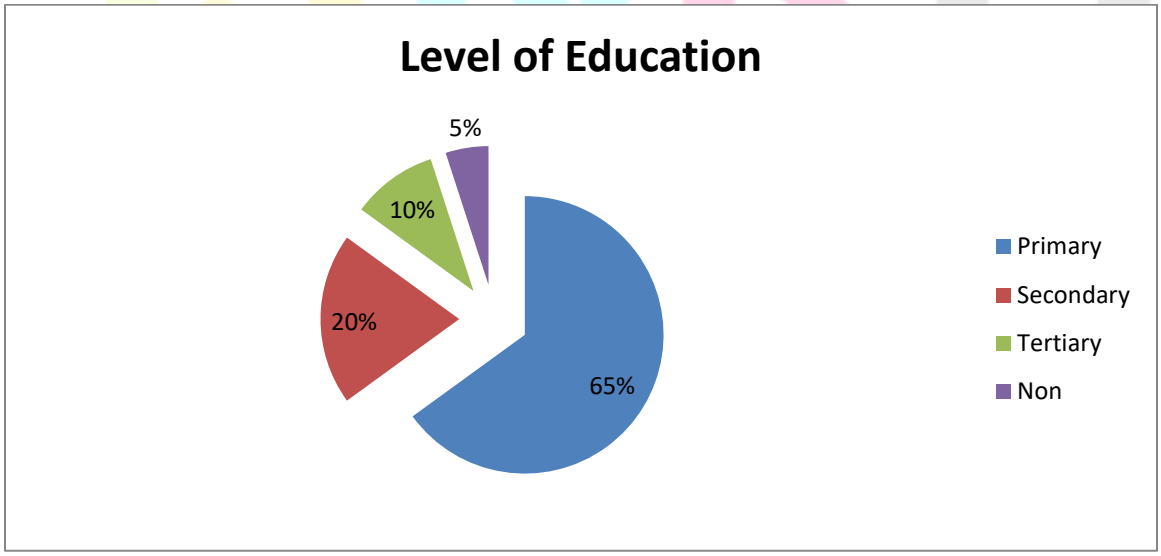

**Figure 2: Level of Education of Respondents (Source: Field data, 2023)**

The findings show that there are five types of energy source in 10 miles which includes Solar power, Hydropower, Biomass, Liquefied Petroleum Gas (LPG) and Wind power: Wind power is nolonger a significant source of energy in the area because of reduced wind speed in the area to environmental factors such as buildings and climate change.

**Reasons for using the technologies of energy in 10 miles**

The respondents listed a number of reasons for using different types of energy technologies. The reasons have been indicated respectively in the table below. Other respondents listed a number of reasons for not using the other sources of energy.

**Table 1: Reasons for using the types of energy found in 1o miles**

| **Solar Energy** | **Hydropower** | **Biomass** | **LPG** |
|---|---|---|---|
| ✓ Renewable and Sustainable<br>✓ Cost-effective compared to other sources.<br>✓ Environmentally Friendly.<br>✓ Energy Security:<br>✓ Versatile and sustainable source of energy. | ✓ Cost-effective when connected to the national grid.<br>✓ Energy Security. | ✓ Renewable:<br>✓ Availability:<br>✓ Carbon Neutral.<br>✓ Waste reduction.<br>✓ Local production.<br>✓ Flexible use.<br>✓ Use of biomass as an energy source can help reduce greenhouse gas emissions.<br>✓ Promote energy independence, and create economic opportunities. | ✓ Mostly available<br>✓ Sustainable<br>✓ Convenience<br>✓ Availability<br>✓ Affordability<br>✓ Environmental benefits<br>✓ Safety to use |

**Petrol/ Diesel**

Petrol and diesel are commonly used as energy sources in Chibombo district for electricity generation, and cooking. They are preferred by some respondents due to the following reasons:

- ✓ Easy Transportation.
- ✓ Electricity generation using generators.

However, the use of petrol and diesel as energy sources in Chibombo district also has some drawbacks. These include:

- ✓ Environmental pollution.
- ✓ Health risks.
- ✓ The two types of fuels are costly.

**Availability and accessibility of energy mix in 10 miles**

The respondents indicated that there are significant challenges in accessing reliable and affordable energy in Chibombo district. The majority of the population in 10miles, particularly in rural areas, relies on traditional biomass (such as firewood and charcoal) for their energy needs. The electrification rate in Chibombo district is 6%, which is relatively low compared to the national average of 5%. The reasons stated for the existing challenges include high connections fees to hydroelectricity and regular replacement of solar batteries. The overall response indicates that accessibility to energy mix is a challenge in a 10 miles.

In terms of clean cooking solutions, only 5% of households in Chibombo district have access to clean cooking solutions such as Liquefied Petroleum Gas (LPG), biogas, and improved cookstoves. However, there are ongoing efforts to promote the use of clean cooking solutions in the area through various projects implemented by NGOs and international development organizations such as REA and UNDP.

**5.4 Factors that influence energy availability and accessibility in 10 miles**

There are a number of factors that influence the availability of energy mix in 10 miles according to the respondents. These factors have been shown in the figure below.

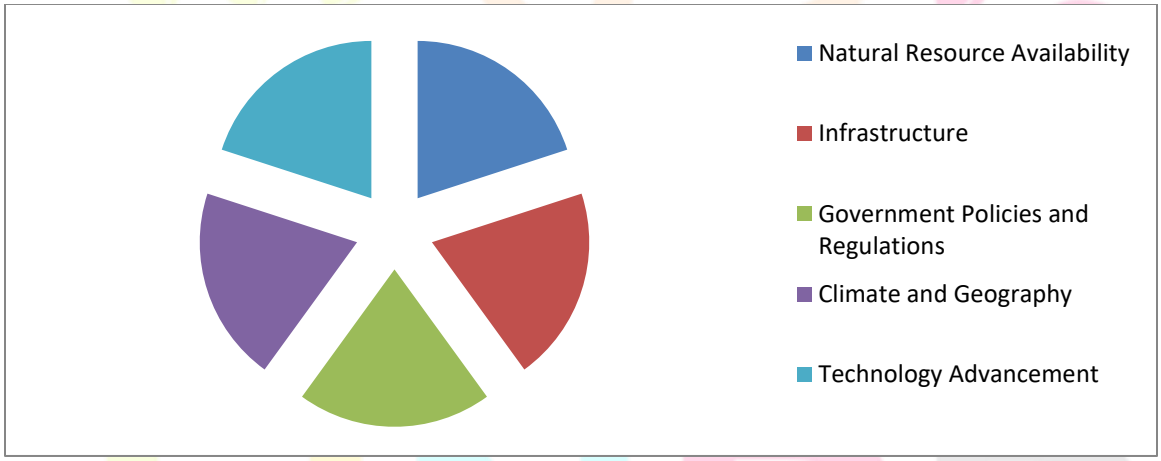


**Figure 3: Factors that influence the availability of energy mix in 10 miles (Source: Field data, 2023)**

**Strategies that households and institutions have put in place to access energy mix in 10miles**

There are a number of factors that influence the availability of energy mix in 10 miles according to the respondents. These factors have been shown in the figure below.

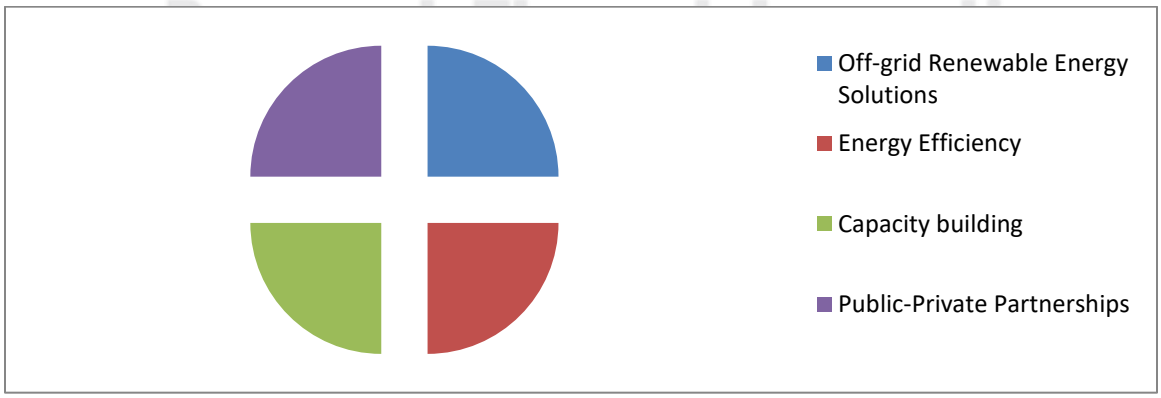


**Figure 4 Strategies to access energy mix in 10 miles**

This chapter endeavored to present the findings of this study in a more coherent manner. It drew its findings from data collected from interviews and focus group discussions. In the next chapter, the foregoing findings of the study are discussed with the reviewed relevant literature concerning specific research objectives.

## Discussion of the Results

### Energy technologies in 10 miles

Energy consumers should be free to select from the variety of energy technologies that are usable in a particular area. The primary national electrical grid is powered by hydro technology within 10 miles, however the levels of electrification are low. As a result, many individuals cannot use it. Biomass, solar and liquefied petroleum technology, such as solar light fixtures and gas and improved wood-burning cook stoves, is examples of alternative sources. Key informants indicated that with assistance from the Japanese government and the Rural Electrification Master Plan (REMP), the Zambian government has started a project to improve access to electricity in rural areas through the development of mini-hydropower plants, solar household systems, and the extension of the national grid.

### Motivation for using the technologies of energy in 10 miles

Energy mix requires a lot of resources up front and has high startup costs. Connection to the national electrical grid is economically possible but needs large construction expenses because the bulk of rural poor people live in remote and frequently inaccessible places. As a result, novel and cost-efficient technologies are needed. According to research on other developing nations, the bulk of the poor in rural and peri-urban areas cannot afford the services provided by (Allen & Janda, 2006). Renewable Energy Technologies (RETs), however, are the less expensive option in off-grid locations. The cheaper sources of energy such as solar and biomass is preferred because they require once expense. Solar utensils require once expenditure and very affordable, biomass on the other hand is free and readily available.

### Accessibility and Availability of energy mix in 10 miles

Overall, while there are still significant challenges in accessing reliable and affordable energy in Chibombo district, there are ongoing efforts to increase access to modern forms of energy and promote the use of clean and sustainable energy solutions. Chibombo district faces significant challenges in accessing reliable and affordable energy. The majority of the population in the area, especially those in the rural parts of the district, relies on traditional biomass (such as firewood and charcoal) for their energy needs.

There have been tremendous efforts by the Zambian government to increase access to modern forms of energy, such as electricity and clean cooking solutions. The Rural Electrification Authority (REA) is working to increase access to electricity in rural areas by implementing various electrification projects, including solar mini-grids and grid extensions.

According to the Rural Electrification Authority (REA), as of 2021, the electrification rate in Chibombo district was 6%, which means that only a small percentage of the population has access to grid electricity. However, there are ongoing efforts to increase access to electricity in area through the implementation of various electrification projects, including solar mini-grids and grid extensions.

In terms of clean cooking solutions, only 5% of households in 10 miles have access to clean cooking solutions such as Liquefied Petroleum Gas (LPG), biogas, and improved cookstoves. However, there are ongoing efforts to promote the use of clean cooking solutions in the area through various projects implemented by NGOs and international development organizations such as REA and UNDP. Overall, while the availability of modern forms of energy in Chibombo district is still relatively low, there are ongoing efforts to increase access to energy and promote the use of clean and sustainable energy solutions in the area.

**Factors that influence energy availability and accessibility in 10 miles**

Based on the data collected in the from the respondents, there are a number of factors that influence the availability and accessibility of energy mix in the area. In the case of 10 miles, the factors that influence accessibility and availability of energy mix include:

**Availability of Natural resources**

Natural resource availability influences accessibility and availability of energy in the area. The availability of natural resources such as biomass has greatly influenced the availability of energy mix. The availability of natural resources such as biomass has a significant impact on the availability and composition of the global energy mix. Biomass such as organic matter, wood, crop residues, and animal waste that can be used as fuel to generate energy plays a significant role in ensuring energy mix.

In most parts of 10 miles where biomass is abundant, such as rural areas with large forests or agricultural lands, it has historically been a primary source of energy for heating and cooking. However, with advances in technology, biomass can also be converted into electricity and biofuels, which can contribute to the diversification of the energy mix.

Other natural resources such as natural gas, and renewable energy sources such as wind, solar, and hydropower, also play a significant role in the energy mix. The availability of these resources varies across different regions, and their relative importance in the energy mix can also depend on economic, political, and environmental factors.

**Availability of Infrastructure**

The presence of infrastructure such as power grids, transmission lines, and distribution networks has largely affected the accessibility and vailability of energy in Chibombo. The quality and quantity of this infrastructure has also impacted the reliability of energy supply. The infrastructure required extracting, producing, transmitting, and distributing different types of energy sources can vary widely, and the level of infrastructure development can greatly influence the cost and availability of different energy sources.

For example, regions with a well-developed natural gas infrastructure may rely more heavily on natural gas as a primary energy source. Similarly, regions with abundant hydroelectric resources may rely more heavily on

hydroelectric power, while regions with limited access to water resources may need to rely more heavily on other sources of energy, such as coal or natural gas. In the case of 10 miles, the area has no infrastructure to enhance the availability of hydroelectric paper, solar plants and other energy sources to ensure accessibility and availability of energy mix.

Additionally, the availability of infrastructure can also impact the integration of renewable energy sources into the energy mix. For example, the development of a robust transmission and distribution network is essential for the widespread adoption of wind and solar power, as these sources of energy are often located in remote areas far from population centers.

Overall, the availability of infrastructure is a critical factor in shaping the energy mix of a region, and investments in infrastructure development can play an important role in promoting the adoption of cleaner and more sustainable sources of energy.

**The level of economic development**

The level of economic development in 10 miles has greatly influenced the availability and accessibility of energy. A more developed economy may have greater demand for energy, leading to greater investment in energy infrastructure and technologies.

Economic development refers to the process by which an economy becomes more advanced, diversified, and prosperous over time (Sen, 2005). As an economy develops, the demand for energy typically increases, which can put pressure on the energy infrastructure and supply chain.

In 10miles, which is an area in chibombo district in Zambia, the level of economic development has influenced the availability and accessibility of energy in a number of ways. For example: as the economy of Chibombo grows, there may be greater investment in energy infrastructure such as power plants, transmission lines, and distribution networks. This can lead to greater availability and reliability of energy for households and businesses. Information from the business owners indicated that the increase in economic activity in the area greatly contributed to bring hydroelectric power closer.

Economic development can also lead to an increase in incomes, which can make energy more affordable for households and businesses. This can improve accessibility to energy and allow for greater use of energy-intensive technologies. Most of the respondents interviewed who were in employment are connected to at least one or two energy sources.

In less developed areas, such as rural parts of Chibombo, the level of economic development can influence the availability and accessibility of energy through programs and policies aimed at rural electrification, as evidenced from the programmes by REA and UNDP. As the economy develops, there may be more resources available for such programs, which can expand access to energy in rural areas.

Economic development can also lead to greater adoption of energy-efficient technologies and practices, which can help to reduce demand for energy and improve the overall efficiency of the energy system. This can improve availability and accessibility of energy by reducing strain on the energy infrastructure.

Overall, the level of economic development in 10 miles can have a significant impact on the availability and accessibility of energy. As the economy develops, there may be greater investment in energy infrastructure, increased affordability of energy, and expanded access to energy in rural areas. Additionally, the adoption of energy-efficient technologies and practices can help to improve the overall efficiency of the energy system, further improving availability and accessibility of energy.

**Government policies and regulations**

Government policies and regulations have impacted energy availability and accessibility in Chibombo. For instance, subsidies for renewable energy such as solar make it more cost-effective to generate electricity from renewable sources such as solar and wind. Chibombo, like many other regions, is impacted by government policies and regulations that affect energy availability and accessibility.

Government subsidies on energy increased energy availability and accessibility in Chibombo by making it more affordable for households and businesses. By reducing the cost of energy, households and businesses will be more likely to use energy sources that were previously unaffordable, such as electricity or gas. The use of solar energy in in 10 miles became more pronounced when government removed tax on the importation of solar panels and other solar equipment.

Government policies that promote renewable energy can increase the availability of renewable energy sources in Chibombo, such as solar or wind power. By setting targets for the production of renewable energy, the government can encourage investment in renewable energy technologies, which can help to increase the amount of renewable energy available in Chibombo. Government regulations that mandate energy efficiency standards for buildings, appliances, and vehicles can help to reduce energy consumption in 10 miles. By reducing the amount of energy required to power homes, buildings, and transportation, the government can help to ensure that energy resources are used more efficiently and are therefore more widely available.

Fuel taxes: Government taxes on fossil fuels can impact the availability and accessibility of energy sources in 10 miles. By making fossil fuels more expensive, the government can encourage households and businesses to switch to alternative energy sources, such as renewable energy, which can help to increase energy availability and accessibility.

Overall, government policies and regulations can have a significant impact on energy availability and accessibility in 10 miles. By promoting renewable energy, energy efficiency, and reducing the cost of energy, the government can help to ensure that energy resources are available and accessible to all.

**Climate and Geography**

10 miles is located in Chibombo district of central province of Zambia, Africa. The local climate and geography in Chibombo has had a significant impact on the availability and accessibility of energy. Chibombo experiences a tropical climate, characterized by hot and humid conditions throughout the year. This can impact energy availability in several ways. For example, high temperatures can cause power outages due to increased demand for air

conditioning and other cooling devices. Additionally, heavy rainfall during the rainy season can lead to flooding and damage to energy infrastructure, further reducing energy availability.

Geography can also play a role in energy accessibility in Chibombo. The district is located in a rural area with a dispersed population, which can make it difficult and expensive to extend energy infrastructure to all areas. In addition, the terrain in Chibombo is relatively flat, which can make it more challenging to harness renewable energy sources such as wind and solar power.

Despite these challenges, efforts are being made to improve energy availability and accessibility in Chibombo. For example, the Zambian government has launched initiatives to increase access to electricity in rural areas, including Chibombo. Additionally, there is potential for the district to benefit from renewable energy sources such as hydropower, which can be harnessed from nearby solar plants in Lusaka and other surrounding areas.

**Population Growth**

Population growth can increase the demand for energy in Chibombo District, as more people require energy to power their homes, businesses, and other activities. This increased demand for energy can put pressure on existing energy infrastructure and resources, leading to potential energy shortages or blackouts. Population growth in 10 miles has greatly contributed to the depletion of biomass in 10 miles.

To meet the growing energy demand, 10miles and Chibombo District may need to invest in new or expanded energy infrastructure, such as power plants, transmission lines, or renewable energy sources like solar or wind power. This can require significant financial resources, as well as careful planning and coordination with local communities and stakeholders.

Efforts to increase energy efficiency and conservation can also help to reduce the demand for energy in Chibombo District, while providing benefits such as cost savings and reduced environmental impact. Overall, managing the energy demands of a growing population requires careful consideration of multiple factors, including technology, economics, and social and environmental concerns.

**Conclusion**

In conclusion, the energy mix in 10 miles can have a significant impact on the energy deficit. Over-reliance on traditional biomass fuels and fossil fuels may contribute to environmental degradation, health issues, and energy insecurity, while diversifying the energy mix with renewable energy sources can provide a sustainable and clean solution to meet the energy demand and reduce the energy deficit in the long term.

## RECOMMENDATION

1. Planning and implementing a balanced and sustainable energy mix that considers the availability, reliability, affordability, and environmental impacts of different energy sources can play a crucial role in addressing the energy deficit in 10 miles.

2. It is essential to carefully assess and plan the energy mix to ensure energy security, sustainability, and resilience in 10 miles.
3. Proper policies and interventions may be needed to promote renewable energy adoption, improve energy efficiency, and address socio-economic and environmental challenges associated with energy deficit in 10 miles. This could include initiatives such as promoting the use of clean cooking stoves, investing in renewable energy infrastructure, improving energy access in rural areas, and raising awareness about sustainable energy practices among local communities.
4. Engaging local stakeholders, including communities, businesses, and government agencies, in decision-making processes related to energy mix and energy deficit can help ensure that the existing energy mix has a positive impact on the energy deficit.

## REFERENCES


Agency, Z. D. (2014). *Energy Sector Profile.*

Alasuutari, P. (2010). The rise and relevance of qualitative research. *International Journal of Social Research Methodology*, 139-55.

Allen, D., & Janda, K. (2006). The Effects of Household Characteristics and Energy Use Consciousness. *A Pilot Study. USA*, 13-18.

Atteridge, A. (2013). Transforming household energy practices to reduce climate riskd. *Charcoal Use in Lusaka, Zambia*, 5-8.

Azizalraman, H., & Hasyimi, V. (2019). A model for urban sector drivers of carbon meissions. *Sustain. Cities Soc*, 44, 46-55.

Babbie, E. (2010). *Introduction to social research. International edition. 5th edition.* Wadsworth: Cengage learning.

Babbie, E., & Mouton, J. (2001). *The practice of social research.* Cape Town: Oxford Uniersity Press Southern Africa.

Banda, T., & Bass, S. (2014). *Inclusive green growth in Zambia: Scoping the needs and potentials, IIED Country Report.* London: IIED Press.

Barnes, D. F. (1988). *Electric Power for Rural Growth: How Electricity Affects Rural Life in Developing Countries Rural.* Ser. Boulder, CO: Westview.

Barnes, D. F. (1990). *Population Growth, Wood Fuels, and Resource Problems in Sub-Saharan Africa.* Washington: World Bank.

Becker, H. S. (1998). *Tricks of the trade: How to think of your research while you are doing it.* Chicago: University of Press.

Beutell, N. J. (2017). *Research Gate*. Retrieved April 21, 2021, from Research Gate: http://www.researchgate.net

Bless. (1990). *Fundamentals of Social Research Methods; An African Perspective. .* Lusaka: Government Printers.

Block, E. (1986). The comprehension strategies of second language readers. *TESOL Quarterly*, 20, 3, 463 - 494.

Bookchin, M. (1993). *What is soial ecology? In Environmental Philosophy: From Animal Rights to Radical Ecology.* Englewood Cliffs: Prentice Hall.

Braun, V. V. (2019). *Thematic analysis". Handbook of Research Methods in Health Social Sciences.* New Jersey: Hoboken.

Collodel, A., De Beer, F., & Kotze, D. (2012). *Development studies research methodology: Only study guide for HMDVA81.* Pretoria: University of South Africa.

Commission, E. (2003). *European Energy and Transport Trends to 2030.* Brussels: EC.

Creswell, J. W. (2009). *Qualitative and Mixed methods approaches*, 77.

Creswell, J. W. (2009). *Rsearch design: Quantitative, Qualitative and mixed methods approaches.* Thousand Oaks: CA: Sage.

Delgado-Romero, E. A., Singh, A. A., & De Los Santos, J. (2018). Cuentame. *The promise of qualitative research with Latinx*, 318.

Deneulin, S., & McGregor, J. A. (2010). The Capability Approach and the Politics. *In The European Journal of Social*, 501-519.

Development, M. o. (2008). *National Energy Policy .* Lusaka: Ministry of Eneergy and Water Development.

Dreier, O. (1997). *Subjectivity and social practice.* Aarhus, Demark: Subjectivity and social practice.

Dreier, O. (2008). *Psychotherapy in everyday lif.* New York: Cambridge University Press.

energies, P. (2020, July 20). *The Energy Mix and Energy Transition*. Retrieved April 20, 2021, from Planete energies: https://www.planete-energies.com/en/medias/close/what-energy-mix

Energies, P. (2020, July 20). *What is the energy mix?* Retrieved September 18, 2021, from What is the Energy Mix?: https://www.planete-energies.com/en/medias/close/what-energy-mix

Energy, M. o. (2019). *National Energy Policy.* Lusaka: Government Printers.

Engestrom, Y., & Sannino, A. (2010). Studies of expansive learning. *Foundations, findings and future*, 1-24.

Greenbaum, T. L. (1993). *The handbook goes focus group research.* New York: Lexington Books.

Hamel, J., Durfour, S., & Fortin, D. (1993). *Case Study Methods.* Newbury Park, CA: Sage Publications.

Hosenfeld, C. (1984). *Case studies of ninth grade readers. In J.C Alderson and A.H. Urquhart.* London: Longman.

J, W. (2010). *Renewable Energy Technologies for Rural Development.* Geneva, Switzerland: UNCTAD Current Studies on Science,.

Kaela, P. (2018). *Zambia's Energy Mix by the Year 2050.* Lusaka: University of Zambia.

Kajoba, G. M. (2007). *Vulnerability and Resilience of Rural Society in Zambia: From the Viewpoint of.* RIHN: Annual Project Report.

Khambalkar, V. P., Kathede, S. S., Dahatonde, S., & Korp, N. D. (2010). Renewable Energy. *An assessment of public awareness*, 31, 133 - 142.

Kohlbacher, F. (2006). *The use of qualitative content analysis in case study reseach. Forum: Qualitative Research. 7.* Art.21.

Kombo, D., & Tromp, D. (2006). *Proposal and Thesis Writing.* Nairobi: Don Bosco.

Krueger, R. A. (1994). *Focus group: the practical guide goes applied research. .* Thousand Oaks: Sage.

Masini, A., & Menichetti, E. (2012). The impact of behavioural factors in the renewable energy investment decision making process. *Conceptual framework and empirical findings*, 40, 28 -38.

Maxwell, J. a. (1998). *Designing a qualitative study: Handbook of applied social research methods.*

Mayring, P. (2014). *Qualitative content analysis: theoretical foundation, basic procedures and software solution.* Klagenfurt: URN: http://nbn-resolving.de/urn:nbn:de:0168-ssoar-395173.

Miciula, I., & Miciula, K. (2014). Renewable Energy and Its Financial Aspects as an Element of Sustainable Development of. *Scientific Works of the University of Economics in Wroclaw*, 239-247.

Moon, K., & Blackman, D. (2014). A Guide to Understanding Social Science Research for Natural Scientists. *Conservation Biology*, 1167 -1177.

Mudenda, P. K., Makashini, L., Malama, A., & Abanda, H. (2018). Reviewof Renewable Energy Technologies in Zambian Households: Capacities and Barriers Affecting Successful Deployment. *MDPI*, 2-14.

Mwape, S. C. (2015). *The Struggle against the Unsustainable Usage of Woodlands through the Promotion of Alternatives Energy Sources in Peri-Urban Areas. Master Thesis.* Lusaka, Zambia: The University of Zambia.

Office, C. S. (2011). *2010 Census of Population and Housing.* Lusaka: CSO.

Palys, T., & Atchison, C. (2008). *Research decisions.* Toront: Thomson Nelson.

Phiri, C. (2015, July 21). *ERB Waives Duty on Solar Products*. Retrieved April 20, 2021, from Zambia Reports: https://zambiareports.com/2015/07/21/erb-waives-duty-on-solar-products/

REN21. (2015). *SADC Renewable Energy and Energy Efficiency: Status Report.* Paris, France: REN21.

Roula , I.-L. (2016). The impact of renewable energy consumption to economic growth. *A panel data application*, 58-63.

Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research Methods for Business Students, 6th edition.* Pearson Education Limited.

Silverman, D. (2000). *Doing qualitative research: A practical guide.* Thousand Oaks, CA: Sage Publication.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research.* Thousand Oaks, CA: Sage Publications. .

Vorganova, O. (2012). In Ministry of Education. *Youth and Sports of Ukraine*, 158.

Yin, R. K. (1984). *Case Study Research: Design and Methods.* Beverly Hills: Sage Publications.

Yin, R. K. (2003). *Case Study Research: Design and Methods, 3r ed.* London, UK: Sage.

Zaidah, Z. (2003). *An Investigation into the effects of Discpline-Specific Knowledge, Proficiency and Genre on Reading Comprehension and Strategies of Malaysia ESP Students. .* University of Reading.